# CALIFORNIA FISH AND GAME

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## CONTENTS



## A PRELIMINARY SURVEY OF MISSION BAY STATE PARK*

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### INTRODUCTION

After Mission Bay was declared a State park and a wild life sanctuary, it was desired to learn how the wild life of the bay could be maintained and how sport fishing could be improved. At the request of Assemblyman George B. Bowers of San Diego, two members of the Staff of the California State Fisheries Laboratory (Division of Fish and Game) were sent to the area to make a survey, to report upon the existing conditions, and to suggest methods by which those in charge could improve them. Conditions proved to be far better than might have been expected in an area so close to a city the size of San Diego.

* Contribution No. 134 from the California State Fisheries Laboratory. November 28, 1933.

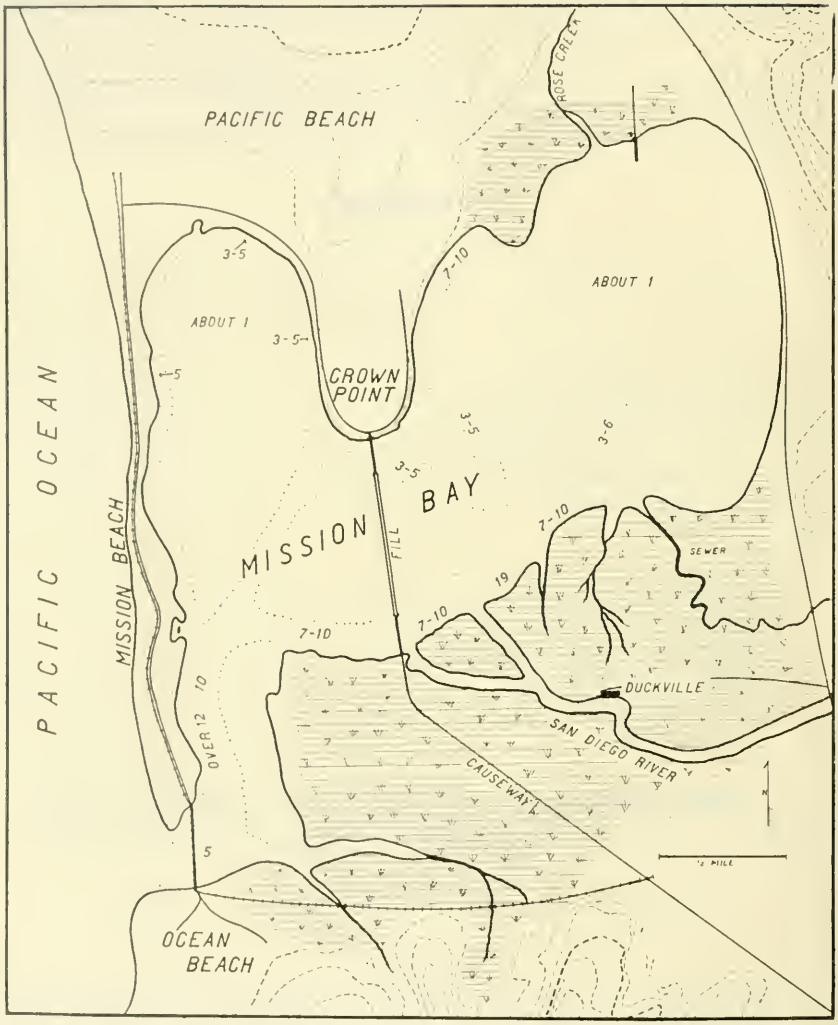


Fig. 1. Map of Mission Bay, San Diego County, California. November, 1933. Contour lines are dashed; contour interval 25 feet; dotted lines mark channels; depths in feet at mean lower low water. Only the roads nearest the bay are shown. There are many marshy islands in the western part of the bay but very few in the eastern section. There may be channels which are not shown, and undoubtedly there are many deep holes. Many small sloughs are not shown on the map.

## DESCRIPTION OF MISSION BAY

Mission Bay (False Bay) is an enclosed body of water immediately north of San Diego Bay, California. A square, $2\frac{3}{4}$ miles on an edge, would include all of Mission Bay, nearly all of the marshes which border it on the south, Crown Point which projects into it from the north, and very little else.

### *Country Surrounding the Bay*

Little of the country surrounding the bay is under cultivation. Wherever there are no habitations, gardens or marshes, the land is dry and barren and supports very little vegetation. The various sections are discussed separately below:

The southern marsh is about two miles long and in most places is from half a mile to a mile wide. It is hard to limit it definitely because there is a gradual change from a typical salt marsh to a dry sandy wasteland; many sloughs and strips of marsh extend into this waste. The moist area is a paradise for shore and marsh birds. There are numerous small sloughs in the marsh which are not shown on the accompanying map.

The eastern shore is bordered by a new highway which will soon be part of the main route from Los Angeles to San Diego. Low barren hills rise back of the highway.

The northern marsh is much smaller than the southern one and although important it is far inferior to it as a retreat for birds.

Crown Point is a mesa which projects about three-quarters of a mile from the northern shore. There is a sandy beach at its base. Connecting Crown Point with the southern marsh is a mile of highway which passes over a bridge, a fill, and then a second bridge. This highway crosses the marsh on a causeway and joins the Ocean Beach-San Diego road. The north shore west of Crown Point is of sandy clay, low and barren.

The sand spit (Mission Beach) which separates the bay from the ocean, is $2\frac{1}{4}$ miles long and at no point much over one-quarter mile wide. A combination highway and street car bridge connects the southern end of the spit with Ocean Beach.

### *Houses and Other Buildings*

Ocean Beach, south of the western part of Mission Bay, is a residential district. The sand spit (Mission Beach) is built up fairly solidly with resort type houses. Crown Point is a real estate subdivision. To the east of Crown Point and along the eastern shore of the bay are a few scattered houses. On the southern marsh is a group of a half dozen houses known as Duckville. This spot can be reached by water or by a dirt road from Old Town.

### *Streams Entering Mission Bay*

The San Diego River flows through the southern marsh and enters the bay at about the middle of the southern shore. The stream is dry all summer but is a serious flood menace in the winter. There are a few fresh-water potholes near the point where this stream enters the marsh.

Rose Creek enters the bay through the northern marsh. This stream carries water only during the wet season.

Tecolote Valley drains some water into the bay during rainstorms.

*Pollution*

There is very little possibility of any pollution which would hurt fishing in Mission Bay. The sewage from the dwellings along the bay shore could have no effect on a body of water of this size. The only industrial plant that could possibly contaminate the bay is the Cudahy Packing Company, a slaughterhouse near the marsh at the southeast corner of the bay. Maximum contamination from this plant would be unimportant. In this area a rather odorous sewer empties into Hardy's Slough. (See map.) It will not bother fishing in the least and is three-quarters of a mile from any place that is ever likely to be used for swimming or picnicking.

*Waters of Mission Bay*

Crown Point and the highway south of it divide Mission Bay into two distinct sections. The western one is more built up, has many small wharves projecting into it, and has had a good deal of dredging done in places. The inner or eastern section is larger and is much more nearly in the wild state. It is infinitely more interesting from a naturalist's point of view.

The entire bay is very shallow and most of the bottom is of sandy mud. There are many large areas of eel grass. In the parts of the bay farthest from the entrance there are level mud flats; a little nearer the mouth the tide is stronger and has cut shallow channels and filled in shoals. These channels join, become deeper and more sharply separated from the flats. The current in the larger channels is strong but flows smoothly until within about half a mile of the ocean. In this last stretch there is a violent boiling and swirling which keeps the water full of sand and makes steering a boat difficult.

The entrance is about 250 yards wide. The main channel, from the entrance to a half mile east of the San Diego River mouth, is from 7 to 10 feet deep, not considering occasional deep holes. One such hole just east of the river mouth is 19 feet deep in places, and there may be others which are even deeper. Most of the larger branch channels are from 3 to 6 feet deep with occasional holes up to 10 feet or more. All these depths are at mean lower low water, i.e., zero tide. There is plenty of water in the channels to float a skiff at any stage of the tide. On a fairly calm winter afternoon when there is a minus tide, the channels of the eastern bay are as interesting a spot as any nature lover can imagine. Most of the sea life is uncovered; a great deal of the part that is not, can be seen on the bottom. Sharks, skates, rays and true fishes dash hurriedly out of the way and on all sides there are thousands of shore birds feeding and calling noisily. Gulls, pelicans and ducks also abound. The ducks are still wary and hard to approach—the area has not been closed to hunting long enough for them to learn the refuge it provides.

In addition to the natural channels there is a narrow dredged stretch which follows the shore of the western section of the bay. At present this channel is about 5 feet deep. When the dredging was

done, the waste material was allowed to form a low dike between the channel and the mud flats. Boats can cross this dike at high, but not at low tide. A fisherman on the wrong side of the dike may easily be caught by an outgoing tide even though there is plenty of water over the flats.

Another dredged channel parallels the fill which crosses the flats south of Crown Point. The dredging was done to get material for the fill.

Grassy islands occupy a considerable part of the western section of the bay. Most of these are awash at extreme high tides but some are not. Since there was not enough time to chart them properly, most of these islands have been left off the map accompanying this report. The eastern section of the bay contains a very few small grassy islands.

## SPECIES OF FISH NOW PRESENT IN MISSION BAY

### *Fishes Taken by Anglers*

A number of species of fishes are regularly sought for and often caught by anglers. The most important of these are listed below. Other species than those mentioned occur in the bay but in small numbers.

1. Rock bass (*Paralabrax nebulifer*). This fish is very common everywhere at all seasons and is taken by anglers in the channels of all parts of the bay. Specimens up to five pounds are to be caught. A desirable species.

2. Spotted rock bass (*Paralabrax maculatofasciatus*). Less common than the ordinary rock bass. A desirable species.

3. Spotfin croaker (*Roncador stearnsi*). Runs of this species occur throughout the year. Taken in the deep channels and holes in all parts of the bay. Five-pound individuals are not uncommon in the bay. A favorite fish with anglers.

4. Yellowfin croaker (*Umbrina roncador*). Occurs with the spotfin. Equally esteemed by anglers although it seldom exceeds three pounds in weight.

5. California corbina (*Menticirrhus undulatus*). Said to enter the bay in occasional runs. Attains a weight of over five pounds. A desirable species.

6. Diamond turbot (*Hypsopsetta guttulata*). Commonly called "flounder" by local fishermen. Very numerous in all parts of the bay, and taken by anglers at all seasons. The usual length is 6 to 10 inches.

7. California halibut (*Paralichthys californicus*). Occasionally taken near the entrance and in the deep channels. The usual weight in Mission Bay is about four pounds. A desirable species.

8. Smelt (species of family Atherinidae). Caught in various parts of the bay, sometimes in large numbers.

9. Salt-water perch (species of family Embiotocidae). Taken near the entrance, especially around pilings.

10. White sea-bass (*Cynoscion nobilis*) are reported to enter the bay at times. A desirable species.

11. Round sting ray (*Urolophus halleri*). Exceedingly abundant, especially on the mud flats. Seldom exceeds 20 inches in total length. Not sought for but often taken, much to the annoyance of anglers.

Dangerous to bathers by reason of its sting and its habit of lying partly buried on the bottom. By far the worst pest in the bay. Has no game qualities whatever.

12. Bat sting ray (*Aetobatus californicus*). Found in abundance on the mud flats and in the channels. Exceeds 50 pounds in weight and is a hard fighter when hooked. Known to destroy clams. Carries a dangerous sting. Furnishes excellent sport if the fisherman has enough line to stop the first rush.

13. Skates. Several species of skates inhabit the bay. Some attain a weight of 50 pounds. Said to destroy clams. Negligible game qualities.

14. Sharks. Several species of sharks inhabit the bay. Some of these furnish anglers with excellent sport. Individuals of four and five feet in length are common.

*Bait Fishes*

Large numbers of several kinds of small fishes inhabit Mission Bay. These are used as food by the larger fishes and are employed to some extent as bait by fishermen. The ones that are probably most common are listed below.

1. Top minnow (*Fundulus parvipinnis*). Exceedingly common. Excellent live bait.

2. Long-jaw goby (*Gillichthys mirabilis*). Locally called mud sucker. Good as live bait.

3. Smelt (species of family Atherinidae). Good as live bait.

4. Anchovies (species of family Engraulidae). Not seen by us, but said to be common. Excellent bait, alive or dead.

5. Amphioxis or lancelet. Too small for use as bait but is preyed upon by many species of fish.

*Other Species*

1. Mullet (*Mugil cephalus*). Very common. Attains a length of two feet. Feeds on vegetable matter and is consequently not taken by anglers.

2. Needlefish (*Strongylura exilis*). Called gar by local fishermen. Very common. Attains a length of three feet. The target of spear wielders on the Mission Beach bridge. Seldom takes the hook.

SPECIES OF SHELLFISH NOW PRESENT IN MISSION BAY

*Clams*

The mud flats of Mission Bay support a large population of several kinds of clams. The clams are used by man principally as bait and to a small extent as food. The following list of the commoner species has been compiled from Weymouth * and from the observations of the authors of this report.

1. Jack-knife clam (*Tagelus californianus*). Locally called razor clam. By far the most numerous clam in the bay. Most extensively

* Weymouth, Frank W. The edible clams, mussels and scallops of California. Calif. Fish & Game Commission, Fish Bull. No. 4, 1921.

used for bait. Several diggers supply the bait stands with thousands of jack-knife clams daily during the summer.

2. Hard-shell cockles (species of *Chione*).
3. Rock cockle (*Paphia staminea*).
4. Scallop (*Pecten circularis*).
5. Gaper (*Schizothaerus nuttalli*).
6. Washington clam (*Saxidomus nuttalli*).
7. Purple clam (*Sanguinolaria nuttalli*).
8. Wedge shell (*Donax californica*).

Other species probably occur in the bay. The cockles are used to some extent as food and bait. All others, with the exception of the jack-knife clam, appear to be too scarce to be of any importance.

Fig. 2. A view of part of Mission Bay, showing the mouth of one of the larger sloughs; Old Town in the background. Photo by authors, November, 1933.

*Crabs*

Several species of crabs occur in Mission Bay. Probably none of them reaches a size large enough for human consumption. The crabs are important, however, as a source of food for game fishes. They are noted as bait stealers and as such are a nuisance to anglers.

*Other Shellfish*

The burrowing shrimp (species of *Callianassa*) is very common in Mission Bay. It is extensively used as bait. Locally called "crawfish." Gathered in large numbers for sale by bait stands.

Mussels (species of *Mytilus*) occur on the pilings of Mission Beach bridge and probably on wharves. Used as bait.

Barnacles occur on pilings of barges and wharves.

## FACILITIES FOR FISHING

### *Bait and Tackle Stands*

There are three stands at the south end of the bridge across the bay entrance at which bait and fishing tackle can be purchased. Another bait and tackle stand is located on the causeway at the south end of the southernmost Crown Point bridge. Boats can be rented at these points and at several places along the shore at Mission Beach.

### *Pier Fishing*

The bridge across the entrance is a favorite place for anglers, although the fishing is usually poor. All species listed above are taken occasionally, but the diamond turbot (flounder) is the fish most often caught. The tidal current is very swift—perhaps too fast for good fishing. Spearing is a common practice at this bridge. Needlefish are the usual targets, but owing to their agility and slender shape, are seldom hit. Occasional runs of large sharks cause great excitement and result in broken spears. Large pieces of kelp, carried by the swift current, are an annoyance to the anglers whose lines they foul.

The bridges south of Crown Point are available to anglers. Fishing for flounders, rock bass, croakers and sharks is very good at times.

There are some twenty-three small wharves along the shore at Mission Beach. Most of these are private. Fishing for rock bass and croakers is said to be good at times.

A wharf on the mud flats near the mouth of Rose Creek is in the midst of the best sting ray and skate grounds. It may be possible to catch other species here.

### *Beach and Shore Fishing*

There are beaches at the entrance to the bay on both sides of the ends of the bridge. The beach on the north side extends along the shore of the peninsula. There is a board walk along the most northern part of this beach. Fishing is said to be good sometimes at certain places along the beaches. Rock bass, croakers, flounders and perch can be caught here.

The beaches around Crown Point are favorite fishing spots. Good croaker and rock bass fishing can be had here at times.

There is fishing from the shore at several other places, notably along the causeway rock fill and at the ends of the Crown Point bridges.

### *Boat Fishing*

There are many good fishing grounds—channels and holes—that are accessible only by boat. Croaker fishing is often good in the holes or deep spots.

Some of the channels along the marsh and around the islands are accessible at present only by boat.

The current under the Mission Beach bridge is so swift and tricky as to be dangerous for row boats that venture near the breakers when the tide is ebbing.

## CONSERVATION OF WILD LIFE

The most important item in the protection of all forms of wild life in this region is to leave the marshes and mud flats in their present natural state.

### *Game Fish*

The species of game fish which are at present in the bay will probably need no additional protection for many years, *provided* there is no reduction in their food supply.

### *Bait Animals*

By far the largest part of the bait animals taken from the bay are: jack-knife clams, burrowing shrimps (known locally as crawfish), top minnows, and gobies (small fish known as mud suckers). These animals form a very valuable food supply of the birds and game fishes. Since there are noticeable signs of depletion, these forms should be given added protection. Commercial bait men could obtain their stock from San Diego Bay, which is close by and is reputed to have more than ample supplies of bait.

### *Birds*

Mission Bay is closed to hunting—as it should be. At present, there seems to be no need for any sort of predator control, though the problem may arise in the future.

### *Seals*

There is said to be a small herd of seals resident in Mission Bay. These are probably harbor seals (*Phoca vitulina*). They were not seen by us. Fishermen complain that the seals not only destroy game fish but also drive them out of the bay. We are not prepared to say to what extent this is true. However, the seals are an attraction of the park. Many people who do not care to fish do enjoy watching the antics of a herd of seals. Therefore, the seals of Mission Bay should not be destroyed. If their numbers become too large, in the judgment of the California Division of Fish and Game, that body can be empowered to kill a few males. This can be done without in any way endangering the existence of the herd.

### *Control of Sting Rays*

A reduction in the number of sting rays in Mission Bay would be highly desirable. These species form serious competition for game fishes, and the round sting ray is a great menace to bathers. There is no way to eliminate sting rays entirely, but their numbers can be reduced by interesting anglers in taking them. Sportsmen's clubs in the San Francisco Bay region do this by having contests and awarding prizes for the largest rays caught. Once or twice a year great numbers

are taken by the club members, but no consistent effort is made to catch them throughout the year. Contests should be held on Mission Bay, not once a year but continually. The park board or possibly some sportsmen's organization could publicize the contests and award prizes for the largest bat ray and the largest round ray taken each month. While trying to catch large ones, the anglers would destroy hundreds of others and would learn what sport the bat ray affords when taken on rod and reel.

*Introduction of New Species*

Any native species of plant or animal that could thrive in the bay under present conditions would already be there in numbers. Non-native species form an entirely different problem. An introduced species may seem highly desirable in itself and yet crowd out or devour many valuable native species and become a serious pest. For this reason, new species should never be introduced until a thorough investigation has been made to determine what harm they may do.

Striped bass have been introduced into Mission Bay. These fish may perish, they may migrate out of the bay, or they may grow up and stay in the bay. They will not reproduce and any striped bass fishing will have to be kept up by continued planting. Striped bass require fresh water for spawning and there is no suitable stream entering the bay. It is to be hoped that these fish will not markedly interfere with native game fishes.

The soft-shell clam (*Mya arenaria*) is an introduced species which thrives in San Francisco and Tomales bays. It might do well in Mission Bay if introduced there. It is equal to the native jack-knife clam as bait and is superior as food. However, it might prove more attractive to sting rays (which feed upon and destroy great quantities of soft-shells in northern California bays) and less attractive to game fishes. It might supplant the now abundant jack-knife clam almost entirely and then prove to be useless to local game fishes. (It has supplanted other species in San Francisco Bay.) We do not recommend introducing this or any other species of shellfish into Mission Bay without a fairly extensive investigation, and certainly not without consulting F. W. Weymouth, Paul Bonnot, or H. C. McMillin, authorities on shellfish.

## PHYSICAL IMPROVEMENTS IN MISSION BAY

*Flood Control Channel*

The largest proposed change of which we have heard is to make a wide flood control channel to lead the San Diego River straight out to the mouth of the bay. Several years ago the river was diverted from the same route and forced to enter the bay east of Crown Point. Since then, it has been showing tendencies to silt up the marshes and fill in the bay. The new channel should be a great improvement.

*Breakwaters*

In connection with the flood control channel, it is proposed to run one or two jetties into the ocean at the entrance of the bay. If this is done, we recommend that fishing be permitted from the jetties, and

if they are of the usual broken granite construction that board walks be placed along them. These would probably be washed away periodically but could be replaced. They would not need to be elaborate, anything is far better than climbing over broken granite.

*Bulkheads*

We have heard proposals to bulkhead the bay shore in various places. In any wild life preserve, bulkheading should be used as sparingly as possible, and above all things the edges of the marshes should not be bulkheaded.

Fig. 3. Part of the eastern half of Mission Bay. One of the causeway bridges is at the left; Pacific Beach in the background. Photo by authors, November, 1933.

The main channel hugs the western shore for a half mile or so and is said to be cutting the sand away. Bulkheads may be necessary here and would not be particularly objectionable, but we recommend that groins be seriously considered before any construction is started.

*Roads*

A highway could be built to advantage along the edge of the proposed San Diego River flood control project. Because of the effect on the wild life of the marsh, we recommend that no other roads be built between the flood control channel and the bay. If any are built, all but the very smallest sloughs should be bridged and these should be provided with large culverts. Under no circumstances should any sloughs be blocked.

*Dredging*

Only a small amount of dredging could be done to advantage in Mission Bay. There should be no attempt to dredge any extensive areas of mud flats. No dredged material should be deposited on the marshes and as little as possible on mud flats. A channel along the eastern shore would attract channel-loving fish to the edge of the new highway. The construction of such a channel would fit in very well with existing plans. It is proposed to fill in some ground between the highway and the water to protect the road from wave action. The material for this fill could most easily be gotten by dredging. Any such channel should be connected with one of the larger natural channels.

As previously mentioned, the dredged channel which skirts the western half of the bay has a low dike between it and the mud flats. A few small cuts could be made through the dike to enable fishermen to get their boats off the mud flats and into the channel when the tide is low.

*Construction of New Wharves*

The construction of several wharves would have the twofold result of providing additional places to fish and of attracting more fish to enter the bay.

Fishermen would naturally be glad to have more places to fish. Present wharves and bridges were not built primarily for fishing and their location could be better from the anglers' point of view.

Pier-loving fish are not numerous in Mission Bay. If a few good wharves were built, we believe that salt-water perch, kingfish, queenfish, and other species would be attracted to enter the western part of the bay. The wharves should be built with many piles—either concrete or untreated redwood—so that marine growths such as mussels and barnacles would grow in profusion. These animals harbor other creatures, principally worms, upon which fish feed. The inducement for "pile-feeding" fish to enter the bay would improve fishing markedly.

One or two piers could be built not far within the entrance of the bay on the west shore. These wharves should project into the deep channel but should be so located as to be out of the full force of the swiftest current. Currents and depths must be studied carefully before these piers are built.

A wharf could be built from the eastern shore crossing the proposed channel and extending perhaps a hundred yards across the mud flats. It should cross the channel at some place where there is enough current to promote the growth of eel grass. (There are more fish in such places.) This would probably be near the edge of the southern marsh, and there is no reason why the wharf should not cross the tongue of marsh which projects northward along the edge of the highway. Such a wharf would be of interest not only to fishermen but to nature lovers who like to watch the life among the eel grass and on the mud flats, and could be used by nature study classes. It should not be more than two or three feet above high tide line, except where it crosses the channel where it could be somewhat higher to enable boats to pass under it.

The wharf near Rose Creek on the north shore needs repairing. It is in a neglected condition but could be improved by the expenditure of very little money.

We understand that the bridge across the entrance has been condemned and will be replaced by a new one a short distance inside of it. We recommend that the old bridge be left standing as a place to fish. It is probably strong enough to support a few fishermen even if it is unsafe for vehicular traffic.

*Bridges and Board Walks*

A number of good fishing spots are inaccessible now except by boat. These holes and channels lie along the banks of the marsh and marshy islands. The marsh is under water at extreme high tide, is cut by many sloughs, and at best is an uncomfortable place to fish.

The construction of a few hundred yards of slightly elevated board walks along the edges of the marsh near the south end of the causeway bridges would enable anglers to fish in spots rarely touched before. Foot bridges could be built across sloughs.

# TAGGING OF STRIPED BASS *

*By* G. H. Clark

A little over a year ago, on September 20, 1932, the first striped bass (*Roccus lineatus*) was tagged under an investigation which had been instigated by the California Division of Fish and Game and strongly urged and sponsored by the sportsmen of California, to determine the movement of the stripers. An agreement had been arranged between the Division and the sportsmen, which provided that the Division furnish the tags and other equipment and keep records of the tagging and of the tags recovered, and that the sportsmen cooperate by assisting in the actual tagging.

On September 20 and 21, 1932, the Division commenced the work by tagging 50 striped bass, after which instructions on tagging procedure were issued and given to the sportsmen's organizations and tagging equipment was also supplied for distribution by these organizations to responsible striped bass anglers, so that these men could tag bass while on their fishing trips. By the end of the first year, September, 1933, 294 fish had been tagged: 158 by the Division and 136 by the sportsmen. During this period of a year, 35 tagged fish had been caught or 11.9 per cent had been recovered one year or less after being tagged and liberated.

It is, of course, realized that no very definite results from tagging can be gained until large numbers of fish have been tagged. Consequently, in order to expedite the work, the Division tagged 179 bass on October 17, 18 and 19, 1933, and 206 on November 7, 8 and 9, 1933. The sportsmen tagged 11 after September 1, 1933, which made the total number of fish tagged 689. Since September, 1933, there were 7 recoveries, bringing the number of recovered tags to 42, or a 6 per cent return of all fish tagged.

The striped bass tags consist of two celluloid discs, one red and one white, one-quarter inch in diameter, and a nickel pin $1\frac{5}{16}$ inches long. The white disc contains a number and the inscription, "California Division of Fish and Game," and the red disc contains the inscription, "Return to Division of Fish and Game, San Francisco, Calif." The tag is put on between the two back (dorsal) fins one-quarter of an inch below the ridge of the back.

Procedure for tagging is as follows: When a bass is caught on the line, it is brought aboard the boat or on shore. The back of the fish is grasped with the left hand, using a wet gunny sack to protect the hand from spines and to prevent rubbing off of more slime than necessary. Next, the hook is removed as carefully as possible, the gunny

* Contribution No. 136 from the California State Fisheries Laboratory, November 14, 1933.

This work was taken over by the writer after E. C. Scofield resigned from the Division of Fish and Game. Scofield had started the work and determined and ordered the type of tag suitable for tagging striped bass. S. H. Dado of the Division made the awls for tagging, has helped with the tagging done by the Division and has kept a duplicate record of tags. I am indebted to the Bureau of Patrol for use of the launch *Quinnat*, in tagging and to the members of its crew for their assistance.

sack thrown over the snout of the fish, and the fish placed on its belly on a flat surface. Then with a small awl (1/16 inch in diameter), a hole is punched through the back of the fish at right angles to the length of the fish one-quarter inch below the ridge of the back. The pin, with the white disc against its head, lettering exposed, is put through the awl hole; the red disc is put on the pin; and the pin is then curled over with a small pair of pointed-nosed pliers. The length of the fish from snout to end of tail is measured and recorded, and the fish is returned alive to the water. The whole operation of tagging takes about one minute and in no case has it seemed to weaken the fish to any extent.

The following Table I is a record of the fish tagged, numbers of tags, date and locality of tagging.

**TABLE I**

| Number of bass tagged | Tag numbers | Date | Locality | Tagged by |
|---|---|---|---|---|
| 5 | 1– 5 | Sept. 20, 1932 | Southampton Bay, Carquinez Strait | Division |
| 9 | 6– 14 | Sept. 20, 1932 | Middle Ground, Suisun Bay | Division |
| 36 | 15– 50 | Sept. 21, 1932 | Middle Ground, Suisun Bay | Division |
| 5 | 51– 55 | Oct. 27, 1932 | Mile above R. R. Bridge, Suisun Bay | Division |
| 44 | *56–100 | Oct. 27, 1932 | Middle Ground, Suisun Bay | Division |
| 8 | 101–108 | Oct. 28, 1932 | Off Snag Island, Middle Ground | Division |
| 8 | 109–116 | Oct. 28, 1932 | Middle Ground, Suisun Bay | Division |
| 34 | 117–150 | Oct. 28, 1932 | Mile above R. R. Bridge off Avon Wharf, Suisun Bay | Division |
| 10 | 151–160 | Nov. 11, 1932 | Mouth, Andy Mason Slough, Suisun Bay | Sportsmen |
| 3 | 161–163 | Nov. 12, 1932 | West of Wheeler Island and east of Noyce Slough, Suisun Bay | Sportsmen |
| 3 | 164–166 | Nov. 13, 1932 | Mouth, Andy Mason Slough, Suisun Bay | Sportsmen |
| 1 | 172 | April 15, 1933 | San Pablo Bay | Sportsmen |
| 1 | 173 | June 20, 1933 | Point Wilson | Sportsmen |
| 3 | 174–176 | June 22, 1933 | Southampton Bay | Sportsmen |
| 4 | 177–180 | Aug. 26, 1933 | Antioch Bridge | Sportsmen |
| 1 | 181 | Nov. 24, 1932 | Boynton Slough, Suisun Bay | Sportsmen |
| 1 | 182 | Feb. 5, 1933 | Suisun Slough | Sportsmen |
| 2 | 183–184 | Sept. 27, 1933 | Suisun Slough | Sportsmen |
| 4 | 185–188 | Sept. 28, 1933 | Suisun Slough | Sportsmen |
| 1 | 190 | Sept. 28, 1933 | Suisun Slough | Sportsmen |
| 10 | 231–240 | Dec. 3, 1932 | Between Ryer and Roe Island, Suisun Bay | Sportsmen |
| 10 | 241–250 | Dec. 4, 1932 | Grizzly Bay | Sportsmen |
| 5 | 251–255 | Dec. 4, 1932 | Between Ryer and Roe Island, Suisun Bay | Sportsmen |
| 5 | 256–260 | May 13, 1933 | Beacon, Napa River | Sportsmen |
| 4 | 261–264 | May 19, 1933 | Beacon No. 2, Napa River | Sportsmen |
| 6 | 265–270 | June 11, 1933 | Steamboat Slough | Sportsmen |
| 2 | 271–272 | Nov. 11, 1933 | Middle Ground, Suisun Bay | Division |
| 6 | 273–278 | Nov. 11, 1933 | Broad Slough | Division |
| 1 | 292 | July 29, 1933 | Tower, Napa River | Sportsmen |
| 8 | 293–300 | Aug. 19, 1933 | Tower, Napa River | Sportsmen |
| 1 | 351 | May 27, 1933 | Beacon No. 2, Napa River | Sportsmen |
| 16 | 352–367 | May 27, 1933 | Tower, Napa River | Sportsmen |
| 12 | 368–379 | May 28, 1933 | Tower, Napa River | Sportsmen |
| 1 | 380 | May 29, 1933 | Beacon No. 2, Napa River | Sportsmen |
| 1 | 381 | June 10, 1933 | Tower, Napa River | Sportsmen |
| 1 | 383 | June 10, 1933 | Ratto's Barn, Napa River | Sportsmen |
| 4 | 384–387 | June 11, 1933 | Ratto's Barn, Napa River | Sportsmen |
| 1 | 388 | June 17, 1933 | Cutting Wharf, Napa River | Sportsmen |
| 1 | 389 | July 1, 1933 | Mouth, South Slough, Napa River | Sportsmen |
| 2 | 390–391 | July 4, 1933 | Beacon No. 8, Napa River | Sportsmen |
| 19 | 392–410 | July 29, 1933 | Tower, Napa River | Sportsmen |
| 4 | 411–414 | Oct. 8, 1933 | Beacon No. 2, Napa River | Sportsmen |
| 1 | 441 | Aug. 19, 1933 | Tower, Napa River | Sportsmen |
| 47 | 451–497 | Oct. 17, 1933 | Broad Slough | Division |
| 58 | 498–555 | Oct. 18, 1933 | Point Chipps Island, Honker Bay | Division |
| 54 | 556–609 | Oct. 19, 1933 | Point Chipps Island, Honker Bay | Division |
| 6 | 611–616 | Oct. 19, 1933 | Point Chipps Island, Honker Bay | Division |
| 14 | 617–630 | Oct. 19, 1933 | Broad Slough | Division |
| 21 | 681–701 | Nov. 7, 1933 | Off Browns Island, near Pittsburg | Division |
| 1 | 702 | Nov. 8, 1933 | Middle Slough | Division |
| 142 | 703–844 | Nov. 8, 1933 | Grizzly Bay | Division |
| 42 | 845–886 | Nov. 9, 1933 | Grizzly Bay | Division |
| 689 | | | | |

* Tag No. 70 not used.

It will be noticed from Table I that most of the striped bass were tagged in one general locality, Suisun Bay and adjacent waters. This was due to the fact that fish were more plentiful or at least easier to catch in this region. However, about 80 fish were tagged in Napa River, one fish in San Pablo Bay and about 70 in Broad Slough. All fish tagged were caught by hook and line, the sportsmen usually tagging those that were below the size limit, whereas the Division tagged all fish caught except the very small ones under seven inches.

Table II shows the sizes tagged during the first year and those tagged in October and November of the second year of the work.

The greatest number of fish tagged between September, 1932, and September, 1933, were 11 inches in length, the smallest fish was 5 inches, and the largest 41 inches. There are two groups of sizes, those between 8 and 12 inches and those between 14 and 18 inches, and possibly a third group around 19 and 20 inches. The 8 to 12 inch group is in the main composed of 2 year old fish,* the 14 to 18 inch group 3 year old fish, and the 19 to 20 inch group 4 year old fish. The same groups are also apparent in the fish tagged in October and November of 1933, but the majority tagged were of a slightly smaller size. The proportion of each group to the whole in the fish caught and tagged by the Division in October and November, 1933, is: for the first group about 75 per cent, the second about 23 per cent, and the remainder about 2 per cent. If this proportion represents the true condition of the striped bass population in the bay, and it may, although the material is much too scanty to hazard definite opinion, it is not welcome news for the continuation of good striped bass fishing. If the anglers are drawing heavily on fish from 12 to 18 inches in size and not allowing sufficient numbers to reach maturity at 4 to 5 years of age, the population in a short time may fall alarmingly. Now these "ifs" may or may not be true. There is very little evidence to support them, yet there is some basis as shown by the catch of tagged fish, which were caught with various sizes of hooks and of bait. It is food for thought.

As yet, very little information about striped bass movements is apparent. As said before, 42 tagged bass were recovered, which is 6 per cent of the amount tagged, within a little more than a year's time. A great many of the recoveries were made very near the vicinity where the fish were tagged and liberated. There is no evidence as yet that there is a definite movement of the bass in any direction; the bass that moved any distance moved from their tagging spot in all directions. No conclusions of striped bass movements can be made until more bass are tagged and recovered. The longest movement known was that of two bass which were tagged on the Middle Ground in Suisun Bay and recovered in the Mokelumne River. One bass tagged in Southampton Bay, Carquinez Strait, was recovered at Antioch Bridge. Another recovery was made in San Pablo Bay from the Middle Ground, Suisun Bay. Still another from Napa River was recovered at Toland Landing, Sacramento River.

Table III shows the recovered fish, tag numbers, date and locality of recovery, date tagged, place tagged, size when tagged, and number of days between tagging and capture.

* Scofield, E. C. The striped bass of California. Calif. Div. Fish & Game, Fish Bull., No. 29, 1931.

2—9030

TABLE II

| Total length of striped bass tagged, in inches | 5.0 | 5.5 | 6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | 9.0 | 9.5 | 10.0 | 10.5 | 11.0 | 11.5 | 12.0 | 12.5 | 13.0 | 13.5 | 14.0 | 14.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number tagged during first year: September, 1932, to September, 1933 | 1 | ------ | 1 | ------ | 4 | ------ | 7 | 4 | 21 | 8 | 33 | 23 | 43 | 15 | 38 | 15 | 7 | 4 | 8 | 1 |
| Number tagged during second year: October and November, 1933 | ------ | ------ | ------ | ------ | ------ | 3 | 16 | 30 | 54 | 43 | 53 | 37 | 30 | 13 | 16 | 3 | 4 | 2 | 7 | 3 |
| Totals | 1 | ------ | 1 | ------ | 4 | 3 | 23 | 34 | 75 | 51 | 86 | 60 | 73 | 28 | 54 | 18 | 11 | 6 | 15 | 4 |

TABLE II—Continued

| Total length of striped bass tagged, in inches | 15.0 | 15.5 | 16.0 | 16.5 | 17.0 | 17.5 | 18.0 | 18.5 | 19.0 | 19.5 | 20.0 | 20.5 | 21.0 | 21.5 | 22.0 | 22.5 | 23.0 | 23.5 | 41.0 | Total No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number tagged during first year: September, 1932, to September, 1933 | 10 | 10 | 12 | 4 | 5 | 3 | 4 | ------ | 5 | 4 | 1 | ------ | ------ | ------ | 1 | ------ | ------ | ------ | 1 | 293 |
| Number tagged during second year: October and November, 1933 | 18 | 6 | 16 | 9 | 13 | 1 | 0 | 1 | 1 | 0 | 2 | 2 | ------ | ------ | ------ | ------ | 1 | ------ | ------ | 396 |
| Totals | 28 | 16 | 28 | 13 | 18 | 4 | 4 | 1 | 6 | 4 | 3 | 2 | ------ | ------ | 1 | ------ | 1 | ------ | 1 | 689 |

TABLE III

| Tag number | Date of recovery | Place of recovery | Date tagged | Place tagged | Size when tagged (inches) | Number of days released before recovery |
|---|---|---|---|---|---|---|
| 21 | Sept. 25, 1932 | Stake Point, Contra Costa County | Sept. 21, 1932 | Middle Ground, Suisun Bay | 19.0 | 4 |
| 29 | Oct. 2, 1932 | Bay Point | Sept. 21, 1932 | Middle Ground, Suisun Bay | 16.0 | 11 |
| 7 | Oct. 8, 1932 | Seal Isle, Bay Point | Sept. 20, 1932 | Middle Ground, Suisun Bay | 12.5 | 18 |
| 28 | Oct. 23, 1932 | Between Bay Point and Pittsburg | Sept. 21, 1932 | Middle Ground, Suisun Bay | 16.0 | 32 |
| 1 | Nov. 23, 1932 | Above Sears Point, Napa River | Sept. 20, 1932 | Southampton Bay, Carquinez Strait | 12.0 | 63 |
| 93 | Nov. 24, 1932 | Canal Ranch, Mokelumne River | Aug. 27, 1932 | Middle Ground, Suisun Bay | 15.5 | 57 |
| 181 | Dec. 1, 1932 | Peytonia Slough | Nov. 24, 1932 | Boynton Slough | 41.0 | 7 |
| 63 | Nov. 10, 1932 | Mouth, Mokelumne River | Oct. 27, 1932 | Middle Ground, Suisun Bay | 14.0 | 14 |
| 18 | Dec. 15, 1932 | Mouth, New York Slough | Sept. 21, 1932 | Middle Ground, Suisun Bay | 15.0 | 52 |
| 52 | Jan. 2, 1933 | Off Chipps Island Ferry | Oct. 27, 1932 | Mile above R. R. Bridge, Suisun Bay | 14.0 | 67 |
| 154 | Jan. 10, 1933 | Mouth, Old River | Nov. 11, 1932 | Mouth, Andy Mason Slough | 10.5 | 60 |
| 66 | Feb. 9, 1933 | Sacramento River, Collinsville | Oct. 27, 1932 | Middle Ground, Suisun Bay | 19.0 | 124 |
| 160 | Mar. 5, 1933 | End, New York Slough | Nov. 11, 1932 | Mouth, Andy Mason Slough | 11.0 | 114 |
| 4 | Mar. 16, 1933 | Above Antioch Bridge | Sept. 20, 1932 | Southampton Bay | 14.0 | 177 |
| 121 | Mar. 15, 1933 | Above Antioch Bridge | Oct. 28, 1932 | Mile above R. R. Bridge, Suisun Bay | 10.5 | 138 |
| 275 | Mar. 17, 1933 | Above Antioch Bridge | Nov. 11, 1932 | Broad Slough | 10.0 | 126 |
| 72 | April 5, 1933 | San Pablo Bay | Oct. 27, 1932 | Middle Ground, Suisun Bay | 17.0 | 160 |
| 61 | Mar. 20, 1933 | Three Mile Slough | Oct. 27, 1932 | Middle Ground, Suisun Bay | 12.5 | 144 |
| 135 | Mar. 24, 1933 | Three Mile Slough | Oct. 28, 1932 | Avon Wharf, Suisun Bay | 13.0 | 147 |
| 49 | April 27, 1933 | San Pablo Bay | Sept. 21, 1932 | Middle Ground, Suisun Bay | 16.0 | 218 |
| 139 | April 26, 1933 | Near Carquinez Bridge | Oct. 28, 1932 | Avon Wharf, Suisun Bay | 10.5 | 180 |
| 87 | May 1, 1933 | Mouth, Middle River | Oct. 27, 1932 | Middle Ground, Suisun Bay | 13.0 | 186 |
| 89 | May 22, 1933 | Steamboat Slough | Oct. 27, 1932 | Middle Ground, Suisun Bay | 11.0 | 207 |
| 386 | June 25, 1933 | Beacon No. 2, Napa River | June 11, 1933 | Ratto's Landing, Napa River | 11.5 | 14 |
| 383 | June 30, 1933 | Rodeo | June 10, 1933 | Ratto's Landing, Napa River | 12.0 | 20 |
| 266 | July 2, 1933 | Head, Steamboat Slough | June 11, 1933 | Steamboat Slough | 11.0 | 22 |
| 31 | July 13, 1933 | Isleton, Sacramento River | Sept. 21, 1933 | Middle Ground, Suisun Bay | 17.0 | 264 |
| 76 | July 4, 1933 | Tormey | Sept. 27, 1932 | Middle Ground, Suisun Bay | 15.0 | 245 |
| *231 | Aug. 20, 1933 | Mile above Collinsville | Dec. 3, 1932 | Ryer and Roe Island | 8.0 | 260 |
| 396 | Aug. 20, 1933 | Toland, Sacramento River | July 29, 1933 | Tower, Napa River | 12.0 | 22 |
| 236 | Sept. 22, 1933 | Pittsburg | Dec. 3, 1932 | Ryer and Roe Island | 9.0 | 292 |
| 116 | Sept. 22, 1933 | McAvoy | Oct. 28, 1932 | Middle Ground, Suisun Bay | 10.5 | 329 |
| 26 | Feb. 15, 1933 | Rodeo | Sept. 21, 1932 | Middle Ground, Suisun Bay | 15.5 | 160 |
| 146 | Feb. 15, 1933 | Rodeo | Oct. 28, 1932 | Avon Wharf, Suisun Bay | 12.0 | 123 |
| 98 | Feb. 15, 1933 | Rodeo | Oct. 27, 1932 | Middle Ground, Suisun Bay | 20.0 | 124 |
| 179 | Oct. 15, 1933 | Broad Slough | Aug. 26, 1933 | Antioch Bridge | 10.0 | 50 |
| 300 | Oct. 16, 1933 | Middle Ground, Suisun Bay | Aug. 19, 1933 | Tower, Napa River | 11.0 | 58 |
| 272 | Oct. 18, 1933 | Off Bay Point | Nov. 11, 1932 | Middle Ground, Suisun Bay | 17.5 | 341 |
| *100 | Oct. 11, 1933 | Steamboat Slough | July 29, 1933 | Tower, Napa River | 8.0 | 74 |
| 106 | Oct. 15, 1933 | Mile east of Antioch | Oct. 28, 1932 | Off Snag Island | 10.5 | 354 |
| 454 | Oct. 22, 1933 | Sacramento River, Pittsburg | Oct. 17, 1933 | Broad Slough | 16.5 | 5 |
| *477 | Nov. 2, 1933 | Sacramento River, Pittsburg | Oct. 17, 1933 | Broad Slough | 7.0 | 16 |

*Fish recovered, tag recorded and fish liberated again with tag still attached.

As shown in Table III, the shortest period of time a tagged bass was out was four days and the longest was 354 days, though of course there are a great many fish still at large. There seems to be no relationship between the size of fish and the length of time before recovery; however there is some evidence that fish 14 to 18 inches in length were recovered in greater proportion than the smaller sizes, considering the larger numbers of small fish tagged.

The foregoing is in the nature of a progress report of striped bass tagging. The material at hand, number of fish tagged and recovered, do not afford sufficient data on which to base conclusions on the movements of striped bass. It is therefore urged that the sportsmen increase interest in the work and tag more bass in order that we may be able to trace the movements of the stripers with some degree of certainty.

# OCTOPI OF CALIFORNIA *

*By* J. B. Phillips

From time immemorial it has been customary for the layman to apply the term "devil" to animals that have a fearful appearance or to animals to which the power of creating evil has been attributed. It is not surprising that the term "devil" has been applied to the octopus in view of its long, snaky, writhing arms covered with numerous suckers, and the soft, muscular body with sinister-looking eyes. This apprehensive appearance has been heightened by various tales woven around a very few facts. Altogether, the term "devilfish" is misleading as it is subject to local or personal interpretation, whereas the term octopus in this particular case is a descriptive and universally accepted name.

## POPULAR DESCRIPTION OF COMMON OCTOPUS

Briefly an octopus may be described as an invertebrate marine animal having a large head and a small sac-like body above eight arms that are more or less united at the base by a membrane. The arms are usually provided with two rows of suckers by means of which they cling to rock or prey. Ordinarily, the octopus lives on the bottom along a rocky coast and moves on and off shore amongst the rocks in search of food. In times of danger, it retreats into the openings and recesses among the rocks. The octopus breathes by taking in oxygen-laden water through a slit in the neck portion of the body. This water passes over feather-like gills in the body cavity and is forced out through a funnel-like siphon that is visible on the right side of the neck portion. Locomotion is accomplished in two different ways. When frightened, the octopus can rocket itself backward by a series of sudden contractions of the body, rapidly taking in and expelling jets of water. Ordinarily, the octopus moves about on the bottom by lengthening and contracting its eight muscular arms. Loss of an arm only inconveniences it temporarily as it can grow another.

The octopus is somtwhat of a seavenger as well as a fresh flesh eater. It shows particular liking for rock crabs which it stalks and drops on from above. Several crabs can be held at one time and are eaten by tearing off the legs and getting to the soft inner parts from the under side. A pair of chitinous beak-like jaws, situated within the mouth of the octopus, is an aid in such cases. The octopus also feeds on abalones and mussels. Abalone divers tell of occasionally finding an octopus patiently exerting pressure on an abalone. The abalone eventually tires and relaxes, even as an oyster gives in to a starfish. The octopus can also open mussels in a similar manner. The powerful grip of the octopus is due to the vacuum created by lifting up the floor of the sucker, while the rim of the sucker is attached, and then dropping the floor.

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* Contribution No. 137 from the California State Fisheries Laboratory, November 8, 1933.

### OCTOPUS AS FOOD

Strange as it may seem to some, the octopus is considered a food delicacy by certain people in America, mainly Japanese, Chinese, Italians and Greeks. Present day gastronomical acceptance of octopus by these people may be traced back to the ancient Romans and Greeks, who considered it the finest "fish" in the sea. Gourmands of Rome ate with relish every species of octopus caught in the Mediterranean Sea. These they baked in a sort of big pie, cutting up the arms and filling the head with spices.

The usual method of preparing octopus for the table by present day connoisseurs is to cook it in boiling salted water twenty to thirty minutes. The animal is first dipped in the boiling water a few times as an aid to loosening the skin. After boiling, the animal is skinned, cut into pieces and served with a vinegar sauce. For particular flavor, some Italians add tomatoes and garlic while boiling. Before cooking, the arms of an octopus might be pounded to loosen up the muscular fibres. An aid to cleaning an octopus is to turn the mantle inside out at the neck portion.

### COMMERCIAL IMPORTANCE

The commercial octopus fishery of California is of minor importance. Since 1920, the annual catch has varied from 10,000 to 165,000 pounds, with about 75,000 pounds as the usual yearly landing. Of the total annual State poundage, 85 per cent (all *Polypus hongkongensis*) is delivered at the two Monterey Bay ports: Monterey and Santa Cruz. Monterey deliveries are the greatest in the State, comprising 65 to 70 per cent of the annual State catch. Next to Monterey, the ports of largest deliveries are Santa Cruz and San Francisco. During the past few years, San Francisco has surpassed Santa Cruz. Monterey, however, holds its place by a wide margin. Within the past few years, landings of Sonoma and Mendocino counties have increased and rival those of San Francisco and Santa Cruz. Los Angeles, the only other port of consequence, normally receives a few hundred pounds a year.

### METHODS OF CAPTURE IN CALIFORNIA

At Monterey and along the California coast in general, octopi are captured, for the most part, in cage-like baited traps set close to the rocks. The so-called "devilfish" or octopus trap is constructed as a wire screen box or a wicker basket. The most widely used trap is the wicker basket, similar to the one pictured in Fig. 4. These traps are 4 to $5\frac{1}{2}$ feet high and about $2\frac{1}{2}$ to 3 feet in diameter at the large (mouth) end. A trap-door is located at the small end of the trap, opposite the large end, and is for baiting the trap and extracting the catch. There is but one mouth, which is in the form of a funnel at the large end. This funnel is about 2 feet long and starts with the circumference of the large end. It tapers to about a 6-inch opening in the center of the trap. Most traps of this type are constructed of rattan with a few wires around the circumference for reinforcement. The rattan is better than an entirely wire construction because of its flexibility when in contact with rocks.

In southern California, a box-like trap covered with chicken wire is used more commonly. This trap is not set in very deep water as the species of octopus most common there is smaller and inhabits comparatively shallow water.

At Monterey, there are two and sometimes four octopus fishermen, all Italians. These fishermen have 10 to 30 traps apiece. The traps

Fig. 4. An octopus trap such as is used at Monterey. This trap is 4½ feet high and is constructed mainly of rattan. Note funnel terminating in small opening in middle of trap. The large end resting on ground is the mouth of the funnel. Specimens of prawn, accidentally caught in trap, are being exhibited. Photo by Joe Wales, November, 1930.

are baited and anchored one-half to one mile from shore in series of about 10 traps. The main fishing locality is off the rocky shores of the open coast between Point Pinos and south to Carmel, in 10 to 30 fathoms of water. The traps are looked after each day or two in connection with other fishing. The yield during a normal season (spring,

summer and fall months) is probably an average of 15 octopi a week from a set of 10 traps. The number of deliveries per week and the amounts delivered fluctuate a great deal. On one occasion, during the last summer, 400 pounds of octopi averaging 25 pounds apiece were brought in by a fisherman after one trip. The octopi delivered at Monterey average 20 to 30 pounds each. A record specimen weighed 90 pounds. During the winter months, few octopi are delivered because of the unsettled water conditions along the coast. The price paid fishermen may range from 5 cents a pound in the summer to 15 cents a pound in the winter, depending upon abundance.

The reason more fishermen do not take up octopus fishing is that a few fishermen can supply the demand. Furthermore, the return per unit of gear is slight and a set of 10 to 12 traps, plus ropes, anchors, etc., costs about $100. A string of traps may be easily lost when set off an open coast, especially in times of rough water.

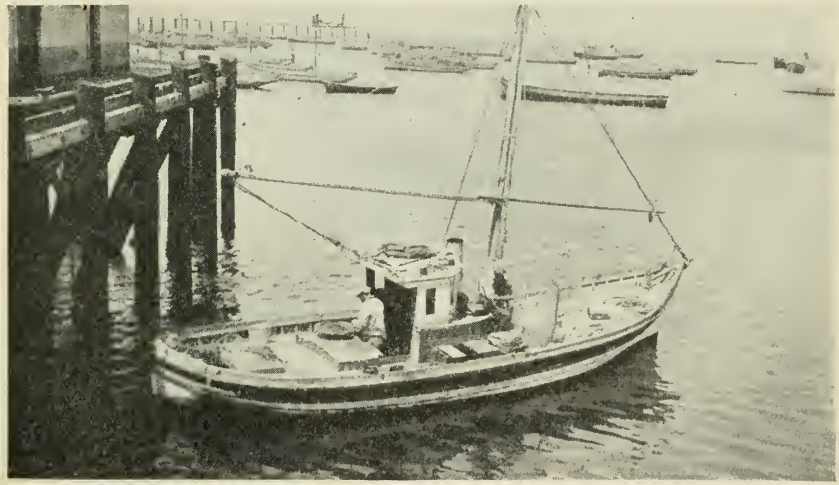

Fig. 5. A typical jig boat at Monterey. This boat is about 30 feet long and has a 12-horsepower gasoline engine. Octopus fishing is carried on by a very few fishermen, in connection with other market fishing. Note octopus trap, similar to one pictured in Fig. 4, being repaired on deck. Photo by J. B. Phillips, May, 1933.

As octopus traps are operated in conjunction with hand line and similar market fishing, the jig type of boat is used in the operations. The jig boats at Monterey are 25 to 35 feet long and have gas engines of 8 to 16 horsepower. Fig. 5 shows a typical type of boat with a trap being repaired on deck.

## METHODS OF CAPTURE IN OTHER COUNTRIES

Bartsch (1931) has published some interesting accounts of methods that other people use in capturing octopus. The simplest method of capture, according to him, is probably that used by Filipinos. On a dark night, a band of Filipinos wearing only "G-strings," form a ceremonial procession to the sea. In one hand they bear lighted torches and in the other, spears. The light of the torches penetrates the shallow water and reveals the luckless octopus, which apparently forsakes the

secure caverns of the reef and goes hunting for food in the shallow flats near shore, where it is easily speared.

On the island of Guam, Bartsch tells about an entirely different procedure. The natives work on the inside of reefs, in the surf. They use large repulsive-looking sea cucumbers tied to a line with a sinker which is lowered among the crevices of the reef. The first action of the sea cucumber is to try to hide, and if he finds a cavity containing an octopus, the latter at once moves out and is easily speared from the canoe. Evidently, the company of the sea cucumber is quite distasteful to the octopus.

Bartsch quotes Dr. H. M. Smith on Japanese methods in the following vein: Octopi are an abundant and important food product in Japan. This cephalopod is caught in various ways, the most interesting of which is by the use of earthenware pots, which are lowered to the bottom by means of cords and left for 8 to 10 hours. The octopi enter the shiny, smooth pots and are evidently reluctant to leave, so that the pots may be pulled to the surface before they try to escape. These pots have a hole in the bottom to allow the escape of water.

Dr. Smith goes on to tell of a reverse procedure of this method in recovering valuable porcelains destined for the Imperial household from a vessel that was wrecked in the Inland Sea about a century ago. Fishermen have recently been recovering these valuable pieces of pottery, which are in excellent condition, by tying strings to octopi and lowering them in the vicinity of the wreck. The animals enter the vessels and retain their hold until drawn to the surface.

### ANIMAL KINGDOM RELATIONSHIP

The octopus is not related to fishes. All animals can be separated into two groups known as invertebrates and vertebrates, that is, with or without a backbone. True fishes belong to the latter group (vertebate), while octopi belong to the former group. Those animals having certain structural characters in common are placed in smaller groupings called phyla. For example, octopus and squid belong to the phylum Mollusca. Although this phylum also includes such external shell-bearing marine forms as abalones, clams, scallops and mussels, all animals of this phylum have in common a mantle, a ventral muscular foot, as well as a shell, or a vestige of one, and a radula. In the case of abalones, clams, etc., the shell is external, whereas in squids it is reduced to a chitinous inner pen or cuttlebone, and in the octopus to an insignificant coiled vestige.

However, the squids, octopi and natuli differ from other members of the phylum Mollusca in that the foot is divided into arms provided with suckers (as well as a strongly developed nervous system concentrated in the head), so that they are grouped together in the class Cephalopoda, meaning "head-footed."

The Cephalopoda are divided into two orders, Tetrabranchia and Dibranchia. The order Tetrabranchia is characterized by the presence of four gills, four kidneys, four auricles, a large external shell, and very short arms bearing no suckers. The only representative of this order is the genus *Nautilus*, to which belongs the chambered or pearly nautilus. The order Dibranchia is characterized by the presence of only two gills, two kidneys, two auricles, a shell enveloped by a mantle, and long arms provided with suckers.

The order Dibranchia in turn is divided into two suborders called Decapoda and Octopoda. The Decapoda are mainly differentiated by the presence of ten arms, eight short and two long. The arms bear suckers and sometimes hooks. The group includes the squids and cuttlefish. The Octopoda are mainly distinguished by the presence of but eight sucker-bearing arms of equal length. The suborder includes the octopus and the paper nautilus or argonaut.

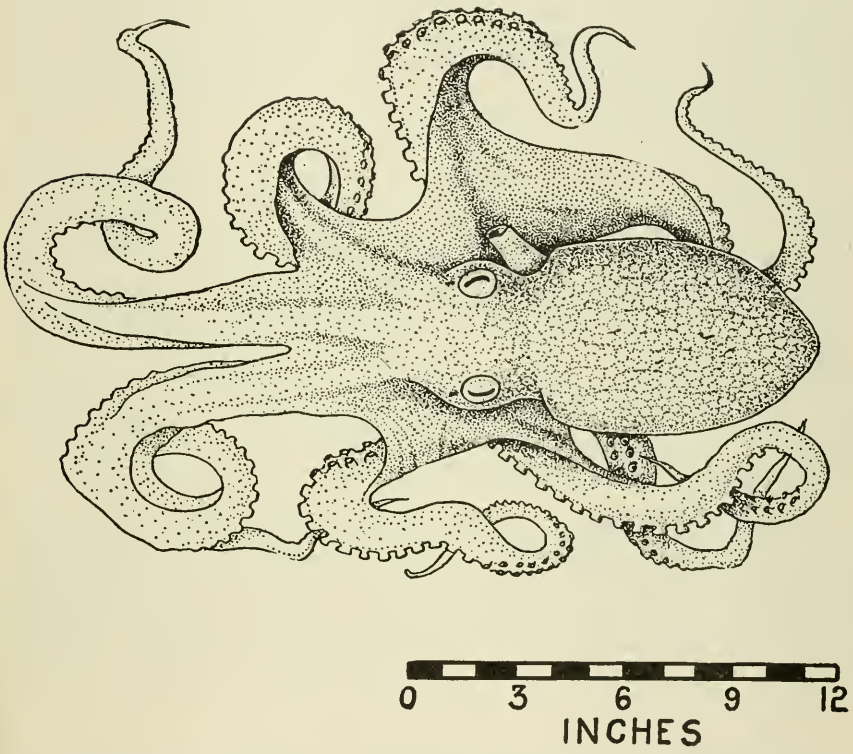


Fig. 6. Octopus (*Polypus hongkongensis*). Drawing by Dr. Harold Heath.

SPECIES OF OCTOPI REPORTED ALONG CALIFORNIA COAST

There are some half dozen species of octopi found along the coast of California. Most species are found in southern waters but the largest and most abundant form is more northern in distribution. There are but two forms that appear in any numbers along our Pacific coast. These are the big octopus (*Polypus hongkongensis*), which attains a total expanse of about 16 feet and is found from Alaska to San Diego on this side of the Pacific and from China northward on the Asiatic side; and the two-spotted octopus (*Polypus bimaculatus*), which attains a length of about 20 inches and is found from San Pedro, California, south to Panama.

Following is a brief description of the octopi found along the California coast, as adapted after Berry (1912):

*Polypus hongkongensis*.—This is the big octopus that represents practically the entire commercial catch in California. It has a wide

distribution, being found on the coasts of China and Japan as well as on our coast from Alaska to San Diego. It is an abundant shore form and reaches a length of 16 feet and a weight of 90 pounds. The usual weight of specimens landed at Monterey is 20 to 30 pounds.

The body is short and almost globular, and the arms are stout and very long. The head is rather small, being separated from the body by a slight constriction. Fairly prominent eyes are located on the top sides of the head. The funnel is long and conical, terminating as usual along the right side of the head. The suckers are largest where the arms join the umbrella, diminishing rapidly in size near the tips of the arms. The surface of the body is somewhat tuberculated, and the color is milky whitish or translucent grayish, the outer surface being overlaid with blackish, brownish or purplish dots.

*Polypus bimaculatus.*—This is the two-spotted octopus, the common shore octopus of southern California. Purplish ocular spots in front of the eyes are a distinguishing feature. The spots are large, round and decidedly darker than the rest of the animal. The body and arms are similar to those of *P. hongkongensis*. Numerous warty papillae cover the surface of the body, varying from a nearly smooth state to very rugose. A large conical, warty projection is present just over each eye.

The distribution of this octopus might be said to start where the big octopus leaves off. It is found from San Pedro southward to Panama. It is taken mainly from tide pools at low tide. Large specimens measure about 20 inches in length.

*Polypus californicus.*—Only a few specimens of this species have been reported and these were taken off San Diego. The body is of moderate size, short, rounded and compact. The arms are stout and moderately long, the basal portions being about one-fourth webbed. The main distinguishing features are the numerous large star-like papillae that cover the surface of the body, becoming nearly obsolete ventrally. Also, above each eye is a rounded flattened tubercle, slightly larger than the rest.

*Polypus gilbertianus.*—This species is also rather uncommon and is reported only from southern California. The body is of moderate size and is a little broader than long. The surface is covered everywhere with numerous minute, rough papillae, giving the skin a somewhat grainy texture. A large softened, flattened, blunt tubercle is present above and slightly behind the center of each eye. The eyes are somewhat large and rather protruding. The funnel is broad at the base, tapering to nearly cylindrical at the extremity. Arms are rather long and slender, being webbed by the strong umbrella for about one-fourth of their length, the membrane continuing from the umbrella to nearly the tips of the arms.

*Elodonella heathi.*—This is another uncommon octopus from southern California waters. The body is of moderate size and the skin is smooth in contrast to the four forms just described. The arms are slender, the third pair being much the longer; suckers in a single row; umbrella extending to about one-third of arms. The head is short, broad and greatly compressed above and below, and is well separated

from the body. The eyes are very large, with protruding lenses. The funnel is broad and thin, not extending to eyes.

*Cirroteuthis macrope.*—This is a rare species previously only reported from San Diego. In September, 1932, a specimen taken by Santa Cruz fishermen was sent by Louis Beverino to Mr. D'Aequisto of Monterey, who brought it to Dr. Rolf Bolin of the Hopkins Marine Station (Stanford University). The distinctive feature of this species is that the umbrella is attached nearly to the tips of the arms, giving a truly umbrella-like appearance. This species is rather small and subgelatinous in consistency. The body is somewhat barrel-shaped and fairly elongate with short broad oar-like fin on either side near the posterior extremity. The head is wide, flattened and broadly continuous with the body above. The left eye is larger and more protruding than the right. The funnel is large, broad and well-imbedded.

*Argonauta pacifica.*—This is the pelagic form, commonly known as the "paper nautilus" (*not* chambered or pearly nautilus) and is found from Monterey, California, to the equator. It is of moderate size, the male being much smaller than the female. In the male, the third arm of the left side is entirely modified into the form of an oval sac for reproductive purposes. In the female, the tips of the dorsal arms are greatly expanded, wing-like, and their function is to secrete the large fragile "shell" or egg case. The coloration of this octopus tends to orange with fine purple dots, more crowded and larger on the back.

*Polypus leioderma.*—This form is reported only from Alaska by Berry. It can be readily recognized by the narrow and distinct keel-like fold of integument that bounds the body laterally. The body is of moderate size, wider than long, and nearly smooth except for a few simple papillae on the dorsal surface. The head is short with large protruding eyes. The arms are not very long; the umbrella extending between dorsal and ventral arms for over one-fourth of length but much shorter between ventral pairs.

## OCTOPUS TALES OF OLDEN TIMES

A review of some of the literature of ancient times bearing on octopi reveals some very interesting stories that were supposed to be scientifically correct. These stories, which were written evidently as truthful accounts, put to shame much of our present day fiction, which is taken for granted as being based on little or no fact.

Bartsch (1917), in his research for the Smithsonian Institution, has published a collection of ancient facts and fancies about cephalopods (squid and octopi), from which the following are taken:

One ancient writer told of an octopus that was in the habit of coming from the sea to feed on salted fish packed in pickling tubs, some distance from shore. Repeated forays prompted the owners of the operations to place a high fence between the works and the sea. However, the octopus surmounted this fence with the aid of a tree, and it was only caught by calling dogs to their aid. The dogs surrounded the marauder but were kept at bay by the terrible stench exuded by the animal and the eight arms which whipped out at the dogs. It was finally killed with three-prong spears. This octopus was reported as weighing 700 pounds, and having suckers as large as urns.

Another story is about an octopus considered dead and placed in a kettle hung over a fire. This particular octopus became sufficiently revived to leave the kettle, climb up the chimney and onto the roof, where after considerable hunting it was discovered hiding behind the chimney.

Statements are also made that natives of the Sudian Isles, when sailing in canoes, always provided themselves with hatchets so that they could immediately cut off the arms of these animals if they happen to be flung over the sides, lest the boat be pulled under water.

The captain of an African slaver on the west coast of Africa recounted the story of a monstrous cuttlefish (a painting of this animal and ship, however, proved the animal to be an octopus of immense proportions) that appeared on top of the water and slung its arms about two of the masts. The weight of this cephalopod dragged the ship over on its side and would have capsized it except for the promptness of members of the crew, who cut off the arms with an axe. This was not accomplished without renewed courage that was instilled into the crew by a prayer to a certain patron saint.

The writings of these ancient peoples have evidently influenced our earlier modern writers. Bartsch reproduces a drawing from an early issue of the San Francisco *Chronicle*, which shows a combination crab and octopus some 100 feet long. The artist not only drew claws on the ends of every one of the eight arms, but enthusiastically modified the body into huge claw-like jaws bearing some sort of large saw-like teeth.

## MODERN VERSIONS

Painstaking workers have slowly revealed that these legends and myths have been woven around greatly distorted facts. Ordinarily, the octopus can be considered a timid and inoffensive creature. It is probable, though, that on occasions a large octopus may entwine itself around a person's limb, when the rest of the body is hidden, so that the octopod is led into believing that the limb is legitimate prey of some sort. This must occur, however, in the natural habitat of the octopus, which is usually at some depth along rocky shores or reefs. Authentic cases of an octopus causing death by drowning or by some other manner are hard to find.

Japanese abalone divers, working to a depth of 100 feet, along the same strip of coast (Monterey, California) where octopus are trapped for market, do not complain of attacks by this eight-armed cephalopod. Occasionally, if they are fortunate, one is cornered and a line is tied around the body so that it can be hoisted to the surface, whence it forms the main course of a meal some time later.

However, Mr. Oscar Lager, a diver now making his home in Monterey, who has had 16 years of experience as an all round diver from Alaska to Mexico, has a different opinion about this subject. Mr. Lager has been down to a depth of 187 feet and claims to have had several encounters with octopi and other sea animals, which he does not care to repeat. He is emphatic in his assertion that large octopi are treacherous, especially those of the South Seas.

There may be a few authentic cases of encounters between fishermen and divers and octopi, but in general the octopus need not be considered a dangerous animal.

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# PREDATORY ANIMAL STUDIES

*By* Donald D. McLean

## INTRODUCTION

This predatory animal study program in the State game refuges was started on the first of January, 1932. This report covers the period from that date to June 30, 1933. Beginning July 1, 1933, it was found necessary through lack of funds to reduce the number of trappers to four.

Because definite information regarding the food of predators was lacking, it was arranged to examine the stomachs of all animals and to positively identify the contents. The Stanford University Museum kindly furnished working space, and their collection of birds and mammals for reference in the determination of contents proved invaluable.

Coyotes and bobcats were the primary species included in this study, although when other species were trapped their stomachs were preserved for study. Refuge areas on which trapping was conducted were reported to be heavily stocked with both coyotes and bobcats. Trappers were required to make daily reports on the number of traps out, miles of trap line, number of animals caught, weather conditions, and number and species of game seen. Maps showing trap lines, location of settings, and location and elevation where each animal was caught, were also required. Other information which they could give from personal observation was included in the reports.

Much data pertaining to the range, number and habits of coyotes and bobcats at various seasons, on these areas, was secured.

| *Trapper* | *Size of areas trapped* |
|---|---|
| J. N. Ray | Game Refuge 3B, San Benito Co., 21 sq. mi. plus 61 sq. mi., totaling 82 sq. mi. Elevation 950 feet to 3287 feet. |
| Shaw | Game Refuge 1O, El Dorado Co., 118 sq. mi. Elevation 2200 feet to 7285 feet. Part of game refuge 1J, Amador Co. 15 sq. mi. Elevation 5500 feet to 8000 feet. Part of Game Refuge 1I, Placer Co., 21 sq. mi. Elevation 1700 feet to 8400 feet. |
| R. Ray | Game Refuge 1M, Kern Co., 116 sq. mi. plus 26 sq. mi., totaling 142 sq. mi. Elevation 2000 feet to 7541 feet. Game Refuge 1K in Fresno Co., 59 sq. mi. plus 61 sq. mi., totaling 120 sq. mi. Elevation 1000 feet to 10,044 feet. Los Banos Waterfowl Refuge, Merced Co., approximately 5 sq. mi. plus 2 sq. mi., totaling about 7 sq. mi. Valley conditions. Elevation 90 feet. Gray Lodge Waterfowl Refuge, Butte Co., approximately 4 sq. mi. plus 1½ sq. mi., totaling about 5½ sq. mi. Valley conditions, elevation 60 feet. |
| McDonald | Game Refuge 2A in Lake, Mendocino and Glenn Cos., 60 sq. mi. plus 41 sq. mi., totaling 101 sq. mi. Elevation 3000 feet to 6954 feet. |
| Willburn | Game Refuge 1D, Trinity Co., 104 sq. mi. Elevation 2800 feet to 6262 feet. |
| Powell | Game Refuge 1R in Tuolumne Co., 151 sq. mi. Elevation 1600 feet to 7500 feet. Game Refuge 3E, Santa Clara Co., 6 sq. mi. plus 4 sq. mi., totaling 10 sq. mi. Elevation 2250 feet to 4209 feet. |
| Munneke | Game Refuge 1G in Tehama Co., 169 sq. mi. plus 24 sq. mi., totaling 193 sq. mi. Elevation 1000 feet to 5500 feet. Game Refuge 1F in Lassen Co., 75 sq. mi. plus 4 sq. mi., totaling 79 sq. mi. Elevation 5100 feet to 7000 feet. ⅓ of Game Refuge 3D, Ventura Co. plus 72 sq. mi., totaling 133 sq. mi. Elevation 950 feet to 6300 feet. |

| *Trapper* | *Size of areas trapped* |
|---|---|
| Wallace | Half of Game Refuge 4A, San Bernardino Co., totaling 280 sq. mi. Elevation 2000 feet to 11485 feet. Also on the quail refuges at Los Flores and Talmadge in that district. |
| Williams | Game Refuge 4E, San Diego Co., 81 sq. mi. Elevation 3000 feet to 5000 feet. |

CATCH DATA

| | *Coyote* | *Bobcat* | *Skunk* | *Fox* | *Coon* | *Opossum* | *House cat* |
|---|---|---|---|---|---|---|---|
| J. N. Ray | 175 | 117 | 52 | 29 | 31 | 5 | 4 |
| Shaw | 68 | 19 | 34 | 7 | 1 | -- | -- |
| R. Ray | 80 | 70 | 22 | 14 | 3 | 1 | 14 |
| McDonald | 26 | 44 | 32 | 33 | 43 | -- | -- |
| Willburn | 10 | 5 | 4 | 15 | -- | -- | -- |
| Munneke | 102 | 31 | 34 | 32 | 6 | 9 | 4 |
| Powell | 22 | 22 | 35 | 9 | 9 | 1 | -- |
| Wallace | 63 | 20 | 90 | 15 | 2 | 2 | -- |
| Williams | 17 | 41 | 17 | 57 | 4 | -- | -- |
| Totals | 563 | 369 | 320 | 211 | 99 | 18 | 22 |

| | *Badger* | *Ringtail cat* | *Bear* | *Mink* | *Weasel* | *Mountain lion* |
|---|---|---|---|---|---|---|
| J. N. Ray | 20 | -- | -- | -- | -- | -- |
| Shaw | -- | -- | -- | -- | -- | -- |
| R. Ray | 1 | -- | -- | 2 | 3 | 1 |
| McDonald | -- | 11 | 5 | 19 | -- | 1 |
| Willburn | -- | -- | 1 | -- | -- | 5 |
| Munneke | 4 | -- | -- | -- | -- | -- |
| Powell | 2 | -- | -- | -- | -- | -- |
| Wallace | 1 | -- | -- | -- | -- | -- |
| Williams | -- | 2 | -- | -- | -- | -- |
| Totals | 28 | 13 | 6 | 21 | 3 | 7 |

932 coyotes and bobcats
1680 total number of animals

*The following tables apply to coyotes and bobcats only:*

MILES PER ANIMAL

| | *Total No. miles of trap line* | *No. of coyotes* | *Miles per coyote* | *No. of bobcats* | *Miles per bobcat* | *Total No. animals* |
|---|---|---|---|---|---|---|
| J. N. Ray | 18,500 | 175 | 105.7 | 117 | 158.1 | 292 |
| Shaw | 6,419 | 68 | 94.4 | 19 | 337.8 | 87 |
| R. Ray | 11,419 | 80 | 142.7 | 70 | 163.0 | 150 |
| McDonald | 9,932 | 26 | 382.0 | 44 | 228.8 | 70 |
| Willburn | 1,347 | 10 | 134.7 | 5 | 269.4 | 15 |
| Munneke | 10,971 | 102 | 107.5 | 31 | 353.9 | 133 |
| Powell | 7,118 | 22 | 323.7 | 22 | 323.7 | 44 |
| Wallace | 3,395 | 63 | 53.9 | 20 | 169.7 | 83 |
| Williams | 2,592 | 17 | 152.5 | 41 | 63.2 | 58 |
| Totals | 71,693 | | | | | 932 |

SETS PER ANIMAL

| | *Total No. of sets* | *Sets per coyote* | *Sets per bobcat* | *Sets per animal* |
|---|---|---|---|---|
| J. N. Ray | 16,872 | 96.4 | 145 | 57.7 |
| Shaw | 13,263 | 195.0 | 698 | 152.8 |
| R. Ray | 12,630 | 157.8 | 180.4 | 88.9 |
| McDonald | 13,673 | 526.0 | 310.7 | 195.7 |
| Willburn | 3,958 | 395.8 | 791.6 | 264.0 |
| Munneke | 10,902 | 106.8 | 351.7 | 82.7 |
| Powell | 12,570 | 571.4 | 571.4 | 285.7 |
| Wallace | 4,757 | 75.5 | 237.8 | 54.7 |
| Williams | 2,297 | 135.1 | 56.0 | 39.7 |
| Total | 90,922 | | | |

77 miles per animal for the group
97.5 sets per animal for the group

## COST DATA

| | Days | Salary | Coyotes | Bobcats | Miles | Sets | Days per animal | Cost per animal |
|---|---|---|---|---|---|---|---|---|
| J. N. Ray | 539 | $1,800 00 | 175 | 117 | 18,500 | 16,872 | 1.8 | $6 16 |
| Shaw | 511 | 1,790 32 | 68 | 19 | 6,419 | 13,263 | 5.9 | 20 60 |
| R. Ray | 476 | 1,790 32 | 80 | 70 | 11,419 | 12,630 | 3.3 | 11 93 |
| McDonald | 540 | 1,790 32 | 26 | 44 | 9,932 | 13,673 | 7.7 | 25 57 |
| Willburn | 187 | 650 00 | 10 | 5 | 1,347 | 3,958 | 12.2 | 43 33 |
| Munneke | 395 | 1,548 39 | 102 | 31 | 10,971 | 10,902 | 2.9 | 11 64 |
| Powell | 421 | 1,500 00 | 22 | 22 | 7,118 | 12,570 | 9.6 | 34 05 |
| Wallace | 232 | 1,480 00 | 63 | 20 | 3,395 | 4,757 | 2.8 | 17 83 |
| Williams | 183 | 750 00 | 17 | 41 | 2,592 | 2,297 | 3.2 | 13 00 |
| Totals | 3,484 | $13,099 35 | 563 | 369 | 71,693 | 90,922 | | |

Each animal cost $14 05

Number of days per animal, 3.73

## RECORD OF STOMACH EXAMINATIONS

Predators' stomachs to the number listed below contained the particular items mentioned:

Coyote—537 stomachs
297 empty
240 with contents

| | |
|---|---|
| 100 deer | 45 ground squirrel |
| 2 quail | 40 cow |
| 13 bird | 24 sheep |
| 78 rabbit | 5 hog |
| 11 mouse | 7 chicken |
| 6 wood rat | 7 gray squirrel |
| 8 gopher | 3 kangaroo rat |
| 2 insects | 1 goat |
| 3 lizard | 1 antelope |

Bobcat—324 stomachs
168 empty
156 with contents

| | |
|---|---|
| 13 deer | 17 ground squirrel |
| 5 quail | 2 chicken |
| 34 bird | 9 gray squirrel |
| 24 rabbit | 8 gopher |
| 31 mice | 1 house cat |
| 35 wood rat | 1 skunk |
| 1 insect | 1 sheep or goat |
| 1 lizard | |

Skunk—133 stomachs
95 empty
38 with contents

| | |
|---|---|
| 28 insects | 1 pine squirrel |
| 2 lizard | 1 cow |
| 7 mice | 1 junco egg |
| 2 deer | 1 wood rat |
| 4 bird | 1 ground squirrel |
| 6 rabbit | |

Coon—59 stomachs
39 empty
20 with contents

| | |
|---|---|
| 1 snake | 1 duck |
| 8 insects | 1 grebe |
| 6 frogs | 1 rabbit |
| 3 mice | 2 berries |
| 2 bird | 1 garbage |

Fox—152 stomachs
101 empty
51 with contents

| | |
|---|---|
| 8 bird | 2 quail |
| 5 insects | 1 ground squirrel |
| 10 berries | 1 chicken |
| 30 mice | 1 kangaroo rat |
| 5 rabbit | 1 lizard |
| 1 cow | 1 deer |
| 2 wood rat | |

## DEER REMAINS IN COYOTES BY MONTHS

| 1932 | Male | Female | 1933 | Male | Female |
|---|---|---|---|---|---|
| January | 1 | 2 | January | 1 | 5 |
| February | 2 | 1 | February | 1 | 1 |
| March | – | – | March | 2 | 1 |
| April | 4 | 3 | April | 3 | – |
| May | 3 | 3 | May | 4 | 2 |
| June | 1 | 3 | June | – | 2 |
| July | 2 | 1 | | — | — |
| August | 4 | 2 | Totals | 53 | 47 |
| September | 5 | 7 | | | |
| October | 7 | 2 | | | |
| November | 4 | 5 | | | |
| December | 9 | 7 | | | |

RANGE OF COYOTES AND BOBCATS

In refuge 3B in San Benito County during the first three months of the year, most of the coyotes were taken between 1200 and 1500 feet elevation, and during the next seven months at about the 2000-foot level. In November and December they were back down to the 1700-foot level.

In refuge 1-O in El Dorado County from January to May most of the coyotes were taken near the 4000-foot line. During June and July they had moved up to about 4500 feet. November and December, before the heavy storms, found most of them at the 6000-foot level.

In refuge 1J in Amador County, during the month of October, all coyotes were taken between 5300 and 6500 feet altitude.

During the months of August and September in refuge 1-I in Placer County, coyotes were taken near the 5000-foot contour.

On refuge 1G in Tehama County few coyotes were caught possibly on account of heavy trapping in the foothills to the west by private trappers.

On refuge 2A in Lake, Mendocino and Glenn counties there was little shifting of the coyote population. Few were taken above the 3500-foot contour.

One interesting thing pertaining to the range of coyotes was noted in 1-O in El Dorado County. On Big Silver Creek and its middle fork, 23 miles of trap line was run for a considerable period of time when deer were plentiful in the area without a single coyote being caught. They did not come into the area during the entire summer.

Certain refuges appear to be in the concentration areas of coyotes. Refuges 1F in Lassen and 3B in San Benito are so situated. Both of these refuges are in sheep grazing areas. In 1F the coyotes left when the sheep were driven out, which was about a month before the deer went to their wintering ground. In 3B there were plenty of coyotes throughout the year but the sheep remained also. Other refuges, although well supplied with game and other food but harboring no sheep, did not have coyotes in such numbers.

The area over which a resident coyote will range is not as large as might be supposed. It is a circuit covered at intervals of several days, each day covering an area about five miles square. The female coyote during the pupping time has a short range; at other times it is about the same as the male.

I have only two definite records where coyotes were seen killing deer. In El Dorado County, in snow about 3½ feet deep, a deer was killed by a coyote and in San Benito County three coyotes had killed a doe. In the last instance one coyote was ham stringing the doe while the other two were working from the sides near the head. They all came down a steep slope together and finished her in the creek bed.

Bobcats range below 5000 feet, which is the approximate upper limit of the heavy brush region. A few are found in the timber area. These are mostly wandering males. They were caught at all seasons and elevations in 3B. In 1-O, 1J and 1-I they were scarce as most of these refuges are above the average bobcat range.

In refuge 1G few bobcats were found in the refuge, but just outside its western boundary at a lower elevation they were fairly

plentiful. In refuge 2A the average elevation of capture was 3100 feet.

Squirrels and rabbits are the principal food of the coyote while the wood rat is the mainstay of the bobcat. Both animals eat carrion but the bobcat does so to a much less degree. Coyotes gnaw on carcasses from the time they are fresh until nothing but hide and bones remain.

In the San Benito County refuge and vicinity during the hunting season for deer and the month following, 7 coyotes had eaten deer. During the other 15 months the trapper was operating, only 11 had eaten deer. Thirty-nine per cent of the coyotes that had eaten deer did so in one-sixth of the time the trapper was working. This would indicate that the hunter is of considerable help to the coyote. Wounded deer, hides, legs, heads and other remains thrown away by the hunter are very acceptable to the hungry coyote.

In refuges in the northern Sierras where heavy winter conditions prevail, the findings are not the same as in the Coast Range. Only three coyote stomachs of those trapped in the hunting season contained deer remains. However, during the two winters the trapper was operating, there was a heavy loss of deer on account of deep snows. When the carcasses of these deer were available in the late winter and spring, deer remains showed up in almost all the stomachs. Heavy winters are good for the coyote but hard on deer.

Of the 537 stomachs examined, 240 contained food and of that number 100 or $41\frac{2}{3}$ per cent contained deer meat, bones, hair or other parts; 27 per cent of the 100 were taken during and in the month following deer season; 30 per cent of the 100 were taken in the winter deer kill area, leaving 43 per cent for other times of the year. It is possible that the first kill is made by some other agency (mountain lions kill over 30,000 deer a year in California) and that the coyote, at this time of the year, is a second feeder. Only two coyote stomachs contained hair of young fawns during the time spots were present. These were both taken in San Benito County.

## SUMMARY

In San Benito County it required 18,500 miles of trap line and 16,872 sets to take 175 coyotes in 17 months. An average of 105.7 miles of trap line and 94.6 sets for each animal.

In Lake County coyotes were not so numerous. In 18 months time only 26 coyotes were taken on a trap line of 9932 miles with 13,675 sets. An average of 382 miles and 526 sets per animal.

In El Dorado County in 18 months time with 6412 miles of trap line and 13,263 sets, 68 coyotes were taken. An average of 94.4 miles and 195 sets per animal.

In San Diego County in 7 months time, by running 2592 miles of trap line and 2297 sets, 17 coyotes were caught. An average of 152.5 miles and 136.1 sets per animal.

In Lassen County in three months with 2585 miles of trap line and 1272 sets, 51 coyotes were taken. An average of 50 miles and 25 sets per animal.

In Kern County during 10 months, with 8604 miles of trap line and 7414 sets, 52 coyotes were taken. An average of 165.6 miles and 142.5 sets per animal.

In Trinity County during 6½ months time on 104 square miles, 1347 miles of trap line was run to capture 10 coyotes or an average of one coyote to 10.4 square miles; and one coyote to 134.7 miles of trap line. A total of 3958 sets were exposed or an average of 395.8 sets per coyote.

This summary shows something of the relative abundance of coyotes in the various refuges.

Bobcats were most numerous in San Benito and Lake counties. In the Coast Range, coyotes and bobcats are practically resident wherever found, not migrating perceptibly. In the Sierras the seasonal migration of coyotes is east and west. The summer resident coyotes at high elevations drop down replacing those at a lower level, which in turn move down replacing others until there is a greater or less movement into the valleys. This migration begins at approximately the time sheep are moved from their summer range. The upward migration follows the receding winter and possibly the spring herding of sheep to the summer range. After winters of heavy snow in which many deer are killed, these coyotes find a bounteous food supply.

In the Pinnacles region of San Benito County where the coyotes are mostly resident, the best catches of coyotes were made when sheep were concentrated in a relatively small area. Trapping became poorer when sheep ranged over greater areas in the spring. In Kern County on 1M very few coyotes were taken on the refuge when the sheep had been moved to the valley ranges. From the information at hand, the movement of sheep has a greater effect on the abundance of coyotes in a given locality than any other factor.

Trapping on certain areas did not prove worth while. The Gray Lodge Refuge in the Sacramento Valley north of Marysville Buttes at an elevation of 60 feet, is a good example. No coyotes were secured in 38 days of trapping, with 25 miles of trap line each day, and an average of 30 sets per day.

Refuge 1G in Tehama County was not satisfactory possibly because of private trapping to the west on the wintering ground.

Part of 1-O in El Dorado County in the drainage basin of Big Silver Creek and its middle fork did not produce a coyote during a month's trapping in July when coyotes should have been in that region. No signs of coyotes were in evidence. A total of 393 miles of line with 659 sets were exposed during the month.

The Mount Hamilton region is interesting because in the refuge, which includes the mountain above the 2200-foot contour, practically no bobcats or coyotes are found at any season, while around the base of the mountain below the refuge they are not uncommon.

It is impossible for coyotes and bobcats to be numerous beyond their food supply. When the population reaches the point where the food begins to decrease, then the predators must decrease. The coyote is dependent to a large extent on rabbits and squirrels, and where coyotes are plentiful, as in San Benito County, squirrels and rabbits are also numerous. Although quail are particularly abundant (more than 300 were seen per day) in all parts of that area trapped, only one coyote out of 175 had quail remains in its stomach. Only two coyotes out of 563 trapped, in this study, had quail remains.

In this same region in San Benito County wood rats, which are the bobcat's mainstay, are fairly plentiful and we found bobcats were

also relatively numerous. In only five bobcat stomachs were we able to find quail remains.

In refuge 2A in Lake, Mendocino and Glenn counties, where the squirrel and rabbit population is low, coyotes were not numerous. However, the bobcat population was fairly high as was also the wood rat. In all the refuges trapped only two coyote stomachs contained fawn hair and these were both from San Benito County.

# HISTORY OF THE YOSEMITE ELK HERD

*By* James Moffitt

All photographs courtesy of National Park Service

Some of the hundreds of thousands, more properly millions, of visitors to Yosemite National Park during the past twelve seasons may, upon returning next year or later, wonder what has become of the elk herd that ranged the meadow near Yosemite Lodge. To answer this question and also to put on record the planting, success and final departure of the herd from the valley is the purpose of this paper.

This elk was first recognized as being different from other North American elk in November, 1904, by Dr. C. Hart Merriam, then Chief of the U. S. Bureau of Biological Survey, and was described by him as a distinct species in February, 1905 (*Proc. Biol. Soc. Wash.*, vol. 18, 1905, pp. 23–26). Merriam called this animal *Cervus nannodes*, or the dwarf elk. It is also variously known as the California valley elk, valley elk, tule elk and dwarf wapiti.

The first attempt to transplant valley elk was made in November, 1904, by the Biological Survey under Dr. Merriam's personal direction. In this year, a single calf was introduced into Sequoia National Park, but the following season 20 elk were successfully planted there (Merriam, C. H., *The Scientific Monthly*, Nov. 1921, pp. 465–475).

In 1914, a group of California naturalists and sportsmen concerned themselves with the status of the California valley elk. At that time but a single herd estimated at 400 individuals existed on the Buttonwillow Ranch of Miller and Lux in Kern County. The danger of "keeping all your eggs in one basket," so to speak, was apparent, for if disease or some other factor exterminated this herd the species would become extinct. The late Dr. Barton Warren Evermann, then Director of the California Academy of Sciences, and M. Hall McAllister, present Chairman of this institution's Committee for the Conservation of Wild Animal Life, were the fathers of a movement to rectify this precarious condition. Briefly, a plan was adopted to catch and distribute to several favorable localities scattered over the State, a portion of the Kern County elk herd. This was accomplished in the years 1914 and 1915 with the cooperation of Miller and Lux, Inc., and the California Academy of Sciences. In 1914 the academy distributed 54 animals to seven areas as recorded in Dr. Evermann's interesting article on the subject in California Fish and Game (vol. 1, pp. 85–96). The following year 92 elk were introduced into 14 additional localities (Evermann, California Fish and Game, vol. 2, pp. 70–77). Twelve of these animals were sent to Del Paso Park at Sacramento.

These plantings constituted fulfillment of the academy's original program. M. Hall McAllister, co-leader in the venture with Dr. Evermann, however, always cherished the desire that a planting might also be made in Yosemite Valley. The first concrete move in this direction seems to have occurred on December 26, 1918, when McAllister and the

late Stephen T. Mather, then Director of the National Park Service, lunched together in San Francisco, and McAllister broached the subject. Correspondence shows that McAllister, with characteristic energy, followed up this opening and in the next spring definite steps were taken in this regard.

At that time the Park Service's policy was not against exhibiting caged or exotic species of animals in the National Parks, and the only concern over the venture seems to have been the fear that the animals might not survive the severe winters of Yosemite. In order to secure information in this regard, the Park Service addressed leading authorities on the subject. One of them, Dr. Joseph Grinnell, Director of the California Museum of Vertebrate Zoology, ruled that the animals should not be introduced into the Valley for the reason that they were never native to the region, a contention that Grinnell has steadfastly upheld to the present day, and which finally became one of the main reasons for removing the elk from Yosemite. Grinnell's original objection was overruled by Dr. T. S. Palmer of the U. S. Bureau of Biological Survey, an ardent supporter of the elk introduction, with the prediction that the animals would thrive in the Valley where they would comprise an attraction to thousands of visitors, while few people would see them in their native habitat at Buttonwillow.

Official sanction of the elk introduction into Yosemite was provided by the Director of the National Park Service on March 10, 1920, when an agreement was entered into between this body and the California Academy of Sciences which stipulated that the academy would bear all expenses of materials and cost of erection of a corral for the animals and would deliver to the Park Service at El Portal not to exceed 10 live elk. In return, the Park Service agreed to assume transportation expenses for the materials and the animals from El Portal to the Valley, expenses incident to care and feed for the animals after their delivery, upkeep of the corral and such other subsequent expenses in connection with the herd as might arise.

July, 1920, saw completion of the elk paddock, an enclosure of 28 acres, fenced with heavy woven wire eight feet high and costing over $2,000. It was now ready to receive the animals and arrangements were made by the academy to procure some elk from the herd that was planted on the Monterey Peninsula in 1914 and which had increased greatly. Efforts made by the Del Monte Properties Company in August and September, 1920, to capture elk from this herd proved failures and they were unable to deliver the animals. On account of the lateness in the season, efforts to effect the introduction were abandoned for that year in October.

The academy made new arrangements the following spring and on May 23, 1921, four animals, three cows and a six weeks old bull calf, were introduced into Yosemite Valley from the Del Paso Park herd near Sacramento. Four days later one of the cows died, presumably from injuries received while she was being roped and captured. The remaining three elk quickly adapted themselves to their new habitat.

August 20, 1921, nine additional elk were introduced into the Yosemite paddock from the Buttonwillow Ranch of Miller and Lux where they were caught by cowboys with riatas. Quite evidently, some of these animals were injured by their capture in this manner and two

of them, a bull calf and an old cow, died shortly after arrival. The remaining seven Buttonwillow elk withstood the introduction well and on September 1, 1921, the Yosemite herd numbered 10 healthy animals consisting of 4 bulls, 5 cows and 1 bull calf.

The winter of 1921–1922 was one of unusual severity in Yosemite with deeper snow on the ground than had been experienced in many years. It was necessary to erect a shelter to protect the elk from the weather and they were fed alfalfa hay. In spite of this condition, the animals appeared to weather the first half of the winter satisfactorily for on February 14, 1922, then Superintendent W. B. Lewis wrote M. Hall McAllister that the elk seemed to be pulling through, though they were not so sleek or fat as in the fall. Conditions must have been even more severe in the following months, for the next record available, as of May 2, 1922, notes that five of the animals died in the spring, leaving only 4 cows and 1 yearling bull.

This proportion of sexes was thought to be unbalanced, so on May 12, 1922, a yearling bull was introduced into the Yosemite elk herd from Del Paso Park, and the real start of the Yosemite herd should probably be counted from that date when it was composed of 4 adult cows and 2 yearling bulls. None of the cows calved in 1922, but the fact that two cows bore calves respectively on May 9 and 10, 1923, is of note as it indicates the fecundity of the yearling or 15 months old bulls in the previous fall.

The following table demonstrates the growth of the herd and its occasional losses from July, 1922, to the time of its departure from the Valley in 1933, as nearly as it has been possible to ascertain this information from available records.

| *Date of record* | *Total animals in herd* | *Bulls* | *Cows* | *Calves* | *Loss and reason therefor* |
|---|---|---|---|---|---|
| July 1, 1922 | 6 | 2 | 4 | | |
| July, 1923 | 8 | 2 | 4 | 2 | |
| July, 1924 | 11 | 4 | 4 | 3 | |
| July, 1925 | 13 | 7 | 3 | 3 | 1, 2-yr.-old cow died in 1925. |
| July, 1926 | 15 | 8 | 5 | 2 | |
| July, 1927 | 16 | 9 | 5 | 2 | 1 animal escaped from corral. |
| July, 1928 | 19 | 10 | 6 | 3 | |
| July, 1929 | 22 | 10 | 9 | 3 | |
| July, 1930 | 23 | 10 | 9 | 4 | 1 calf died soon after birth, and apparently 2 others died this year. |
| July, 1931 | 23 | 11 | 10 | 2 | Loss of 2 elk unaccounted for in this year. |
| Jan., 1932 | 22 | 10 | 10 | 2 | 1 bull died of old age, Dec. 22, 1931. |
| Feb., 1932 | 18 | 6 | 10 | 2 | 4 bulls killed for scientific purposes, Feb. 21, 1932. |
| July, 1932 | 21 | 7 | 11 | 3 | |
| July, 1933 | 27 | 7 | 11 | 6 and 3 yearlings. | |

The elk were kept in the corral continually from the time of their arrival until April 29, 1927, when it was decided to open the gates and permit the animals to leave the enclosure and to roam the Valley at will. This experiment proved to be a failure because of danger of injury to Park visitors, particularly from the bulls that become quite pugnacious during the rutting season. Therefore, all the elk were returned to the corral on November 16, 1927, and were not again released. Sometime later, however, four animals broke through the fence and gained a liberty that three of them enjoyed for a month before they were returned to the corral. The fourth animal escaped permanently and sometime later was reported as having been seen by Game Warden

C. L. Brown, west of Mariposa, when it appeared to be in good condition, but has not been heard of since.

Records made available for preparing this paper fail to provide the reasons for the loss of two elk in 1930 and a similar number the following year; presumably the animals died from some natural causes. The bull that died December 22, 1931, after two weeks' illness was quite evidently past his prime. He had small 5-point antlers and his teeth were worn to the gums, some of them being badly infected and ulcerated.

From 1924 until 1932, the number of adult bulls equaled or outnumbered the old cows in the Yosemite herd. It is thought that this condition was responsible for the small number of calves that were born each year as an excess of fighting on behalf of the disproportionate number of bulls probably interfered with their breeding activities. At any rate, the proportion of sexes was deemed unsatisfactory so the Park Service, early in 1932, decided to remove some of the surplus males and on February 21, four adult bulls were killed and their remains were preserved for scientific study by several California institutions. The favorable effect of this reduction of surplus males upon the herd is indicated by the fact that six calves, two more than were born in any other season, were dropped the following spring, although it is a fact that the mating season was over before the surplus males were killed.

Early in 1928, sentiment began to develop against keeping the elk in Yosemite Valley permanently. For one thing, the tremendous increase in the number of annual visitors to the Valley since the original introduction in 1922 resulted, by 1928, in the need of every foot of available space on the valley floor for the accomodation of the public. Park officials saw that the space occupied by the elk corral would soon be required for this purpose. The unsatisfactory experiment of liberating the animals in the Valley in 1927 indicated that relief could not be found in this direction. Another reason for the change in sentiment toward the elk was that by 1928 the National Park Service's policy with reference to exhibiting caged or nonnative animals within the Parks had altered, and the Service was now definitely on record against such exhibits.

A letter from Acting Superintendent E. P. Leavitt of Yosemite National Park to M. Hall McAllister in June, 1928, outlined the Service's attitude regarding this problem, but stated that no immediate action was planned. The subject was carefully considered by the National Park Service during the next months when opinions regarding it were secured from interested persons both within and without the organization. Some of the opinions may be of interest for notwithstanding the need of the space occupied by the elk corral for the public's use, then Assistant Field Director Horace M. Albright and now Assistant Director Dr. H. C. Bryant were among the Service's men who expressed the hope that it might be possible to keep the animals in the Valley. Superintendent Thomson tenaciously contended for their removal from the Park. Dr. Joseph Grinnell was, as originally and always, opposed to keeping the elk in Yosemite because they are nonnative to its fauna. M. Hall McAllister suggested if the land occupied by the paddock was required for other purposes, it might be possible to erect a corral in Bridalveil Meadows or elsewhere where

space was available and to transfer the animals there. He also suggested the possibility of reducing the size of the herd and keeping its maximum at 12 animals, the surplus to be butchered and marketed, or turned loose. Thus the matter was, from time to time, brought up and discussed for a period of nearly three years, but no definite solution was reached.

Early in 1932, Superintendent Thomson interested Charles G. Dunwoody, Director of Conservation of the California State Chamber of Commerce, in the National Park Service's problem with the Yosemite elk herd which he hoped to solve by locating a satisfactory area in which to place the animals. Dunwoody at a subsequent meeting of the State Chamber, announced Superintendent Thomson's problem and asked if any of those in attendance could suggest a suitable place to which to transfer the herd.

Fig. 7. This type of country extends along the Owens River for at least 60 miles. The elk were released on the river about at the place marked by the cross. The Sierras are seen in the background, the White Mountains border the other side of the valley.

G. W. Dow, Lone Pine, a leader among Owens Valley sportsmen, was present at this meeting and stated that he would like to have the elk moved to Owens Valley. Dow explained that he considered this an ideal locality in which to permit the animals to roam at large a strip of seemingly ideal habitat bordering Owens River for a distance of nearly 70 miles and owned almost entirely by the City of Los Angeles. He pointed out the natural attractions of Owens Valley for elk habitat, stressing the fact that little agriculture now exists in the valley with which the animals could interfere and asserted that the sportsmen and people of the vicinity would welcome the introduction and protect the animals.

Dow and Dunwoody shortly thereafter met with other interested parties in Los Angeles to contact the Water and Power Board with

reference to the plan. This group's inquiries met with the immediate favorable reaction of the board and soon the City of Los Angeles issued formal permission to introduce elk into its Owens Valley properties. Credit is due to Messrs. Dow and Dunwoody, Roy Booth, Supervisor of the Inyo National Forest, Dean L. Sears and Dr. M. A. Williamson, both of Lone Pine, and the Water and Power Board for bringing the matter to such a speedy and successful conclusion.

In the meantime, Dunwoody and Dow corresponded in this regard with C. G. Thomson, Superintendent of Yosemite National Park, and kept him informed of their progress. Supt. Thomson seemed to favor the plan from the start. On May 10, 1932, Dunwoody advised the Superintendent that details were completed with the City of Los Angeles and that the permit had been granted. A few days later, Dow advised Supt. Thomson that he was already to send trucks in which to move the animals. This prompt action was a bit premature, for the National Park Service had not yet decided to move the elk and would not agree to do so until it was satisfied beyond any question that the herd would succeed in its new location.

The National Park Service soon delegated George M. Wright, Chief of its Wild Life Division, to conduct a thorough study into the details of the proposed transfer both from the viewpoint of its desirability and necessity, and of the suitability of Owens Valley for the animals' success. Wright, on account of other work, was unable to undertake this investigation until the following spring. On June 1, 1933, he rendered a most comprehensive report on the subject to the Director of the National Park Service. It seems advisable here, even at the expense of some duplication in this paper, to put a goodly portion of this report on record, for it indicates how thoroughly the Park Service went into the matter before reaching a decision.

In regard to the necessity and desirability of removing the elk from the Park, Wright outlined the manner in which conditions as they obtained in 1922, when the elk were placed in Yosemite, had changed, as follows:

1. Now contrary to policy to harbor exotics in a National Park.
2. Against National Park policy to exhibit animals in confinement.
3. Inconsistent with National Park's educational program, which is to stimulate visitors to study nature in place, to have elk enclosed in a paddock within sight of its Educational Museum, a living contradiction to this principle.
4. Space used by elk pasture required for caring for great crowds of Park visitors.
5. Maintenance of elk herd costs Educational Department of Yosemite $400 per year for feed for animals.
6. Need for preserving species from extinction that threatened in 1922, now removed with establishment [in 1932] of 1000 acre State Park in San Joaquin Valley with 140 Tule Elk on it.

Wright's report then outlined the requirements that should be met before acting on the proposal to transfer the animals to Owens Valley, as follows:

1. Obtain approval of California Academy of Sciences.
2. Obtain approval of scientific group at the University of California.
3. Obtain approval of the California Division of Fish and Game.
4. Local inhabitants should be favorably disposed to the introduction.

(This requirement already met by assurance of G. W. Dow and other residents of Owens Valley.)

5. That there should be no danger of conflict with economic interests. (This requirement met, no danger of conflict with agriculture for the few remaining farms in Owens Valley are being rapidly acquired by the City of Los Angeles and when its program is completed, there will no longer be any farms there. Presence of elk should be conducive to the prosperity of inhabitants of Owens Valley because of their interest to the tourist trade

Fig. 8. Messrs. Walker, Dow and Merrill demonstrate the height of undergrowth which covers large areas along the Owens River. This should make an ideal home for the elk.

which is a source of considerable income to residents. Stock grazing is no longer heavy in Owens Valley and is now being reduced by the policy of the Water Board. Therefore, feed is abundant and the elk should prosper.)

6. Elk should range on publicly owned lands. (This requirement already met as the City of Los Angeles owns 90 per cent of the land in Owens Valley.)

7. Obtain a means to finance the cost of moving the elk. (G. W. Dow already offered to be responsible for this.)

8. Essential that plan of liberation be conducive to the independent existence of the herd. (Owens Valley seems ideal in this respect for an abundant stretch of moist river bottom land, 60 miles or more in length, with an abundance of willows, tules, rushes, grasses, mud lakes and water, such as is considered excellent Tule Elk habitat, exists there. Temperature extremes in Owens Valley are comparable with those of the Upper San Joaquin Valley where Tule Elk once abounded. Although the elevation is greater than in the San Joaquin Valley, snows that remain on the ground occur only with the greatest rarity in Owens Valley. Nature has fenced the valley to preclude the animals' escape from it, for if the elk attempt to leave the river marshes, high mountains or hostile deserts hem them in on all sides. These factors seem to meet this requirement.)

Wright closed his report with the following recommendations regarding the elk transfer. First, that it is his opinion that the animals would prosper in Owens Valley. Second, that the transfer be

Fig. 9. Bull elk after dehorning. After their horns were removed, they quieted down, showing little interest in each other.

made in late fall, after the rutting season when the bull's horns could be sawed off to prevent their injuring themselves in transit, when the calves would be large and strong enough to stand the trip and when the cows would already be impregnated to insure securing a calf crop the following spring.

Director of the National Park Service H. M. Albright on June 20, 1933, approved Wright's recommendations and authorized the transfer provided that each requirement was met before making the shipment. Accordingly, Supt. Thomson addressed the agencies whose approval was required, requesting that same be granted.

Dr. C. E. Grunsky, President and Acting Director of the California Academy of Sciences, provided Supt. Thomson with that institution's approval of the transfer on September 15, 1933, but expressed some reluctance over it for the reason of M. Hall McAllister's opinion in

its regard. It is only fair here, in deference to McAllister's unfailing interest in the Yosemite elk herd, to put on record his views in this regard, which everyone, including McAllister himself, hopes will prove to be unfounded. McAllister believes that the move is to be regretted because the elk had a good home in Yosemite where their increase was normal. He thinks that fewer people will see and enjoy them in Owens Valley than in Yosemite and fears the danger of their raiding farms there, citing the examples of the Monterey and Eden Valley (Mendocino County) introductions, where ranchers are said to have protected themselves against elk depredations to their crops by employing rather drastic means of control.

Dr. Grinnell had already, in March, provided Wright with his views regarding the transfer, writing that he considers "Owens Valley appoints the best of their own home range." He is enthusiastic over the prospects in Owens Valley for the species, and is glad that the herd has been removed from Yosemite.

Executive Officer J. L. Farley expressed to Supt. Thomson the California Fish and Game Commission's atttude on the subject on September 8. This was that the Commission approved the transfer but can not undertake to purchase feed, if necessity for same arises, for the elk in their new home. Further, that in so far as it is consistent with its other duties, the Commission will endeavor to protect the herd in Owens Valley.

All the conditions having been satisfactorily met, Supt. Thomson on September 30, 1933, so informed the Director of the National Park Service and advised him that the transfer date had been set for October 10.

Meanwhile rather careful and elaborate preliminary work was being done in Yosemite by the Park Service. Specifications for carrying crates were secured from Yellowstone National Park, and the requisite number were constructed in Owens Valley at G. W. Dow's expense. Preshipment handling of the animals themselves can best be described by quoting from Chief Ranger F. S. Townsley's report in this regard (see Figs. 9 and 10):

> For several weeks before the transfer, very definite plans were made to handle the elk with as little difficulty as possible so as not to get them excited. The old deer trap at the upper end of the pasture was rebuilt and a dehorning shoot was made so that it could be used to force the elk into the shipping crates.
>
> The dehorning was done over a period of several days, by trapping only one or two bulls at a time; the rest of the herd did not realize that anything unusual was taking place.
>
> A few days before they were to be crated, all water was shut off except inside the trap, resulting in very little excitement when some of them had to be driven through the trap door.

At the same time, Dow was active on the "receiving end" in Owens Valley. There, bordering Owens River, near Aberdeen, about 14 miles from Independence (see Figs. 7 and 14), he constructed a paddock in which the herd was to be held for a week or ten days after arrival and fed hay until they became acclimated. Materials for the construction of this corral were supplied gratis by the Department of Water and Power of the City of Los Angeles and by some enthusiastic Big Pine and Lone Pine business men. Several employees of

Fig. 10. Small paddock used in connection with trap, trapdoor up ready for use. Two inside doors made it possible to force one elk at a time into dehorning shoot and shipping crate.

Fig. 11. Forcing elk to front of crate so door could be bolted on. Mr. Dow at front of crate adding some reinforcement with wire. Chief Ranger Townsley at the right, holding prod.

the City Department of Water and Power assisted in the erection of the fence, on their own time. He also arranged to supply a large truck for hauling the crates to Yosemite and the elk back to Owens Valley and arranged to come himself to Yosemite for the loading and then accompany the animals home. Dow personally expended several hundred dollars in connection with this venture in which he was assisted by a $100 appropriation from the County of Inyo. The Division of Fish and Game donated the use of one of its large fish planting trucks for hauling the elk, and the services of Fish Planting Assistant E. L. Walker and Game Warden C. J. Walters. The Government supplied a third truck from the Civilian Conservation Corps and a driver for same, Lee Rust.

This equipment was assembled in Yosemite the evening of October 9 and the work of loading the elk was commenced at 8 a.m. the following morning under the supervision of Chief Ranger Townsley (see Fig. 11). Six of the bulls were loaded into individual crates which were placed on the Division's truck and left the valley at 3.30 p.m. (see Fig. 12). By 6.30 p.m., 16 more animals were individually crated and loaded on the large semitrailer type of truck furnished by Dow. This truck left Yosemite an hour later, escorted by Dow in his private sedan. The remaining elk, five calves, were loaded into two crates on the C. C. C. Chevrolet truck which left the valley at 9 p.m. Ranger W. K. Merrill and Assistant Park Naturalist A. E. Borell accompanied Rust in this truck.

The trip from Yosemite to Owens Valley is well described in Ranger Merrill's report from which the following is quoted:

> Ranger Naturalist Borell, Lee Rust and I left at 9 p.m. in a truck with five young elk.
>
> We arrived at Fresno at 1.15 a.m., inspected the elk, gassed the truck and left at 1.30 a.m. I relieved Rust from driving from Fresno to Bakersfield.
>
> We overhauled the second load of elk about twenty-five miles this side of Bakersfield. We arrived at Bakersfield at 5 a.m. Borell relieved Mr. Dow at the wheel and Rust relieved me.
>
> Arrived at Mojave at 9 a.m., had breakfast, inspected the elk and tried to water them, but they would not drink. We left at 9.35 a.m. I relieved Rust to Olancha.
>
> We arrived at Lone Pine at 1.30 p.m., unloaded some of our things, got some more help to unload the elk and left Lone Pine for the elk refuge, which is some forty miles beyond Lone Pine, at 2 p.m. We arrived at the refuge, which is some three miles off from the main highway, at 3.15 p.m.

Assistant Park Naturalist Borell's report of the transfer contains some information relative to the animal's new home in Owens Valley that is of interest and is quoted, in part, as follows:

> The 27 elk (7 bulls, 3 yearlings, 11 cows, and 6 calves) were crated, under supervision of Chief Ranger Townsley and hauled from Yosemite Valley to Owens Valley under escort of Merrill and Borell. Each adult animal and two of the largest calves were in separate crates which were furnished by Mr. Dow. Some of the bulls fought viciously during the crating and as a result were rather badly bruised and skinned up by the time we got them loaded. Once on the road the animals were quiet and I believe received no further injury. We tried to water them at Mojave, but they refused to drink. It was cloudy and cool, there was no car trouble or other delay en route. All except one old bull was delivered in good condition.
>
> The paddock into which we released them is on the Owens River near Aberdeen, which is 14½ miles northeast of Independence, Inyo County. The new home of the elk seems to be ideal, plenty of water, abundance of willow,


Fig. 12. The first load of elk left on Fish and Game Commission truck at 3.30 p.m., October 10. The next truck (seen at left rear) furnished by Mr. Dow (standing third from left) started at 7.30 p.m. Government truck with five calves left at 9 p.m.

Fig. 13. The next morning after delivery the elk seemed to be full of life.

tule, undergrowth and grass. Much of the undergrowth is from three to six feet high (see Fig. 8). Most of the area belongs to the City of Los Angeles and is used only for watershed and cattle grazing. There are a few private ranches left in the valley, and if the elk take to these ranches, there may be difficulties. However, the ranch nearest to the place of liberation was 10 miles south.

Mr. Dow, the Fish and Game officers, and county sheriff seemed to be extremely interested in the welfare of the elk and will do everything they can in the way of care and protection. The animals will be kept in the paddock about a week, until they recover from the trip.

The preceding excerpts from reports of Park Service employees indicate the successful manner in which the elk transfer was executed. Too much praise can not be given these men for their care and foresight in this regard. Dr. Grinnell, writing Superintendent Thomson on November 8, 1933, said: "You can not overestimate my personal satisfaction that the transfer of the elk out of Yosemite Valley was so successfully accomplished. It is evident that a lot of administrative thought and skill was necessary to bring the whole undertaking to conclusion. * * *" It is believed that the careful preshipment handling and loading methods used were largely responsible for the ultimate success of the transfer, for, in the case of the earlier elk plantings, considerable loss seems to have resulted from rough handling of the animals prior to shipping (see Evermann, CALIFORNIA FISH AND GAME, vol. 2, 1916, p. 77).

It may well be, too, that the modern methods of transportation used in the present transfer (see Fig. 12) and resulting in the animals being confined in their crates for a minimum of time, also influenced the final success of the venture. For transportation by modern automobile trucks presents a strange contrast to the horse-drawn wagons used in the earlier plantings (see Fig. 24, CALIFORNIA FISH AND GAME, vol. 1, 1915, p. 92).

The elk apparently adapted themselves quickly to their new surroundings in Owens Valley. All, with the exception of an old bull that was injured prior to shipping, seemed to thrive in the holding pen in which they were kept for nine days. The following account of their liberation from this pen on October 20 is quoted from a letter by G. W. Dow to Supt. Thomson.

We liberated the elk at 9.30 this morning with 100 per cent of the herd in fine condition or in as fine condition as they were when loaded at Yosemite. The old bull that had been hurt previous to the transfer seems to be getting along fairly well and while we have been doctoring him some every day since his arrival here we decided that he would be about as well off turned out of the corral.

We opened the gate this morning and after some time we persuaded them to come out and after they were out in the open they realized there was no fence and they galloped off through the willows and disappeared, with the old bull following along behind calling them. We tried to follow them a short distance but decided they had left and had gone to see if they could find the end of the pasture. After circling around with our cars we made a trip down the river and found that they had not passed so presumed they had not gone very far so we all returned home. About an hour later one of my former employees went down to the corral thinking he would have a chance to see the elk and found that the herd had all returned to the corral.

While the elk were in the corral we fed them about a ton of hay and I believe they were beginning to put on some flesh.

Mr. Carl Walters and Mr. Gene Walker of the Fish and Game Department have taken a very keen interest and have made a trip to the corral every day since the elk arrived.

A later report upon the successful adaptation of the herd to its new habitat was provided by Assistant Executive Officer A. E. Burghduff on November 10, when he wrote as follows: "I saw this band of elk this week and the entire shipment is looking fine exeept for one crippled bull elk that died because of its injury." Evidently, the old bull that was injured prior to shipping and probably should not have been transferred, died of his wounds. The remaining elk, consisting of the following animals, then comprise the nucleus of the Owens Valley herd: 6 bulls, 11 eows, 3 yearlings and 6 calves; a total of 26 animals made up of what is thought to be an excellent proportion of sexes.

Fig. 14. Tule elk in temporary holding corral on Owens River near Aberdeen, Cal. October 12, 1933.

Beside the individuals and agencies previously mentioned in this paper as being eoneerned directly or indirectly with the elk transfer, especial mention should be made of G. W. Dow's unfailing interest and work in its consummation. It would be impossible to give Dow too much praise and credit for his trouble and labor in this regard.

The author prepared this paper at the request of Executive Officer Farley and with Superintendent of Yosemite National Park Thomson's approval. Supt. Thomson kindly furnished correspondence that was helpful in preparing the article and the photographs which are here used for illustrations. A visit to Yosemite Park was neeessary to secure further data and it is a pleasure for the writer to aeknowledge the help and cooperation afforded him at that time by Chief Ranger Townsley, Park Naturalist C. A. Harwell and Assistant Park Naturalists Beatty and Borell. Harwell informed us that he had in the eourse of preparation a paper on the habits of the Yosemite elk herd. On account of the

accessibility and ease of study of the animals when they were confined in the Valley, unusual opportunity afforded for observing their habits and we will look forward to the appearance of Harwell's paper in this regard.

In addition to those mentioned above, the writer is indebted to Assistant Executive Officer Burghduff, Joseph Dixon, Field Naturalist of the Wild Life Division, National Park Service, and to M. Hall McAllister for information and assistance in the preparation of this paper.—*December 20, 1933.*

# MULE DEER STUDY PROGRAM

*By* James Moffitt

The Division of Fish and Game has received numerous reports in the past two or three years from its game wardens, sportsmen, game conservationists and U. S. Forest Service employees purporting a decline in the numbers of mule deer inhabiting the northeastern portion of the State. Deer kill statistics indicate a reduced kill in this area in the past two seasons, which, as discussed beyond, may indicate deer depletion in this section. The Division has investigated the matter and is of the opinion that some reduction, although not an alarming one, has occurred among these deer in recent years. It now desires to ascertain the reasons for the depletion in order that remedial measures may be undertaken.

Before proceeding with an explanation of the mule deer study program, by which means it is intended to procure the information needed, it seems desirable to indicate in more detail than has heretofore been done the range of mule deer in this section, to review the status of these deer in the past and the kill statistics for the area, to recount the increasingly restrictive game laws enacted in recent years and to speculate upon some of the probable reasons for the recent depletion.

The species concerned is the Rocky Mountain mule deer, *Odocoileus hemionus hemionus,* which California hunters often term the "Modoc" mule deer in distinction from the smaller California mule deer (*O.h. californicus*) of southern California. This is the common deer of Modoc County and it is also plentiful in most parts of Lassen County, the eastern half of Siskiyou County and in extreme eastern Plumas, Sierra and Nevada counties (see Fig. 15). South of Placer County, where this deer is of rare occurrence, its status is not well known but a few individuals undoubtedly enter California in summer along the eastern border south to Mono County, where the present species is thought to meet the range of the newly described Inyo mule deer (*O.h. inyoensis*), (see California Fish and Game, vol. 19, 1933, p. 274). Therefore, the vast majority of the Rocky Mountain mule deer's range in the State is included in the area under consideration, which, for convenience, will be termed the "Modoc" region.

The accompanying map (Fig. 15) indicates as nearly as the writer has been able to ascertain, the average summer range of the Rocky Mountain mule deer in California. Some few individuals may, in summer, stray west of the north and south line drawn through Shasta Valley, but the bulk of the mule deer in this section doubtless stop their westward spring migration at this valley's eastern edge. Similarly, further south, occasional mule deer may be noted west of the boundary line indicated; but it is believed that in general this line marks the western range of this deer. Columbian black-tailed deer (*Odocoileus columbianus columbianus*) frequently occur east of this line, in fact they do so commonly and regularly at many points. This is especially

true in summer, when the black-tailed deer that generally winter to the westward invade the eastern parts of Siskiyou, Shasta, Plumas, Sierra, Nevada and Placer counties and western Lassen County. Some black-tailed deer probably winter with the mule deer east of the boundary line, as in eastern Siskiyou County (Red Rock Valley) and in eastern Plumas County (east of Quincy between Keddie and Beckwith peaks, *fide* L. E. Mercer), however the great majority of black-tails winter to the westward. In preparing this map, no attempt has been made to show the eastern range limit of black-tailed deer or the winter range of mule deer.

Mule deer winter at many points throughout the area that they occupy in summer. In fact they winter almost wherever snow depths will permit them to do so throughout their summer range. When they migrate, they generally, but by no means always, do so to the eastward in fall, but at a considerably later date than do the black-tails move westward. There is never a winter mule deer migration west of the summer line shown on the map and it is of the greatest rarity that an individual of this species is said to accompany the black-tails to the westward, however, there are one or two purported records of this having happened in Tehama County. Mule deer winter west to Red Rock Valley, Siskiyou County, in the vicinity of Game Refuge 1-B and in the rough lavas south of it. In heavy winters, when deep snows invade the 1-B country, these deer are said to work westward into Red Rock Valley which is an area of less snowfall (*F. R. Starr*). They also winter in the Crowder Flat country, along both slopes of the Warner Mountains, and on Big Mountain, near Adin, Modoc County (*A. A. Jordan*). A considerable number winter on Bieber Mountain in northwestern Lassen County and in extreme southwestern Modoc County (*Paul Kehrer*). The country between Pittville and Westwood has too much snowfall to permit deer to winter there and the mule deer of this area work eastward in late fall to winter east of the Madeline Plains and in Game Refuge 1-Q, to or across the Nevada line. The animals that summer in eastern Plumas County southwest of Honey Lake along the main divide of the Sierra Nevada Mountains winter on the east slopes of Long Valley and east into western Nevada, south of this point all Rocky Mountain mule deer summering in California apparently winter in Nevada. It should also be mentioned that many, if not most of the mule deer summering in that section of extreme south central Oregon, bounded by the towns of Malin, Bly and Lakeview, apparently migrate southwesterly in fall to winter in the vicinity of Game Refuge 1-B in Modoc County.

According to the reports of some early residents of the Modoc region (L. N. Lorenzen, Mt. Shasta, Thomas Ivory, Canby, and others) in the early days, fifty years or so ago, mule deer were not at all plentiful in the area. Lorenzen recently told the writer that old time cattle riders have informed him that one could ride for a day without seeing a deer in regions where similar excursions today would reveal many of these animals. Deer seem to have increased steadily in the Modoc region from early times until about 1928 when most local inhabitants agree that the peak population for modern times was attained. The following year, and 1930, was apparently the time that the present depletion commenced. The winter of 1932–1933 may,

and we hope did, mark the low point in this decline, for a number of local informants have recently expressed to the writer the view that there were more deer in the area in 1933 than in the previous year. Although many people have been interviewed on the subject, it is

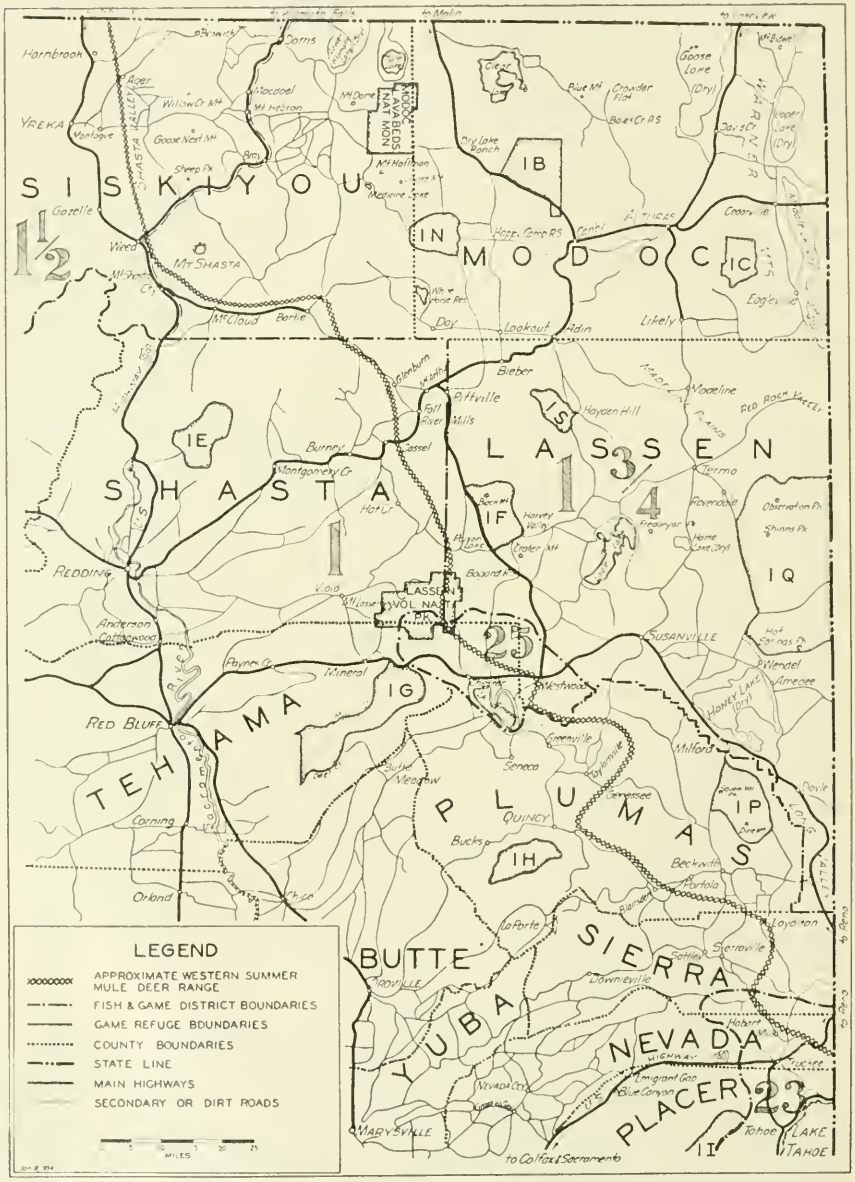


FIG. 15. Summer range of the Rocky Mountain mule deer in northeastern California.

difficult to ascertain the extent of the recent depletion, however, the consensus of such opinion seems to indicate a reduction of about 15 per cent in the herd in the fall of 1932 over a similiar time in 1928.

Prior to about 1920, the number of "outside" hunters visiting the Modoc region each season was small and the majority of deer killed there were taken by local residents. From that time until about 1930, the number of sportsmen from other sections of the State who made hunting trips into the area grew by leaps and bounds so that by the end of this period a veritable army of outside hunters made annual pilgrimages after these large animals. This condition naturally resulted in a correspondingly higher annual legal kill which kept pace with the increase in numbers of hunters until 1931, when reports of less comparative success began to emanate from the sportsmen. In the same period, restrictive legislation which will be discussed later, kept up with the increase in hunters and was apparently responsible for preserving the numbers of deer until 1928 or thereabouts. The Division had no means of recording the annual kill or total number of deer hunters prior to 1927 when the deer tag license law was enacted. The statistics provided below for the deer kill in Modoc and Lassen counties for the years 1927 to 1933, inclusive, will serve well to indicate the relative mule deer kill for the entire area for this period and reports from these counties only are provided for the reason that practically all the deer killed in them are mule deer whereas there is no means of distinguishing between mule and black-tailed deer, in our tag system, both of which are taken in the other counties in this area. We have no means of ascertaining the number of hunters who annually go after mule deer, but because of their known rapid recent increase in this area, we are certain that the increase of sportsmen afield in the Modoc region has been proportionately far in excess of the total increase for the State, at least through the 1931 season. The Division hopes, before the 1934 deer season opens, to evolve a means of checking hunters in and out of the mule deer area which will in future provide this much needed information.

| Year | Deer killed | | | | Deer tags, total sold in State |
|---|---|---|---|---|---|
| | Lassen Co. | Modoc Co. | Total both counties | Total in State | |
| 1927 | 296 | 510 | 806 | 19,507 | 110,760 |
| 1928 | 393 | 729 | 1,122 | 21,515 | 105,638 |
| 1929 | 511 | 835 | 1,346 | 21,222 | 115,472 |
| 1930 | 585 | 1,129 | 1,714 | 24,132 | 123,999 |
| 1931 | 607 | 1,486 | 2,083 | 25,805 | 129,005 |
| 1932 | 508 | 916 | 1,424 | 18,380 | 96,702 |
| 1933 | 551 | 954 | 1,505 | 17,689 | 94,500* |

* Approximate, exact 1933 total not yet available.

It should be noted in the above table that the total State deer kill in all years save 1928 bears a rather consistent ratio to the total number of deer tags sold or number of hunters in the field. At the same time, the kill in Lassen and Modoc counties increased out of all proportion to the State kill. This is a result of more hunters visiting the area, at least through the 1931 season. The decrease in the number of deer killed in these counties in 1931 and 1932 is out of proportion to the decline in deer tag sales for the same period and is probably, in part at least, a result of deer depletion. The increase in the 1933 Modoc deer kill is gratifying for, in spite of unsatisfactory (dry) hunting conditions that obtained in the region last season, more deer were taken there than in the previous year, notwithstanding a falling off in the total State kill and a decrease in number of hunters.

The fact that the numbers of Modoc mule deer held up well in the face of greatly increased hunting effort from 1920 to 1928 may probably be explained by the additional restrictions that were placed upon the hunters in that period. From 1911 to 1925, Modoc and Lassen counties were included in Fish and Game District 1 which still embraces most of the Sierra Nevada country and prior to 1919 also included Del Norte, Humboldt and Siskiyou counties. In 1919, District 1½ was formed, composed of the last-named counties. During this period the following open season on deer obtained in District 1: 1911 to 1914, August 15 to October 31; 1915 to 1920, August 15 to October 14; 1921 to 1924, September 1 to October 15. The bag limit was two buck deer per season throughout the period, but after 1915 it was illegal to kill spike bucks.

District 1¾ was formed in 1925 when it consisted of Modoc and Lassen counties. Here a 30-day open season was declared, September 15 to October 15 in contrast to the six-weeks' season that persisted in District 1 until 1927. Forked-horn deer were also protected in District 1¾, but the limit was two bucks with more than two points on a side per season. The next Legislature (1927) reduced the limit to one such buck per season in Modoc and Lassen counties and changed the open season to September 16 to October 15, which season was also adopted for District. 1.

The boundaries of District 1¾ were enlarged by the 1929 Legislature to include in this district that portion of Siskiyou County lying east of the easterly bank of the Klamath River between the Oregon line and the Siskiyou line of the Southern Pacific Railway and south along this railway to the south line of Siskiyou County. This, from a biological standpoint, was an excellent boundary line, for it would be difficult to locate an artificial one more nearly paralleling the western boundary of the mule deer's range. It is a pity, therefore, that the 1931 Legislature changed this boundary to that portion of Siskiyou County lying east of the Pacific Highway (U. S. 99) between the county's southern line and the town of Weed and east of the Weed-Klamath Falls Highway between Weed and the northern line of Siskiyou County (see Fig. 15). The latter is the present boundary of District 1¾ and no changes have been made in season or bag limit since 1927. It is unfortunate that the above mentioned boundary change was made for a six-weeks' season (September 1 to October 15) and a two-buck bag limit, with no forked-horn protection, now exists in the mule deer range west of the Weed-Klamath Falls Highway. This matter should be corrected by our next Legislature and it is suggested that the Pacific Highway would provide an excellent western boundary to District 1¾ from the southern Siskiyou County line north to the Oregon line. Other westward enlargements to District 1¾ further south, especially in eastern Plumas, Sierra and Nevada counties are apparent from the accompanying map and we hope will be made in 1935. The Division endeavored to have such legislation enacted in the 1933 session, but was unable to accomplish this.

Senator Harold J. Powers, Eagleville, introduced a bill into the 1933 Legislature to shorten the open season in District 1¾ to the period October 1 to 15. This measure was supported by many sportsmen in Modoc County but most of the local hunters in Lassen

County opposed it. The writer made a trip to the mule deer area in March, 1933, to secure the views of our game wardens and others in this regard. The result of these interviews was the conclusion that the measure was not a conservation one by reason of the fact that so short a season would congest the hunters unduly. This congestion of hunters which occurs yearly in the opening days of the hunting season, is the hardest thing that the bucks have to face, for men are everywhere and once a mule buck is "jumped" he usually runs quite a distance before stopping. With a field full of hunters, if the man who jumps the buck does not kill him, there is much more likelihood that he will be shot by some other hunter before he stops running, than if there are not so many sportsmen afield. It seems desirable for this reason, to spread the season over as long a period of time as is reasonable. The Division adopted this policy and contended that the Modoc deer population was not in so precarious a position as to justify enacting this measure, which might not work out to the deer's advantage. This, and the Division's dislike to impose further restrictions on the hunters in the Modoc area until constructive measures to build up its deer population are adopted and tried out, was explained to Senator Powers who did not push his bill thereafter and it "died in committee."

The 1933 Legislature conferred upon the Director of the Department of Natural Resources, with the Governor's consent, the power to close to hunting upon recommendation of the Fish and Game Commission, any area where added protection is needed for game for such a time as the Director may designate, or until new legislation thereon may become effective. This means that the Division could probably close all, or part of the Modoc area if justification to do so developed, so with a close watch being kept upon these deer, sportsmen need not fear that undue depletion will be permitted to occur. The thought has been suggested that portions of the Modoc area might now be closed to hunting. Not only does the Division consider that no necessity now exists to do so, but it believes that such a course would only hasten to create poor conditions in the areas left open by crowding more hunters into them. It is possible that study may develop that hunters camping near water in dry sections where springs are far apart is detrimental to the deer of the vicinity. In such cases it would seem to be in order to either close the area to hunting or to prevent camping at the springs.

Factors other than increased hunting effort are doubtless at least in part responsible for the recent deer depletion in the Modoc region. Foremost among these is a disease commonly termed calf diphtheria and caused by an organism known as *Bacillus necrophorus* an outbreak of which occurred in the Medicine Lake country, especially in the vicinity of Mud Lake, in 1923 and 1924.* A more recent and widespread epidemic of this infection occurred in the same vicinity and also at White Horse and in other localities in 1931. The Division's pathologist investigated many cases of this disease from these areas in that year and definitely diagnosed the disease. This outbreak continued to a lesser extent the following year and very few reports of deer death from its cause were obtained in 1933 in spite

* See CALIFORNIA FISH AND GAME, vol. 10, 1924, p. 191; vol. 11, 1925, pp. 27–28.

of careful watch for it. Game wardens treated water holes in diseased areas with bluestone in 1933, which sterilization may have been helpful in controlling and stamping out this disease. It has been impossible to ascertain the total number of deer that succumbed to the recent epidemic, but same was considerable and conservative estimates run into the hundreds.

Illegal hunting, particularly winter killing of deer, is another factor that undoubtedly has had its effect upon the Modoc deer population. In spite of the best efforts of our game wardens, this drain on the deer herd is known to be considerable and has doubtless increased in recent years due to economic stress and unemployment. Winter deer killing in remote sections of a country that is difficult to traverse at this season on account of deep snows is one of the most difficult types of violation to apprehend. Further, the all too liberal policy of many of our courts toward convicted violators in late years, on the plea of economic stress, has tended to ease the penalty for such violations, which fact works for more abuse of our game laws.

Another possible factor to reckon with in regard to the status of the Modoc deer herd is that of increasingly intensive sheep grazing in the area. Formerly, much of the Modoc region was utilized for horse and cattle grazing. These animals are mainly grass eaters and they do not compete with deer for food to the extent that sheep, which also browse, do. Sheep grazing has increased enormously in the Modoc region in the past twenty years and the effect of overgrazing by these animals is apparent in many localities. This fact may have had an effect on the deer herd by reducing its available food supply.

Other factors which may work in favor of or against the welfare of Modoc mule deer are enumerated beyond in the outline of the study.

The Division decided to secure more information on Modoc mule deer preparatory to effecting game management measures in the region, in the spring of 1933. It also decided to increase the value of its game refuges in that section at the same time. The original plan to locate trappers on four of the mule deer refuges in 1933 and on additional ones in 1934 was by necessity delayed and modified in the summer on account of reduction in personnel and in income. Nevertheless, it was later found possible to proceed with a modification of this program and three skilled predatory animal trappers and field observers were located on Game Refuges 1-B, 1-F and 1-Q in the fall of 1933. In addition to removing predatory animals, especially coyotes, from these areas, these men will do everything possible for the welfare of deer and other game and will also cooperate in this study program.

The Division's Bureau of Education and Research has adopted for its chief field investigational work for 1934 (and probably succeeding years also) the administration of the present study program. The purpose of this work is to ascertain the favorable and unfavorable factors to the Modoc mule deer, means by which same can be altered for the deer herds' benefit, and to compile information that will later provide the basis of a game management program for these animals. The latter means improving habitat and other conditions so that a larger annual crop is secured and "harvesting" this crop in such a manner that the entire herd may maintain its numbers or increase. It is quite evident that our present knowledge is insufficient to permit

us to now adopt such a constructive program, so the present study has been instituted to secure the required information in as practical and speedy a manner as is thought possible.

The natural course to pursue to procure this information would be to put two or three trained biologists into the field to work out the problem. On account of reduction in income and lack of funds for this purpose, it is impossible for the Division to do so at the present time. Because we believe that it is imperative to secure information on the subject at once, we have, therefore, decided to do the best we can with our available man power and observations will be made by game wardens and predatory animal trappers under the supervision of two of the Division's biologists.

Three game wardens, A. A. Jordan, P. Kehrer and F. R. Starr, men with proven ability to make accurate field observations, will conduct prescribed courses of study in as many areas in Siskiyou and Modoc counties. Each of these men will have a predetermined work area on which he will be required to do several days' work each month. The exact location of these areas will not be divulged for the obvious reason that such a course would probably interfere with the study, which it is desired be made under absolutely natural conditions.

Three State predatory animal trappers, A. L. Brown, J. L. McDonald and O. R. Shaw, who were selected on account of their ability to make and record wild life observations, will, in addition to their trapping and patrol duties on State game refuges, conduct similar programs of study on portions of their respective areas. One of these men is located in Modoc County and two of them are stationed on Lassen County game refuges. Thus one man will conduct the study in Siskiyou County, three in Modoc and two in Lassen counties. The writer will direct the work of the game wardens and D. D. McLean, Bird and Animal Economist, Bureau of Game Refuges, will supervise the activities of the trappers. Junior Range Examiner F. W. Johnson, U. S. Forest Service, will cooperate with all the workers and his excellent knowledge of range plants will greatly assist them in the study of food plants and range conditions.

The course of study outlined below was prepared at a meeting of Joseph Dixon, Field Naturalist, Office of National Parks, Buildings and Reservations, Dr. E. Raymond Hall, Curator of Mammals and I. McT. Cowan, University of California Museum of Vertebrate Zoology, J. S. Hunter, Chief, and D. D. McLean, Bird and Animal Economist, Bureau of Game Refuges of this Division, and the writer. The meeting was held in Berkeley, November 22, 1933.

The writer presented the program adopted at this meeting to members of the the U. S. Forest Service and State game wardens at Mt. Shasta November 27. Among those present were: Supervisor T. J. Jones, of the Shasta National Forest, Junior Range Examiner Johnson and other Forest Service employees, Captain of Game Wardens S. R. Gilloon and game wardens Brice Hammack, Jordan, Kehrer and Starr. These men all agreed upon the practicability of the program and considered the study vital at this time. It is a pleasure to acknowledge the endorsement of and promises of assistance to our study program that Supervisor Jones and members of the Forest Service provided at this meeting.

The following is the study program that has been adopted:

### I. Areas.

To be carefully selected to present average conditions of different types of country within mule deer range. Thus one area should present semidesert conditions, another pine-juniper associations, another mountain pine timber, etc. Each individual area should be selected to incorporate, as far as it is possible within its bounds, all types of country (associations) occurring in the general vicinity. For instance, a pine timber area should include the average amount of brush and open meadow land and water that occurs in the general vicinity. "Work areas" *must not* be selected because they are known to harbor either greater or lesser than the average number of deer in the vicinity. In other words, each Work Area should, as far as it is possible, be selected to present average conditions of its general vicinity. It is of course obvious that some of the areas should be located in known "summer range" and others in "winter range."

Following are some vicinities suggested for consideration to locate Work Areas in. It is believed that most of the important different types of country contained within Modoc County can be found in these localities:

A. Red Rock Valley. (Semidesert type with juniper.)
B. Crowder Flat vicinity. (Pine, juniper, mahogany association.)
C. Warner Mountains. (Mountain, pine, brush associations.)
D. Little Hot Spring Valley. (Lava bed type.)
E. Adin Mountain. (Pine, quaking aspen association.)

### II. Censuses.

Two types of censuses will be made by the workers. In each case, the counts will be made as closely coincident as possible, preferably on succeeding days. As far as it is possible, censuses by all workers should be made on the same day.

A. *Number and date of censuses.* Four deer counts will be made each year.

1. *Winter count* designed to be made at *end* of fall migration, or when *all* deer are on their winter range. Date nearest to January 10 when satisfactory weather conditions obtain.

2. *Late winter range census.* To be taken at as late a date in spring as seems positive to still find *all* deer on their winter range. Probable date for this census, first half of April. (*Note:* By subtracting this count from "1" we should be able to figure the "winter loss." This count should provide about the minimum deer population for the year.)

3. *Fawn census.* To be made late enough to be certain to include all fawns (after latest fawns are walking), yet as early as possible. Suggested date, last half of July or August 1. (*Note:* This census should provide the maximum deer population.)

4. *Prehunting season census.* To secure number of deer immediately before hunting season opens. Date September 10. (*Note:* By subtracting number of fawns counted in this census from number counted in census "3," fawn loss may be estimated, except loss of very small young impractical to count, lost prior to census "3," on Work Areas. This will provide "hunting loss" by subtracting same from buck census here obtained (census "4") potential breeding stock may be computed.)

B. *Kinds of censuses.*

1. *Strip count.* Not to be made in Work Area but to be taken over a definitely laid out course, preferably circular, either in the general vicinity of the Work Areas or on some other desirable tract of land. This count will be taken four times a year as above, each time over exactly the same course, by the same observer or observers and at the same time of day. In different years, each count should be made on corresponding days. The length of the route in this count will necessarily vary with the type of country in which it is to be taken according to the ease or difficulty with which deer may be counted (open versus brushy or timbered country) and with the number of animals to be counted. The course should be as long as it is practical for a man to cover carefully in a full half day, or 5 or 6 hours, perhaps 4 to 6 miles.

When definitely selected, each "Strip Count Route" should be carefully laid out, marked (blazed, etc.) and mapped.

2. *Definite area count.* Each area should be carefully selected as outlined in Part I and its size determined in accordance with the requirements of this census. These areas will comprise the Work Areas. Each should be as large as possible, and yet conform with the following requirements: that, by any devisable means, the man in charge may, alone, count with almost full accuracy within a given time, *every* deer within its confines. Here, just as in the case of the Strip Count Route, type of country will greatly affect the size of the Work Area.

C. *Census requirements.* Workers will arrange to segregate age classes of deer and record each separately as follows (in each individual seasonal count):

1. Number of old (adult) does.
2. Number of yearling does.
3. Number of does with single fawn.
4. Number of does with twin fawns.
5. Number of fawns. (Deer of the season to be counted as fawns, i.e., April census fawns will be approximately 10 months old. These animals will be recorded as yearlings in the July census, when a new fawn crop will have appeared.)
6. Number of spike bucks.
7. Number of forked-horn bucks. (Notes if possible on same that have or lack "eye-guard" or "brow-tine.")
8. Number of bucks, three-pointers or better. (Notes wanted on exceptionally large bucks, ones with malformed or deformed antlers, etc.)
9. Special data as follows are desired for bucks only in the censuses indicated:

   a. January census: Number of bucks with shed antlers.
   b. April census: Number of bucks still carrying antlers.
   c. September census: Number of bucks in "velvet."

At the end of each census report, each worker should provide a statement of remarks upon the particular count in which especial emphasis should be given to the following points:

10. *Weather at census taking time,* clear or cloudy, rain or snow falling, depth of snow on ground. Brief statement of the weather at this point for the previous ten days. Temperature. Wind velocity and direction.

11. *General condition of the herd,* noting all exceptional cases such as unusually poor animals, condition and color of pelage (coat) and antlers, visibly diseased or injured animals. Each of the latter cases should be recorded in some detail.

### III. Predatory animals.

The following methods for studying these animals and their effect upon deer are suggested for the use of the game wardens only. D. D. McLean is preparing more comprehensive methods for the use of the trappers on the game refuges.

A. *Secure estimated number of predators* (mountain lion, bear, coyote, bobcat, possibly golden eagle) occurring on Work Areas monthly. In reports indicate which of these animals and quantity thereof appear to be resident on the area, and which are only visitors and approximate extent of visit of each. This information to be secured by:

1. Observation of the predators in life.
2. Observation of tracks, especially in snow.

B. *Effect of predatory animals upon deer.*

1. By observation determine if harassment by predatory animals drives deer from their feeding, resting or watering places or disturbs them and to what extent in (a) feeding, (b) watering, (c) resting.
2. By observation of deer kills use every method possible (tracks, evidence, etc.) to ascertain the cause of each kill. In monthly reports list all kills found on Work Areas, also ones definitely attributable to

predatory animals that are found elsewhere, and in both cases provide all details.

C. At all seasons, workers should be on the alert to note especial conditions (such as deep snow, storm, extreme cold, or heat, etc.) under which predatory animals become particularly or more than ordinarily harmful to deer. It must be emphasized here that we have little exact information relative to the effect of predatory animals upon deer. We wish to particularly stress this phase of the work and the need for care in executing it. All information must be positive or it is worthless; if there is a doubt in a case, express degree of same in your report; if the degree of doubt is large, better state "cause unknown" than to attempt to ascertain it from too scanty evidence.

D. Stomachs of all predators shot or trapped should be labeled as to date, locality and conditions under which same are secured and sent into the office for examination. However, only in extreme cases where the death of numbers of deer would result, should predators be removed from the Work Areas, because if they are, it will defeat the purpose of this study, which is to learn what happens to our deer under *natural* conditions.

### IV. Disease, parasites, poisons.

A. In the case of live deer that are visibly diseased, same should be studied as closely as possible for symptoms which should be recorded, but only in the case of badly diseased or incapacitated animals should they be killed. All deer carcasses found, whether or not on Work Areas, if fresh enough to permit of observation should be carefully examined for the following diseases, symptoms of which are provided herewith. Each case should be reported in detail with locality in monthly report.

1. *Bacillus necrophorus*, or, "calf-diphtheria." Symptoms already known to most game wardens consist of highly inflamed, often mucous filled throat or gullet, mouth, nasal passages or other head areas. The best way to inspect a specimen for this disease is to slit the mouth back from the rear corner of the lips to the neck, open the mouth wide and examine it, especially in back of the tongue and the throat. If these areas or parts of them are inflammed, show a mucous discharge or are greenish-white in color, it is fairly safe to assume that the animal had "deer disease," as this malady is locally termed. When such diseased heads are found they should be sent in for examination.

2. *Liver fluke.* Remove the liver. If it has a blotchy, speckled appearance with whitish blotches or mottlings on its surface, then the animal most probably suffered from this disease, and its liver should be sent into the office for confirmation. Sometimes the fluke can be found as a thin whitish or reddish leaflike structure. If the examination shows a normal, healthy colored liver, that has one or more watery welts about the size of a dime on its surface, the presence of these "cysts" do not indicate liver fluke, but these are the larval stages of the dog tapeworm. This condition is very common among our deer, but is apparently harmless to them except in rare cases of extreme infestation. However, record should be made of all deer livers found to be so affected.

3. *Lung worm.* Cut the lung open. If it is infested with lung worms, these parasites will be seen as coiled whitish or gray strings on close examination.

4. *Pink-eye.* Pussy, mucous discharging and inflamed eye or eyes are good indicators for this disease. In such cases, cut off and send in for examination animal's entire head.

5. *Bot larvae.* The larvae of the bot fly are frequently found in the nasal passages of deer. In most cases, the presence of these "grubs" do not appear to affect the animal's health at all. However, some cases of severe infestation are on record that have caused either great incapacitation or even death in deer. To examine an animal for bot fly larvae infestation, cut open the front of the head from nose to eyes and expose the sinuses, or nasal passages. If bot fly larvae are present, they will readily be seen as they are grayish oval or short "cigar" shaped grubs varying from one-quarter to one inch in length. Specimens (entire

deer heads) need not be sent into the office for examination in cases of moderate or light bot fly infestations; but a record of the presence or absence of this parasite should be included in the report upon each carcass examined. In cases of heavy infestation, where examination fails to reveal other diseases or causes for death, and bot larvae is the suspected cause, then the animal's entire head should be sent into the office for examination.

*General instructions regarding disease.* Inspect each carcass for *all* the above enumerated diseases. The finding of a single disease in itself is not sufficient as the same animal might be suffering from two or more maladies, any one of which or a combination of all might have been responsible for its death. Only in cases where parts are thought definitely to be diseased should they be sent to the office; but in such cases, we do want to receive the affected parts as explained above, except that livers are not wanted that are infected with dog tapeworm cysts only, unless they be unusually heavily infested, nor are the heads bearing but moderate bot larvae infestations desired. Workers are cautioned to thoroughly wash hands and clothing if soiled after making examination or handling a diseased carcass. Wash contaminated parts thoroughly and repeatedly with soap and water. Do not handle food or pipe before washing hands that have been soiled by examining a diseased deer. If "black-leg" is suspected to affect deer, rubber gloves should be worn before touching a diseased carcass and all precautionary measures exercised, as this disease is very dangerous.

B. *External parasites:* Deer are subject to more or less infestation by fleas and ticks. Usually the animals seem to suffer little or no harm, save possible annoyance from these pests. However, an occasional (usually a poor) deer is found that is very heavily parasitized, particularly by ticks. It is only in such cases of extreme infestation that the workers need direct attention to these parasites when the extent of infested areas should be noted together with visible effect upon the animal. Specimens of the parasites should also be preserved in small bottles of alcohol, labeled, and sent in for determination. It should, however, be borne in mind that cases of heavily parasitized deer occur rather as a result of, rather than as a cause, of sickness. Usually some disease or malnutrition gets the deer's condition down so that it can not combat the parasites that normally live on it, then they multiply enormously. Therefore, all cases of heavily parasitized deer should be investigated further for sickness or other ailments.

Mule deer workers should look carefully in cases of bucks examined for evidence of emasculation through tick bites. There is a popular opinion that many bucks lose their masculinity from this cause and definite information is desired in its regard.

Occasionally deer may be found to harbor lice, in this event specimens of the mites are desired by the office, preserved in alcohol and accompanied with full data as to host, locality, etc.

C. *Poisons.* Full data and stomachs for analysis are desired of all deer suspected of having died from poison. Particularly note the poisonous shrubs or plants in your vicinity and endeavor to ascertain by observation whether or not deer eat them and if so, their effect upon the animals. Certain vetches and wild parsley are among the plants that are sometimes poisonous to live stock and we desire information relative to their effect upon deer, if the animal eats them.

## V. Mortality.

A. In the Work Areas the cause of the death of all deer is desired if it is possible to ascertain. Workers should patrol each area thoroughly at least once a month in search of carcasses. When a dead deer is found, every possible means should be resorted to to determine the cause of mortality. Report should be made separately on each dead deer found and incorporated in monthly reports. If it is impossible to ascertain cause of death, carcass should be listed and cause shown as "unknown." It is of utmost importance to record the age and sex of every dead deer in the report.

B. Reports are also desired of dead deer and cause of their mortality that are found by the game wardens on areas other than the Work Areas in the course of their regular patrol duties. These reports, however, should be made separately and each should be plainly marked to preclude any possibility of its becoming confused with the Work Area report.

C. Following are some causes of death in deer:

1. Winter kill (starvation).
2. Predators.
3. Hunting (means will later be devised for securing an accurate record of legal hunting kill on Work Areas).
4. Illegal hunting.
5. Wounded deer lost by hunters that die.
6. Accidents (natural accidents, not man-caused, such as falling off cliff, snagging self in brush, etc.).
7. Old age.
8. Disease.

### VI. Food and Water.

This is one of the most important parts of the investigation. It embraces the relation of our deer herd and live stock and the need of water. It is also one of the most difficult phases of the study upon which to secure definite, unassailable information. It is, therefore, urged that all workers devote especial emphasis to this portion of the study and endeavor to assemble a mass of pertinent facts in this regard.

A. Ascertain actual food of deer on your area by observation (watching them eating) and record list of deer food plants in their order of preference (seasonally) or give percentage figures for food plant preference. Range Examiner Johnson, of the Forest Service, is an expert botanist, familiar with most of the forage plants in the mule deer section. He will cooperate with the workers and familiarize them with the common and important food plants.

B. Note and report from time to time in monthly reports as observations are made, the effect that deer browsing has upon the food plants. Necessarily some of these observations should be made in areas free from live stock or at a season when live stock are not present. Consider the possibility of fencing off small plots in grazed areas to exclude live stock, yet permit access of deer for use as study plots in comparison with the surrounding area.

C. Note and report as above what other animals feed upon the same plants as the deer and their effect upon same.

1. Other wild animals (antelope, rabbits, squirrels, etc.).
2. Cattle and/or horses.
3. Sheep (domestic).

D. Note and report as above what plants cattle and sheep feed upon that deer do not eat, and effect upon same.

E. Take photographs illustrating good food growth, poor growth and cases illustrating where good deer browse has been destroyed by fire, drought, grazing or other causes. "Before and after" photos are particularly desired.

### VII. Migration.

Secure all possible data relative to the migration of deer in your vicinity, especially on and to and from the Work Areas. Provide this information in the monthly reports. The following are some considerations by which to be guided in this phase of the study.

A. Dates of commencement of migrations (spring and fall).

B. Dates of height of same.

C. Dates of conclusion of same.

D. If there are more than the two definite annual migrations, such as a mid-winter migration, caused by deep snow, lack of food or some other factor, record and report same.

E. Note direction of migration travel.

F. Note time migrating is done, by day or night or both.

G. Attempt to ascertain distances migrated (distance from summer to winter ranges).

H. Ascertain range of individual deer (recognizable individuals such as bucks with distinctive antlers, animals with malformed hoofs, etc. Consider possibility of marking deer, ear tagging or marking fawns for instance, for this purpose).

1. By day or week.
2. In a year.

**VIII. Habits.**

There is relatively little *exact* information available regarding the habits of deer. Many hunters have quite definite opinions in this regard that vary enormously. We must, by this study, secure a mass of absolutely reliable and true information on the subject. This should be done by each worker bearing the following suggestions in mind at all times, making notes or field observations of same and incorporating them in the monthly reports. Following are points regarding the "Life History" or "Habits" of mule deer upon which we particularly desire information at this time:

A. Date of commencement of rut.
   1. Date when bucks start "running."
   2. Date of actual mating. Age classes mating. Do yearling bucks and does breed? Do very old individuals breed?

B. Dates upon which bucks drop antlers.
   1. Note earliest date annually upon which first buck with shed antlers is seen.
   2. Note dates when most bucks on your area shed antlers.
   3. Note latest date in spring when buck with antlers is seen.

C. Dates upon which "velvet" is shed.
   1. Exact dates of each instance where buck is seen in process of losing velvet, i.e., shredded velvet clinging to antlers. In each case also note color of pelage or coat at the time.

D. Following information must be recorded regarding fawns:
   1. Date upon which earliest fawn is noted in spring.
   2. Date upon which latest new born fawn is noted.
   3. Dates between which most fawns are dropped.
   4. List dates of all fawns noted so young they can not run.
   5. All yearling does with fawns must be specifically recorded.

E. Any reliable information obtainable (in the case of statements of hunters, etc., provide name and address of same with date upon which statement was secured) upon the following questions:
   1. How long do deer live? (Known positive individual examples.)
   2. How do deer "get along with" sheep, cattle or horses when these animals occupy the same range? In feeding? At water? Proven examples of specific cases on this subject should be obtainable and should be secured from reliable persons in the form of signed statements.
   3. Are there any black-tailed deer in your mule deer range? If so, provide map of range, show area inhabited by each species and note approximate percentages of each kind's abundance.
   4. Are there any hybrid (mule x black-tail) deer in your mule deer range? Provide information in this regard as above.
   5. Do deer eat bronco grass? If so, does it cause lesions in their mouth or throat? Does overgrazing land by live stock increase the bronco grass crop? Does fire do the same?
   6. Is brush-land increasing or decreasing in your vicinity? If decreasing, is it being replaced by conifers? Effect of same upon deer population.
   7. Distance deer range from water (cite examples of deer killed known distances from nearest water). How often do does water? Bucks? How does this vary seasonally, or with hot and cold weather?
   8. Do deer show a preference for some water over other? Do they drink at sheep or cattle troughs or tanks? Do they refuse certain mineral or muddy water?
   9. Do deer use certain mineral springs or salt licks? If so, send in sample of water or salt for analysis with notes regarding extent of use by deer.
   10. Effect of "salting" (placing salt artificially for live stock or deer) upon deer? Their use or refusal of same?

11. Information is desired in regard to the trend of the deer herds population in years past. How abundant were deer in your area 50, 40, 30, etc., years ago? Date of "peak" of deer abundance in your vicinity? Dates of low ebb in deer population your vicinity. (Get signed statements from old residents regarding this.)
12. Is the number of deer in your vicinity increasing or decreasing at the present time? (Statements from reliable persons solicited.)

**IX. Conclusion.**

A. *Maps.* Prepare a map of your general vicinity of sufficiently large scale to enable plotting upon it, so another could locate without your help.

1. Strip Count Route.
2. Work Area.

Prepare larger scale map of Work Area showing in detail all topography, tree, brush, meadowland and water. Be prepared later to mark upon this map, locations of deer, predators, etc.

B. *Reports.*

1. Strip Count Census which is to be made four times a year shall be reported separately immediately following each count.

2. Work Area reports, including reports of the four annual censuses on these areas, and all other information requested in this outline shall be rendered monthly. Prepare and forward these to the office as soon after the end of the month as possible.

C. Time expected to be devoted to this work.

1. *Strip Count Census.* One day on dates designated, 4 times a year.

2. *Work Areas.* Days required for four annual censuses, plus at least 3 to 4 full days per month, preferably more time, at workers' convenience, to be devoted to studying predators, habits, food, searching for dead deer, etc.

The above outline should be self-explanatory. The purpose of the Strip Count censuses is to secure a broader cross-section of the makeup of the whole deer herd (proportion of age classes and sexes) than would the counts on the smaller Work Areas provide. It is believed that these counts over a period of years may well be expected to indicate the trend of the deer population for the entire region.

At the time that this paper goes to press, Work and Strip Count areas have been selected and initial counts are scheduled to be made on them on or about January 10, 1934. This will mark actual commencement of the study which will be closely followed throughout the year and most probably also in one or two succeeding years, until the desired information is obtained.

The author wishes to acknowledge with thanks the assistance rendered him in the preparation of the range map here provided (Fig. 15) by the following Division employees: J. S. Hunter, S. R. Gilloon, Wm. Lippincott, C. O. Fisher, P. Kehrer, L. E. Mercer, F. R. Starr and C. O. Elliger.

# CALIFORNIA FISH AND GAME

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## PERSONNEL CHANGES IN BUREAU OF EDUCATION AND RESEARCH

On October 10, 1933, the resignation of Leo K. Wilson as Chief of the Bureau of Education and Research became effective, to permit him to accept a partnership in the law firm of McClymonds and Wells. Mr. Wilson originally came to the Division of Fish and Game on December 10, 1929, as a publicity man. He was made successor to Dr. Harold C. Bryant, on July 1, 1930, and continued his work as editor of California Fish and Game.

The Fish and Game Commission has chosen Dr. J. O. Snyder to succeed to the responsibilities of the Bureau of Education and Research in addition to his duties as Chief of the Bureau of Fish Culture. The Bureau of Education and Research will retain its identity, and will continue to operate under a separate budget, under the supervision of Dr. Snyder.

Accompanying the changes just noted, James Moffitt has been placed upon full time with the Bureau of Education and Research, and under the supervision of Dr. Snyder will be responsible for the routine work of the Bureau, and will also act as editor of California Fish and Game.

With the high professional standing, and the friendly and untiring interest of Dr. Snyder in our conservation problems, the sportsmen of the State are assured of a continuation of the fundamental scientific and educational work which should accompany a proper conservation program.—*John L. Farley, Division of Fish and Game, San Francisco, December 12, 1933.*

## NEW FISH AND GAME CODE

The new Fish and Game Code which was adopted at the fiftieth session of the California Legislature and is known as Chapter 73, Statutes of 1933, became effective August 21, 1933.

This code embodies all the former Penal and Political Code sections relating to fish and game. The text of the code is clearly worded and the subjects are grouped together so that the average individual can refer to any game law that he desires to look up with greater ease than was possible in the case of our old law books. Everyone seems

to agree that the new code is a great improvement over the former compilation of our fish and game laws.

Copies of the new Fish and Game Code are available, and may be secured from the Division of Fish and Game at the price of 25 cents each.

The code is published in booklet form, size $5\frac{3}{4}$ by $8\frac{1}{2}$ inches. In addition to listing all the active sections of the Fish and Game Code, there are also provided in smaller type original sections that were later amended by the 1933 Legislature.

The code is completely indexed and a map showing the fish and game districts is included.—*James Moffitt, Division of Fish and Game, San Francisco, December 21, 1933.*

## REGULATIONS GOVERNING IMPORTATION OF CERTAIN WILD BIRDS AND ANIMALS

In accordance with the duties imposed upon it by Chapter 76, Statutes of 1933, the Division of Fish and Game has prepared, and has on hand for free distribution to interested persons, a pamphlet known as "Rules and Regulations Governing the Importation of Wild Birds and Animals into the State of California and Conditions Under Which Same May Be Kept in Confinement."

This pamphlet was prepared by the Bureau of Education and Research in cooperation with the State Department of Agriculture. It lists the species of birds, mammals, crustaceans and mollusks, the entry of which into California is prohibited by this law. Certain species which may be admitted to the State under permit are also listed, and proper form for application for such permit is provided. Next, regulations are provided for the destruction of excluded species if found at large in the State, and conditions under which species imported under this act may be kept in confinement.

The officers responsible for enforcing this act are the fish and game wardens, the State plant quarantine officers and the county agricultural commissioners.

Birds or animals that are held captive in accordance with this act may not be liberated in the State.

The pamphlet closes with a description of some of the birds and animals covered by this act. In all cases, descriptions are accompanied by pen and ink drawings of the species, which were prepared by D. D. McLean, of the Division.—*James Moffitt, Division of Fish and Game, San Francisco, December 21, 1933.*

## C. W. A. WORK TO AID DIVISION ACTIVITIES

California sportsmen are to reap much benefit from the Civil Works Administration program. Approval has been given by Captain Edward Macauley, engineer for the C. W. A., providing for the expenditure by the Federal government in California of upward of $100,000 on fish hatcheries, egg-collecting stations, game farms and refuges.

This work will provide employment for more than 300 men. Some of the projects call for 750 days divided between 32 men. The Division of Fish and Game furnishes all materials.

Needed repairs to hatcheries, new roads, new brood ponds, new fences, receiving and aging tanks, all badly needed in the hatcheries, will thus be provided under the program. On the game farms and game refuges necessary improvements will be speeded.

This Federal aid will help enlarge the Friant small-mouthed black bass experimental ponds where more tanks will be added. At Mount Shasta, Forest Home, Burney Creek, Fall Creek, Basin Creek and Brookdale the work will enable hatcheries situated in these localities to increase their output of trout.

Work contemplated on the game farms at Yountville and Chino will enable them to produce more game birds.

Each project will have a supervisor in charge, selected from the locality in which the project is located.—*O. L. Warner, Division of Fish and Game, San Francisco, December 21, 1933.*

## COMMERCIAL FISHERY NOTES

### SARDINES

During September a general strike of all northern (Monterey and San Francisco) sardine fishermen occurred. The fishermen claimed that under the existing price of $6 a ton it was impossible to make a living, so they struck for $8 a ton. Dissatisfaction of many of the fishermen fishing for the outside floating reduction plants was made known, they claiming that short weights were being given them by the outside plants. After many conferences between canners and fishermen, and after the N. R. A. board, State Labor Commissioner, and finally T. A. Reardon, State Director of Industrial Relations, were called upon to mediate the claims, the strike was settled on October 20, with a price of $7 per ton, after the Director of Industrial Relations had been selected as arbitrator.

Several new canning and reduction plants are planning to operate this season in the northern half of the State. The Bayside Fish Flour Co. has commenced operating its new plant at Point Richmond. A new plant at Pittsburg, the Pittsburg Canners, Inc., has installed machinery in a bean warehouse on New York Slough and started operations. The Benicia Canning Co. has thought of operating as a sardine cannery but to date has taken no fish.

For the first three months of the season (August, September and October), 52,377 tons of sardines have been delivered; 227,650 cases of 1-lb. ovals and 37,440 cases of other sized cans have been packed, as compared with 41,349 tons received, 81,328 cases of 1-lb. ovals and 1872 cases of other sized cans for the same period last year (1932).

### SARDINE ABUNDANCE

True to the predictions made the early part of the sardine season by the California State Fisheries Laboratory, sardines in Monterey Bay and off of San Francisco have been relatively scarcer than in the fall of 1932. Knowledge of the sardine population, gained through continual study and sampling of the catch, was the basis for this prediction. No new abundant year class has entered the sardine fishery in three years. As a consequence, the sardine fishery has been supported in the fall by the existing older year groups. Naturally, the

sardines in these groups would decline in abundance when they are heavily fished, if no new supply of younger fish augmented the existing population. This has been the case. Also true to the predictions, a new group of small sardines was apparent in the first catches made off San Pedro after the season opened on November 1, with the smaller fish predominating in numbers over the larger and older existing groups.

MACKEREL

The California mackerel catch this year (1933) will be the largest of any season. In 1929 the catch was 57,974,000 pounds and this year, at the end of October, the catch was in excess of 60,000,000 pounds and will probably exceed the 70,000,000-pound mark by the end of the year. The greatest bulk of this catch is landed at San Pedro and San Diego, and most of the fish are canned.

During October, Fish Bulletin No. 40, "The California Mackerel Fishery," was received from the printer. This bulletin gives an account of the mackerel fishery throughout the world but particularly of the fishery in California in all its aspects, from the fish in the ocean to the final labeled can on the consumer's shelf.

FISHERIES CODES

Various organizations and industries in the fisheries of the State have been at work preparing their codes of fair competition under the N. R. A. or C. R. A. The State Fisheries Laboratory has been able to aid the various groups in compiling statistics of catches of various species of fish and the prices paid per pound, for their use in presenting codes for adoption. In San Francisco the wholesale dealers have presented a code for the wholesale dealers of northern California to the C. R. A. under which they will operate.—*N. B. S.*

## FRESH FISH MARKETING

In its campaign to educate people to eat more fish and to try the various varieties of the sixty or more that are taken from California waters, the Division of Fish and Game has participated in exhibits and given demonstrations to over a million people since September 1.

With the heavy drain on the six or seven popular table fish threatening a depletion, it is the purpose of the Division to show the public that there are dozens of other kinds of salt water fish that are equally tasty and which furnish just as high a percentage of iodine and other valuable food elements as do salmon, bass, sole, sand dabs, barracuda, halibut, smelt and yellowtail.

The exhibit of the Division of Fish and Game represented Monterey Bay, with animated scenes of moving fishing boats and fishermen repairing nets. Two large educational signs showing statistical information of the importance of the fresh fish industry of California and "Reasons Why You Should Make Tuesday Fish Day Too" were posted in the center of the exhibit.

Pamphlets giving the food value of sea foods and our cookery book "Five Hundred Ways to Prepare California Sea Foods" were distributed free to interested housewives.

Demonstrations on methods of preparing and serving fish were given at various meetings. California newspapers maintaining home economics departments and household editorial pages are cooperating by publishing and demonstrating fresh fish recipes, in an effort to create a greater consumer acceptance and demand for California sea foods.—*A. A. Alstrom, Division of Fish and Game, San Francisco, December 21, 1933.*

## KLAMATH RIVER SPAWNING CONDITIONS IN 1932

The season of 1932 was the occasion of an unusually large migration of salmon into Klamath River. It presented also a temptation to take eggs for artificial propagation in excess of hatchery facilities. Fall Creek Hatchery, the only plant for salmon propagation in Klamath River, has a safe capacity for 3,000,000 eggs. A larger number, possibly 4,000,000 may be received, but in that case, crowding becomes entirely too severe for safety. At this time, then, something over 4,000,000 eggs were taken and the racks, still crowded with fish, were opened.

Selected female fish to the number of 1302 were spawned, and an estimated number of 9154 were allowed to continue their migration and spawn naturally. There has been some question as to whether the bed of the river above the Klamathon racks presented a sufficient number of suitable gravel bars to accommodate any number of spawning fish, and also whether the tides caused by the power plant at Copco are destructive to eggs if such are deposited in the gravel of the bars.

Two assistants, Charles F. Moore and Kenneth E. Sullivan, were detailed by Earl Leitritz, foreman of the Fall Creek Hatchery, to determine by actual observation just what happened after the racks were opened. Work was begun November 4 and continued until December 1.

The observers covered the river between the racks and the dam and they also examined Fall, Jenny and Bogus creeks. They worked independently, and their excellent notebooks agree in the main in their findings.

Spawning beds were numerous; 25 or so measuring from 60 to 900 feet long and of various widths, were mentioned in particular. Upwards of 200 nests were examined. Many pairs were seen spawning—2811 dead fish were counted by one observer, 2226 of which were in Fall Creek. This mortality was largely the natural result of spawning and bore no relation to the condition of the river.

Most of the spawning operations are restricted to gravel bars which are left exposed at low water, and where the drainage is so complete as to destroy the eggs. In many cases, the sudden rise of the water whipped out the disturbed gravel of the nests and completely destroyed them. There are no spawning beds in the river above the mouth of Fall Creek as the channel is mostly in solid rock, although many salmon (300 or more) were found there. Jenny Creek is not fit for spawning; Bogus Creek was too roily for examination; Fall Creek was overcrowded. Dead salmon were frequently found in situations where they had been caught by falling water and perished before they were able to finish spawning.

Both observers conclude that although many young fish may come from natural spawning above the racks, there is great destruction as the result of varying levels of the river water. If fairly constant water levels were maintained, much natural spawning might be permitted in that part of the stream.

It follows that the plant at Fall Creek should be enlarged until it is capable of caring for all of the eggs that might usually be taken at the Klamathon racks. With ample justification for expansion there, improvements are being made as rapidly as funds will permit. The improvements are of such a nature as not to become obsolete in the event of the erection of a high dam somewhat farther down the river.—*J. O. Snyder, Division of Fish and Game, San Francisco, November 1, 1933.*

## REPORT ON BLACK BASS PROPAGATION WORK

One year of actual experimental work in the propagation of smallmouth black bass has been completed by the Bureau of Fish Culture, and a brief summary of its accomplishment is of interest.

At the outset it may be noted that the artificial propagation of this particular fish is generally conceded to be one of the most difficult, hazardous and expensive of any which confronts the fish culturist, and further that at no place has its culture gone very far beyond the experimental stage. Moreover, we are attempting the work here in the west far from the native habitat of the species, and in a region where it does not at present thrive well in nature.

In the propagation of this bass, certain difficulties present themselves.

First, eggs can not be collected from wild fish and artificially fertilized as in the case of trout. Brood fish must be held under seminatural conditions and allowed to pair and spawn over gravel nests in brood ponds.

Second, the newly hatched bass begin to take food when they are but a fraction of an inch in length. They do not thrive on artificial food, and hence microscopic animals must be provided in large quantities and at the proper time for the little fish. When these small bass attain a length of an inch or so, they demand other small fish as food, and if not provided they will eat one another.

Third, black bass are voracious and cannibalistic so that large and small fish may not live together. Grading and sorting are difficult.

Fourth, brood fish must be provided with live food or they will become diseased or barren.

It then becomes the business of the bass grower to be able to propagate not only the bass themselves, but also several other species of minute crustacea and fishes as well, and have them present in sufficient quantities at the proper time. It is evident also that to accomplish all this requires the services of a competent naturalist, particularly in a region where nothing of the sort had been previously attempted. The Bureau was fortunate in having a well qualified man in its employ and any success that has been achieved is due largely to the untiring efforts of the present foreman, Merrill W. Brown.*

* Doctors G. C. Embody, H. S. Davis and P. R. Needham and other recognized experts in the propagation of bass have been frequently consulted.

Through the friendly cooperation of the Fresno Sportsmen's Club and Harold K. Fox, its president, a site was procured free of charge in a deserted gravel pit near Fresno and adjacent to the San Joaquin River. The construction consisted of a series of dirt ponds holding about eight acres of water. There was a stock pond, a spawning pond and seven rearing ponds. In addition, six small concrete daphnia ponds were built. Pipes which supply water and afford drainage were connected with the river. An electrically driven pump formed a part of the equipment, and a small pump house served as a laboratory.

Leakage soon developed and two of the larger ponds had to be abandoned. Further leakage also causes an unexpected amount of pumping and it also seriously interferes with proper fertilization of the brood ponds.

Fertilization of the water is required to produce an abundant growth of single-celled algae (minute green plants) upon which daphnia or other microscopic animals may feed. The latter serve in their turn as food for the little bass. Brown found after much experimentation that a mixture of soy bean meal and acid phosphate produced the best fertilizer. He also discovered that the hot climate was unfavorable to daphnia, a minute crustacean commonly used for food in the east, and that a very similar little animal known as moina could be propagated as needed.

In the process of casting about for suitable fish food of larger size, red shiners were brought from San Diego, goldfish, mosquito fish, native minnows and sunfish were experimentally propagated or studied. At last, it fell to the lot of the bluegill to do its part, and now these fish of all sizes and ages are available for the always hungry bass.

In short, a system of propagation has been experimentally established by means of which a food supply depending upon a chain of complex operations is made available under the particular climatic conditions of the location.

Various pests have appeared to deplete the pond fish—herons, large and small, kingfishers and mergansers. A handy shotgun, more noisy than efficient, kept these at bay, but it seemed unwise to use it on the biggest and worst offender, a local angler caught red-handed. At one time, countless numbers of tadpoles hatched out and seriously threatened the supply of moina which was intended for the small bass.

The actual expenses incurred in the year's work amounts to $4,138.62. This includes supervision and labor (foreman and part-time assistant), supplies and miscellaneous charges—not a great deal when everything is considered. About 40,000 fish were hatched. Six thousand eight hundred seventy-six bass measuring 2½ to 3 inches were planted in favorable situations where future observation is possible. Two thousand three hundred fifty of these were successfully shipped to the region of San Diego, 520 miles, to test the possibility of long distance transportation. The loss at the ponds is largely traceable to cannibalism, which was difficult to control as the hatching extended over an abnormally long period. Extremes of temperature occurring over short intervals of time interrupted hatching and destroyed fish.

The net results are a carefully established background for future work and a demonstration that small-mouth black bass may be propagated here.—*J. O. Snyder, Division of Fish and Game, San Francisco, November 20, 1933.*

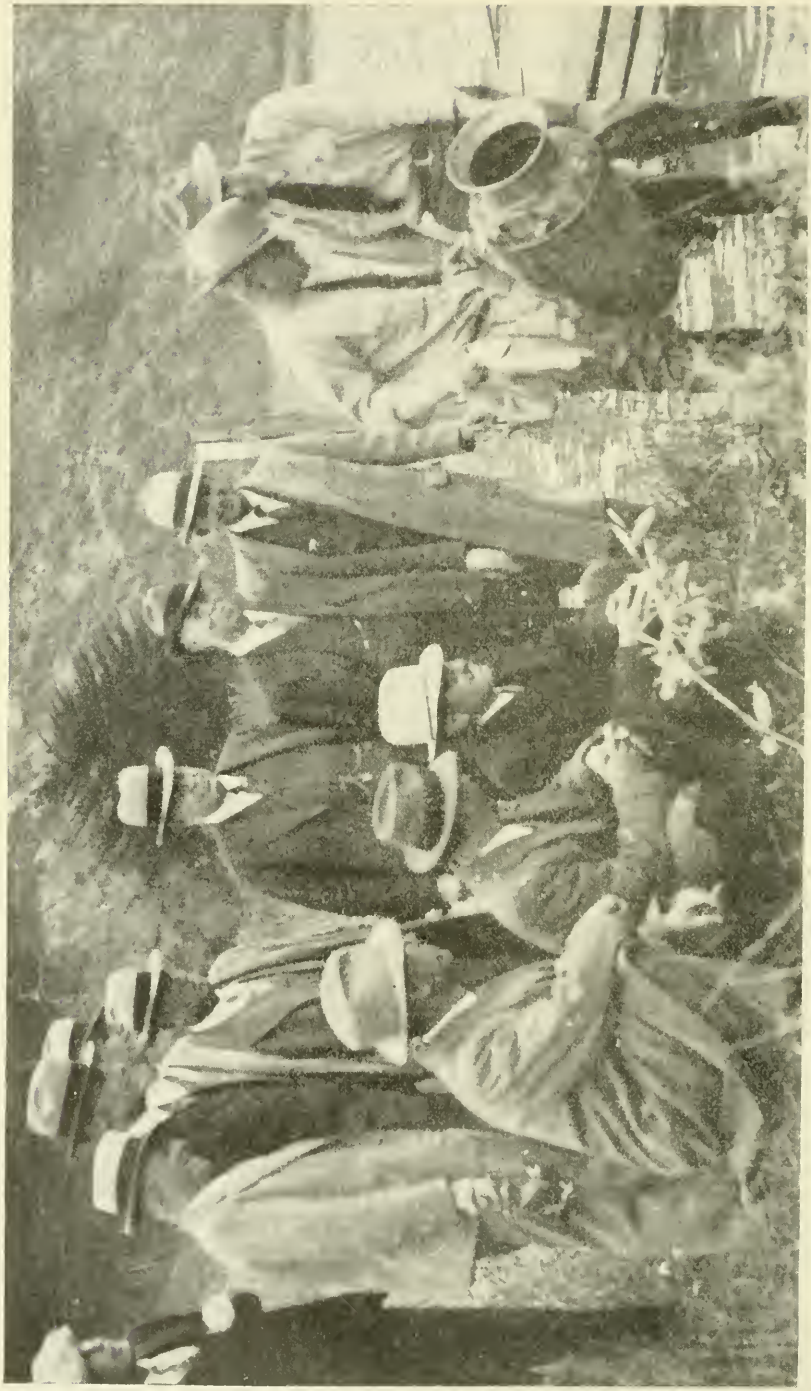

Fig. 16. Original planting of large-mouthed black bass in Lake Merced, San Francisco County, October 28, 1933, under sponsorship of Associated Sportsmen of California. Photo courtesy Associated Sportsmen of California.

## LARGE-MOUTHED BLACK BASS INTRODUCED INTO LAKE MERCED *

A planting of large-mouthed black bass in Lake Merced, San Francisco County, which is used as a storage lake for the municipal water supply of San Francisco, was made on October 28, 1933. This introduction was sponsored by the Associated Sportsmen of California and is in keeping with the policy of the Fish and Game Commission to plant fish in bodies of water in the State where public fishing will result.

Two hundred and twenty cans of these fish were netted under the direction of George Neale, in charge of the Bureau of Fish Rescue, in the upper Sacramento Valley sloughs. They were transported to San Francisco by motor truck under the care of game wardens of the Division. Not a fish was lost from the time they were taken from the river waters until they were released in the lake. Some of the bass weighed as much as eight pounds, and none were less than one-half pound in weight. This supply of brood stock will be added to until some 2000 large-mouthed bass will have been planted in the lake.

These bass are prolific spawners and develop quickly, therefore, it is expected that within the next three years the lake will be well stocked with this species of game fish. Until they increase in numbers and size, the lake will be closed to angling.—*O. L. Warner, Division of Fish and Game, San Francisco, November 15, 1933.*

## FIRST CALIFORNIA PHEASANT SEASON A SUCCESS

California's first open season on pheasants is now history.

During the six-day period, November 15 to 20, when these great upland birds could be legally hunted, more men went out in the fields to try their luck than have fared forth for any other small game in many years.

While no exact figure could be obtained as to the number of male birds that were killed during the season, 20,000 seems to be a fair estimate. This figure is based on reports of game wardens who kept a careful check on all hunters and their kill, questioned sporting goods dealers and devoted much effort to ascertain the success of the open season in every section where pheasants were hunted.

The wardens' reports revealed many interesting facts. A great number of sportsmen and some of our field men figured there would be a veritable slaughter of these birds because they were becoming so tame and domesticated. But it appears that the cock pheasant is a very wary bird and well able to take care of himself. He soon got it through his head that the report of a shotgun meant no good for him when his native, wild instincts asserted themselves and he surprised many a shotgun wielder with his speed in flying and running, his deceptive flight, and his ability to hide and back track on the nimrod.

* The 14th Biennial Report of the State Board of Fish and Game Commissioners for the years 1895–1896, p. 30, reveals that in June, 1895, the Spring Valley Water Company planted 300 large-mouthed black bass in Lake Merced. These fish were procured from the East by the Fish Commission.—Ed.

After the first day, it was quite a feat for a hunter to get his limit of two birds, and many had difficulty in getting one in sections where the birds were plentiful.

Women seemed to take great interest in hunting pheasants and the wardens noted many in the field.

Very few female birds were killed.

Northern and central California were the centers of the most successful hunting.

The interest in this new sport in California is indicated in a report by Warden Charles Sibeck, who patrolled the delta region of the Sacramento Valley. One excerpt reads:

"Quail and dove seasons draw many hunters to the delta country, but on opening day of the pheasant season, men and women bought licenses to hunt these birds, making up the largest army of hunters I have ever seen."

Andy Hamilton, Redding, who has for years been active in the introduction and propagation of pheasants in that vicinity, kindly provided his personal reactions to the pheasant season in that vicinity which are quoted here:

"The sportsmen are well satisfied that they have a real game bird in the pheasant, and one that can take good care of himself, under any conditions. Unfortunately, Shasta County has a comparatively small area suitable for pheasants, but what area we have is ideal and the birds seem to multiply rapidly.

"There was quite a difference of opinion as to how many birds were killed in this vicinity. It is my opinion that about 1000 birds were killed. To get this estimate, I personally contacted 90 hunters who on 146 trips killed 362 birds. These were only the hunters who came in my store."

August Bade, Superintendent of State Game Farms, says there are some million pheasants in California. The kill of 20,000 would seem to present no problem of depletion. Most of those who followed the season declare that it will be beneficial to the birds left, that they will not be so tame and will revert to the cunning that has made them an outstanding game attraction in other States.

Landowners seemed to enter into the spirit of the occasion, and but few refused permission to hunt on their property if courteously asked.

Wardens reported the following kill of pheasants in these areas:

Sacramento delta section, 1360 birds; Yuba, 500; Antioch, 1200 to 1500; Vallejo, 500; Los Angeles and Chino, 1000; Redding, 1000; Owens Valley, 300; Santa Clara and Alameda counties, 350; Tule Lake, over 1000; Bayshore, below Redwood City, 200; Modesto, 450; Tehama, 250; Napa, 300; Humboldt and Mendocino counties, 400.—*O. L. Warner, Division of Fish and Game, San Francisco, December 20, 1933.*

## 1933 QUAIL SEASON

The 1933 quail season seems to have been "spotty" throughout the State. Early reports indicated that in southern California where these birds are not as plentiful as they used to be, the hunting was excellent, and experienced quail hunters had no trouble getting their

limits. As the season progressed, the birds scattered and locating them became more difficult.

In central California, hunting was said to have been good, and the best success was had by those who used trained dogs.

In the northern areas, where quail have been plentiful in previous years, the sport was not as excellent as in the past.

Little complaint was heard from sportsmen about the reduced limit, and those who hunt with dogs thought that the six-week season was about the proper length.

Band-tailed pigeons gave the hunter more sport this season than they did last. In localities where these birds are to be found, they were extremely numerous in 1933 and most hunters who went after them were successful in taking limits.—*O. L. Warner, Division of Fish and Game, San Francisco, December 20, 1933.*

## OREGON ADOPTS UPLAND GAME BIRD LANDOWNER CONTRACT LAW

The State of Oregon has recently enacted a new piece of fish and game legislation that will be of interest to California upland game bird hunters. This act provides the "set-up" for carrying out the sportsman-landowner cooperative shooting system lately advocated by so many game authorities. We understand that this act has been in effect for but a short time and that, as yet, no actual contracts have been undertaken.

The following excerpt from the Oregon Game Code provides the text of this measure:

SECTION 30. Game Script—Issuance—Contracts with landowners.

(a) The game commission hereby is authorized to enter into contracts with any landowner, his lessee or managing agent in any county of the State of Oregon by the terms of which contract the game commission shall issue to anyone holding a current hunting license, or combination hunting and fishing license, script or coupons at a price not to exceed 50 cents, which coupon or script shall entitle, subject to the provisions hereof, the person to whom same is issued, to go upon any land of any owner thereof who has contracted with the game commission for the purpose of taking Chinese or Hungarian pheasants or any other of the upland game birds during the open season and within the lawful bag limits therefor. And it shall be lawful for the owner of such land or his lessee or managing agent to collect from such hunter one coupon for each of such birds taken on the land of such landowner, his lessee or managing agent and the game commission is further hereby empowered to redeem any of such coupons at and for a sum not exceeding 90 per centum of the amount for which the coupons were originally sold to the licensee.

The provisions of this act shall inure to the benefit of any and all owners of land, their lessees or managing agents, desiring to take advantage thereof in any county or counties of the State of Oregon where the game commission shall declare said script may be used, but nothing herein contained shall be deemed or construed to require the game commission to provide for the use, sale or redemption of such script in each and every county in the State of Oregon.

The game commission hereby is authorized to promulgate such further rules and regulations as is necessary to carry out the intent of this act.

(b) The game commission shall furnish to all landowners, their lessees or managing agents, appropriate signs to be posted by such persons on lands subjected to the provisions of this act.

(c) Nothing herein contained shall be construed to prevent any landowner, his lessee or managing agent from limiting the number of said game birds killed on his land by limiting the number of persons allowed upon his land during any day, week or hunting season.

(d) Any person who shall counterfeit any hunting script issued by the game commission or who shall alter same shall be deemed guilty of a felony and, upon conviction thereof, shall be sentenced to pay a fine of not less than one hundred dollars ($100) nor more than five thousand dollars ($5,000), or to imprisonment in the penitentiary for a period of time not exceeding five years or by both such fine and imprisonment.

Here in California, our present game laws require no legislative action to permit the operation of the sportsman-landowner cooperative shooting system. Legal advice has ruled that the existing Fish and Game Code contains authority for the Fish and Game Commission to undertake similar contracts to those above described.

Several sportsmen's organizations, notably the Associated Sportsmen of California and numerous chapters of the Izaak Walton League, are vitally interested in the development and working out of a similar plan in this State.

The state-wide Fish and Game Committee of the California State Chamber of Commerce has had functioning for some time a subcommittee on quail projects which has particularly concerned itself with the possibility of developing the sportsman-landowner cooperative plan in our State. Progress toward the end of preparing a workable scheme for use in California is reported by this subcommittee.

The Fish and Game Development Association is another California organization that is intensely interested in the possibilities of the sportsman-landowner movement for the improvement of upland game bird shooting in our State. This progressive organization has continuously advocated the establishment of "trial areas" in which to test out the mechanics of operation of the system. It is hoped that actual operation of at least one trial area may be effected within the near future in order that we may have early proof of the adaptability of the system to California conditions.—*James Moffitt, Division of Fish and Game, San Francisco, December 4, 1933.*

## WATERFOWL ABUNDANCE IN CALIFORNIA IN 1933

In spite of dire prophesies to the contrary, the 1933 fall flight of waterfowl in California seems to have been considerably in excess of the 1932 flight. At the time this note is written, there yet remain ten days of the 1933 season and, in the absence of reports from other areas, it is therefore too early to draw definite conclusions. Perhaps the large numbers of ducks and geese that have been observed in California this fall present a concentration here, but this fact can not be determined until reports are available from other Pacific Coast States.

There seems, however, to be no doubt whatever that ducks were more abundant in California during the present season than in the previous year. The Division has made particular effort to secure reports from reliable individuals in the various waterfowl concentration areas of the State, and in most instances these reports indicate more birds in 1933 than in 1932.

The writer was at Tule Lake, Siskiyou County, November 28, when this body of water was still open, and in fact just commencing to freeze at its margin. No doubt, a similar open condition existed in most of the lakes of that vicinity and eastern Oregon. This fact, the result of a warm fall in contrast to an unusually cold one a year ago, per-

mitted many thousands of ducks and geese to remain on the lakes of the higher plateau region. At this time, there were thousands upon thousands of ducks on Tule Lake in addition to myriads of geese, and State Game Warden Fred R. Starr stated that ducks were much more numerous there than at any time in the previous season.

Several sources have consistently reported more ducks in the Butte Creek Basin region of the Sacramento Valley this year than a year ago. This, in spite of the fact that weather conditions as above outlined permitted large numbers of the birds to remain in the plateau region that were unable to stay there so late a year ago.

Suisun Bay and marshes, and the South San Francisco Bay marshes have had more ducks on them in 1933 than in the prior season.

Early this season, water was, as usual at this time, short in the San Joaquin Valley. In spite of this fact, ducks are reported to have visited this section in greater numbers this year from August to date. Several gun clubs from this region have reported more sucessful kills throughout the present season than were obtained a year ago. Large numbers of ducks were reported in the San Joaquin Valley in September and October, and on the opening of the season, November 1. Fair shooting was had in this region in November, but less success was had during the first two weeks in December. Storms occurring about mid-December brought in a large number of new birds, particularly widgeon, teal and shovellers, to the San Joaquin Valley, and excellent shooting is reported from that area after December 16.

Several observers in the Wasco-Delano section of northern Kern County report more birds there this year than last. Similar reports emanate from the Lancaster-Palmdale region and from the Imperial Valley.

When figures from our neighboring States are available, we hope that the above encouraging reports will not indicate an undue concentration of ducks in our State, but will show that the duck crisis has passed and that the birds are commencing to regain their former numbers.—*James Moffitt, Division of Fish and Game, San Francisco, December 21, 1933.*

## DEER TAG RETURNS FOR 1933

Tabulation of deer tags places the number of bucks killed during the 1933 open deer season in California at 17,689. This is 691 less than the number legally taken in 1932. The decrease in 1932 over 1931 was 7425, over ten times the decrease of the current year.

Tags sold during 1933 totaled approximately 94,500 a decrease over last year of about 2200.

In noting the decrease in the number of successful hunters, the fact must be considered that in game districts 4 and 4¾, the season was five days shorter than normal this year, due to the fact that the law changing the season in this area to the period August 16 to September 15 did not become effective until August 21. Therefore, the deer season in districts 4 and 4¾ did not open until that date and, of course, had to close on September 15.

The 1933 tags returned show that there were 556 less deer bagged in San Bernardino, Los Angeles, Riverside, Orange, San Diego and Imperial counties than in 1932. Los Angeles County this year returned

571 tags against 819 last season; Riverside, 354 against 488; San Diego, 173 against 363; San Bernardino, 153 against 187; Orange, 36 against 87. Imperial County showed an increase of one, there being five deer killed there this year.

In Tulare County, there were 104 less deer killed than last year; El Dorado, 92; Glenn, 97; Siskiyou, 86; Trinity, 78; Placer, 77.

The following counties registered the greatest gains: Monterey with 104; Inyo, 116; Kern, 67; Plumas, 83; San Luis Obispo, 59 more deer killed in 1933 than in the previous season.

Two thousand fifty-seven hunters succeeded in getting their legal limit of two bucks.

The highest five counties, with Mendocino leading, as it has done for years, are: Mendocino, 1233; Modoc, 954; Plumas, 912; Fresno, 882; Humboldt, 838.

Other counties which turned in over 200 tags include: Siskiyou, 823; Sonoma, 745; Monterey, 631; Los Angeles, 576; Lassen, 551; Santa Barbara, 547; Shasta, 517; Lake, 481; San Luis Obispo, 436; Ventura, 354; Trinity, 340; Marin, 301; El Dorado, 368; Inyo, 296; Napa, 281; Kern, 263; Madera, 266; Colusa, 222; Butte, 205.

The following figures show the size of the deer killed during the past season:

Two-pointers, 7417; 3-pointers, 5298; 4-pointers, 2453; 5-pointers, 370; 6-pointers, 58; 8-, 9-, 10-, 11-, 12- and 14-pointers, 2021. There were ten 10-pointers, two 12-pointers and two 14-pointers reported killed this year.—*O. L. Warner, Division of Fish and Game, San Francisco, December 20, 1933.*

## DEER AS CARRIERS OF A CATTLE DISEASE

That deer may harbor a certain disease of cattle and possibly serve as a means of spreading this infection is the conclusion reached by two investigators, William H. Boynton and Gladys M. Woods of the Division of Veterinary Science, University of California.

This cattle disease, anaplasmosis, is considered by many to be due to a minute animal, called a protozoan, which appears as a dot in the red corpuscle of the blood. Because of its dot-like appearance, it has been named *Anaplasma,* a Greek term meaning "without protoplasm." This pin-point organism breaks up the red corpuscles of the blood, thereby causing anemia and jaundice, the principal symptoms of anaplasmosis or "*Anaplasma* infection."

Through the assistance of Ronald P. Harville, two deer, a mule buck and a southern black-tailed buck, were furnished the investigators by the Division of Fish and Game. Both were injected with blood containing the tiny organism, *Anaplasma,* but neither showed any symptoms of anaplasmosis, and although a few "dots" resembling *Anaplasma* were observed in the red corpuscles of the mule deer, they were too few to justify a positive diagnosis. However, when blood was taken from the southern black-tailed deer and injected into two cattle, one of them became infected and exhibited symptoms characteristic of anaplasmosis. Blood taken from the mule deer and inoculated into two cattle caused death in both cases, with symptoms and lesions typical of the disease. This proves that infection was present in these deer even though no definite sign of the disease appeared. Animals which

harbor infection without showing any evidence of it themselves are called "carriers."

Now that deer are proved to be "carriers" of anaplasmosis, how can they be a menace to cattle? The fact that anaplasmosis is a blood infection means that blood from a "carrier" animal must be introduced into a susceptible one in order to produce disease. By what means can the blood of deer be transmitted to the blood of cattle? A ready answer is: "insects." Previous discoveries of other investigators indicate that certain ticks and blood-sucking flies may transmit the disease through their bite. It is possible that these flies may attack deer; some of the ticks, at least, which were found on the two deer under investigation are among those proved to be transmitters of the disease. Since these ticks may first bite "carrier" deer, drop off, and crawl onto cattle grazing in the vicinity, biting them in turn, and thereby injecting the causative agent into the cattle, there is always a chance of spreading anaplasmosis in this manner—a possibility that should receive further attention.—*W. H. Boynton, Division of Veterinary Science, University of California, Berkeley, November 15, 1933.*

## ANOTHER "NEW" DEER FOR CALIFORNIA

I. McT. Cowan's work on Pacific coast deer was outlined in the October issue of CALIFORNIA FISH AND GAME (Vol. 19, p. 274), where his description of a new subspecies of mule deer from the Inyo region was mentioned.

The November, 1933, issue of the *Journal of Mammalogy* (Volume 14, pp. 326–327) contains the description of another "new" subspecies of mule deer from California. To this deer, Cowan has bestowed the name *Odocoileus hemionus fuliginatus*. The type specimen was secured on the Barona Ranch, 30 miles east of San Diego, October 8, 1928, and was taken by Webb Toms, who was a State Game Warden at that time.

Cowan provides the following range for the new subspecies: "From San Jacinto and Santa Rosa Mountains, Riverside County, and San Mateo Valley, San Diego County, California, southward at least to La Corona, Sierra San Pedro Martir, Lower California, Mexico." Thus the new subspecies inhabits San Diego and southern Riverside counties in California, and the northern portion of Baja California.

Cowan's paper provides no vernacular name for the new deer, so its seems advisable to call it the San Diego mule deer because its range is in the so-called San Diegan faunal district.

This new mule deer is evidently most closely related to the California mule deer (*Odocoileus hemionus californicus*) and is of the same size. The San Diego mule deer differs from the typical California mule chiefly in its much darker coloration, being, in fact, the darkest of all mule deer. This darkness is not a slight one, but is extremely noticeable, and it is remarkable that the fact was not observed long ago.

Cowan had 16 specimens of the San Diego mule deer available for his study, one of which, from the Santa Ana Mountains, Orange County, showed a close approach to the California mule deer, hence it is probable that the subspecies intergrade in that vicinity.—*James Moffitt, Division of Fish and Game, San Francisco, December 20, 1933.*

## DEATH OF BUCK DEER RESULT OF FIGHTING IN RUT

Many hunters believe that all buck deer live until they are shot and give little or no allowance for the number of deer that die each year from natural causes or accidents. That the latter factor is responsible for the death of a considerable number of our male deer annually is beyond question. Many types of fatal accidents may occur to deer.

For instance, this summer, Captain of Game Wardens S. R. Gilloon, of Mount Shasta, was called upon to autopsy a spike buck that was found in a dying condition near Volners, Shasta County. The supposition was that this deer was suffering from an infection known as *Bacillus necrophorus,* or "calf diphtheria." It was brought into Delta by a government truck where it died, and where Captain Gilloon later autopsied it. He found no indications of the above mentioned disease, but ascertained that the deer's stomach was ruptured, which, no doubt, accounted for its death. This accident could have occurred by the deer having been hit on the highway by an automobile, or by its having fallen off a cliff.

Another accident of a different character was brought to my attention during the past deer season. Some sportsmen of my acquaintance were hunting deer with dogs west of Boonville, in Mendocino County, on September 10, 1933. The dogs ran a three-point buck for some distance and then bayed it. One of the hunters approached the animal quite closely in an endeavor to account for its unusual behavior, for it is unknown for dogs to bay an unwounded buck. The animal presented all appearances of having been wounded, so the man killed it, and on approaching it, he noticed a deep wound in the thorax, or what is generally termed, the "sticking place." Skinning the animal later revealed that this wound was unquestionably caused by the animal running into a snag while attempting to escape from the dogs. Undoubtedly deer may so occasionally snag themselves when frightened from causes other than hunters.

Another type of accident that it appears may be more common than the lack of reports of same would indicate is the death of bucks caused by their fighting in the rutting season.

Game Warden J. W. Thornburg, Jackson, California, has kindly provided us with the following notes of his observations in this regard:

During the winter of 1931 to 1932, while stationed at Summit Camp, on the Salt Spring-Tiger Creek conduit of the Pacific Gas and Electric Company, in El Dorado County, I had unusual opportunities to observe the numbers of deer that were wintering in the vicinity.

One day in the latter part of November, 1931, I was driving up the road from Summit Camp to Bear River Intake and had taken several photographs of the many deer along the road. On rounding the turn near Beaver Creek, I was forced to apply my brakes so that all four wheels of the car locked in order to avoid having a head on collision with two beautiful four-point bucks that were battling in the road.

One of these deer leaped from the road to the upper bank, and after retreating for about 30 feet, stopped and turned around. The other animal ran a short distance up the road and then also went on up the upper bank. As soon as this last animal was above the bank, the first buck started after him with bowed neck, hair along the back and shoulders bristling, and they resumed their battle. I had a front row seat for the show and watched it from my automobile at close range. What an opportunity I lost for photographs having used all my film previous to finding these deer.

I was amazed at the cleverness used by these animals in keeping themselves head on to one another in order to prevent one from getting in a broadside blow. Time after time, each buck was down on its knees, and like a flash he would be back on all fours. While down in this manner, his adversary would try to maneuver around in time to get a broadside blow at the other. There seemed to be no choice in size between these two bucks, but the one that left the road first seemed to be the stronger of the two.

I left these deer fighting and returned to meet Game Warden Vernon Sutton whom I told about the incident. We then returned to the spot where the deer had been fighting and walked about a hundred yards up the hill where we saw the two bucks, one of which was with a number of does, and the other about 100 yards to one side where he would watch for a few minutes, and then start after the bunch of does. The other buck would let him come within 50 yards of the females when he would start to meet him, at which the outsider would turn back and quite evidently admit his defeat.

Two days later, at only a short distance from the location of this battle, I found a dead two-year old buck, well scarred and with a large hole punctured just behind his ribs. Close examination of his carcass showed many scars of the sharp points of antlers. There was a scar about three inches in length which ran deeper

Fig 17. Game Warden Welch and the buck that was severely wounded in a fight with another. Photographed at Kernville, Cal., November 29, 1933.

toward the puncture. On opening the carcass, I found that the intestines were punctured which apparently caused the animal's death.

On December 14, 1931, while patrolling the flume, some distance above Bear River, I found at an underpass, a large four-point buck that had evidently been in a terrific battle. He had deep scars all over his body, and was so crippled in the back that his hind legs were useless. He had dragged himself down the hill some distance from above the flume and was so weak he was unable to go any further. He had evidently been where I found him for a couple of days. On back-tracking this animal, I found the snow much torn up for some distance and all the evidences of a terrific battle.

The finding of these two deer that had unquestionably died of injuries sustained in fighting during the rut, seems to be proof enough to show that there are a considerable number of male deer that lose their lives each year from this cause. I believe that there are many more male deer killed by being gored, or by being otherwise injured in fighting during the rutting season than are killed by locked horns or antlers, cases of which have been reported. My reason for this contention is the fact that the antlers must be very nearly the same size, spread and shape in both animals in order that they may lock.

Game Warden Roswell C. Welch, Kernville, California, provides the following report of another instance of buck injury through fighting in the rut.

On Wednesday, November 29, 1933, I received a report that an injured deer had been found near Havilah by some C. C. C. men. Upon my arrival at the camp, the superintendent sent a couple of lads with me to point out the place where the deer was.

I found the deer to be a very large buck which had apparently been in a battle with another of his kind and had come out second best. One antler had broken off inside of the skull, and hung useless. There were two punctures in his side which had pierced his lungs. His body was covered with cuts and gashes. While still alive, it was plain he would soon die so we mercifully dispatched him and dressed the carcass in an attempt to save the meat.

Apparently, there had been a terrific encounter, as brush and small trees had been trampled and the ground had been torn up over a considerable area. There was all the evidence of a battle royal. This buck was extraordinarily large for this vicinity; his antlers had five distinct points on each side and several minor points which some would have counted, but I considered him a fine five-point buck.

It would have been interesting to have seen what this buck's adversary looked like, and I am wondering how he fared in the encounter, not to mention my curiosity as to his size.

The deer in this vicinity are at present right in the middle of the rut, which was the cause of this fight. Quite often, on patrol, I see evidence of battles in the torn up ground, and sometimes I see a couple of bucks fighting, but usually these fights are of short duration. One would be fortunate indeed to have been able to have witnessed this fight.

*—James Moffitt, Division of Fish and Game, San Francisco, December 4, 1933.*

## DEER FENCING LAW REPEALED

Chapter 732, Statutes of 1933, repealed sections 162 to 165 inclusive of the Agricultural Code. These sections included the so-called "Deer Fencing Law" which was enacted by the 1931 Legislature, and provided for State contributions toward the erection of deer proof fences to protect crops that were endangered by deer.

The section providing for the issuance of revocable permits by the Fish and Game Commission for the killing of deer upon evidence of their destruction of crops was not altered by the 1933 Legislature, but was merely reworded and is now section 1293 of the Fish and Game Code.—*James Moffitt, Division of Fish and Game, San Francisco, December 21, 1933.*

## DEER HUNTING SUCCESS IN ANGELES NATIONAL FOREST

W. L. Sears, Acting Supervisor of the Angeles National Forest, has provided some interesting statistics relative to the number of hunters, cars and success of hunters entering the Saugus District of that national forest during the first three days of the 1933 deer season as compared with the previous year. This information was compiled by Ranger M. W. Durham of the Saugus District and is printed here through the kindness and permisison of J. W. Nelson, Assistant Regional Forester, U. S. Forest Service.

Sears remarks that "there is a reduction in numbers [of hunters] under that of last year which is due, most likely, to the change in the dates of the opening of the season, there being two seasons in adjoining

districts now open at the same time, which gives us a better distribution of hunters."

The following is a compilation of Ranger Durham's figures:

| | 1933 | 1932 | Loss or gain |
|---|---|---|---|
| Total number of automobiles | 782 | 1,097 | 315 loss |
| Total number of hunters | 822 | 1,531 | 709 loss |
| Total number of persons | 2,078 | 2,531 | 453 loss |
| Total deer killed, first 3 days of season | 105 | 85 | 20 gain |

Thus, in 1933, 822 hunters killed 20 more deer than did 1531 hunters in the same area in the previous season. In 1932, only one hunter out of every 18 was successful in this area while the following year nearly one hunter out of 8 bagged his buck.—*James Moffitt, Division of Fish and Game, San Francisco, December 21, 1933.*

## SHELDON'S DEER OF CALIFORNIA

A paper covered booklet of 72 pages entitled "The Deer of California," by H. H. Sheldon, former Field Naturalist with the United States Bureau of Biological Survey, was issued as Occasional Paper No. 3 of the Santa Barbara Museum of Natural History, November 1, 1933. Copies of this booklet may be obtained from that museum at $1.50 each.

This publication is printed on coated paper which provides excellent reproductions of the many illustrations that it contains.

The introduction informs the reader that this treatise is in answer to numerous discussions, stories, news items and arguments pertaining to the deer of California. Nevertheless, Sheldon states that considerable field work and comparative study is yet required to complete the final classification of California deer. The author notes that just as a knowledge of football increases the pleasure of watching the game, so does a knowledge of the game laws, characteristics and habits of the quarry add zest to the hunt.

He states that California harbors more varieties of deer than are found in any other State in the Union, and that our deer hold their own numerically by reason of the natural protection afforded by wilderness haunts, the reduction of mountain lions, and wise game laws protecting does and limiting the kill of bucks, and the establishment of numerous game refuges.

Following the brief introduction is a colored map showing the ranges of the kinds of deer occupying California, and following this map, the various species are described. These include the Rocky Mountain mule deer, California mule deer, burro deer, Columbian black-tailed deer, southern black-tailed deer and western white-tailed deer.

Sheldon's distributional map is a great improvement over Hall's similar one (see CALIFORNIA FISH AND GAME, vol. 13, 1927, p. 57). The ranges that the present author provides for California deer coincide fairly well with the ones outlined in Grinnell's recent work (see p. 87, this issue), but Sheldon more definitely defines the area along the western flank of the southern Sierra Nevada in which the Columbian black-tailed and California mule deer evidently meet and intergrade. His distributional map shows this to be slightly north of the Yosemite

region, which agrees with information at our disposal, except in that the area inhabited by deer of both species is probably larger than Sheldon's map indicates, for we have records of "good" black-tailed deer from the Yosemite Valley and Joseph Dixon has recently told us that he has seen specimens of true California mule deer from the western flank of the Sierras as far north as east of Sacramento. Sheldon's map indicates that the California mule deer ranges east across the southern Sierra in Kern, Tulare and Fresno counties into Inyo County. This treatment must now be modified in view of Cowan's findings and ascription of a new mule deer to the Inyo region (see CALIFORNIA FISH AND GAME, vol. 19, 1933, p. 274), so the California mule probably does not range east of the Sierra crest here or at any other point.

Sheldon's description of the California mule deer states that "the upper surface of the tail is centered with the dark median line of black following its length to the tip, and is edged with white" (p. 15), he also states that the white rump patch is much restricted as compared with that of the Rocky Mountain mule deer. This description agrees with Caton's original one of the California mule deer, the type of which was taken near Gaviota Pass in Santa Barbara County, and apparently the tails of all mule deer from this region have the dark dorsal median line. On the other hand, many examples of California mule deer from the western flank of the Sierra Nevada from the Yosemite region to Kern County and also, we understand, from the San Gabriel and San Bernardino mountains of Southern California, have pure white tails except for their black tips, lacking the dark dorsal stripe. Sheldon does not mention this fact in his text, but in the caption for the illustration of such a white-tailed mule deer, photographed in Sequoia Park, which appears on page 22 of his work, he draws attention to this fact and states that these deer come into this region from the Nevada side and meet the range of the California mule deer here. On page 25, he illustrates another deer from the same region which has a very narrow black dorsal tail stripe and avers that this is the result of intergradation between Rocky Mountain and California mule deer, adding that the dark median tail line is not sufficiently prominent to classify this deer as a typical California mule deer. The latter statement is doubtless true, but the reviewer can find nothing in Sheldon's work to support his statement that Rocky Mountain (now correctly Inyo) mule deer come west into this region and interbreed with the California form. We consider that California mule deer are variable as to this character and that in the center of this form's range more animals have white than black-lined dorsal tail surfaces. The preponderance of black-striped-tailed deer in the northern extremities of this form's range, southern San Luis Obispo and Santa Barbara counties on the west, Tuolumne and Mariposa counties on the east, *may* be the result of intergradation of this species with black-tailed deer. If such is proven to be the case, then the type of *californicus* can not be regarded as typical of the race if such a statement can be made, but it represents a borderline specimen indicative of intergradation with black-tailed deer. Perhaps a thorough study of this form will show that typical examples from the center of its range have white tails except for black tips. This hypothesis is simply pro-

vided as another explanation for the tail variability in this form, for the reviewer is loath to accept the theory that either Rocky Mountain or Inyo mule deer migrate west in fall to interbreed with California mule deer. It has been his experience that with the possible exception of very rare instances in Plumas, Lassen or Tehama counties, all Rocky Mountain mule deer winter east of the Cascade-Sierra crests.

Sheldon's descriptions of deer are accompanied by drawings of the ears of the various species, their hoofs and metatarsal glands, and the tails of the different species.

Next the author discusses the antlers of our deer, and among the illustrations there is one of a large set of antlers from a doe. Sheldon admits that the number of points on the antlers does not always indicate the deer's age, but he states that in general this fact is true. We believe that this statement might more properly be restricted to mule deer, for black-tailed deer seem to bear forked horn antlers more often than those with three or four points to the side. In this section, the author presents some X-ray photographs of the lower jaws of deer showing the teeth by which the animal's age can be ascertained with fair accuracy.

A short section on the glands of deer and one on their mating habits follow.

Next the author discusses some methods of deer hunting in which he brings out some interesting points in regard to the animal's habits. There follows an excellent section illustrating and describing the methods of skinning a deer and of preserving the head for a trophy. The uses of deer are then discussed and here an excellent method for preparing jerky is described.

A short section on predatory animals that prey upon deer follows and next a very brief discussion of the parasites that are harbored by deer.

The next section, entitled "The Pack Trip and How to Throw a Diamond Hitch," will probably be of most interest to campers, for the description and excellent illustrations describe better than we have seen attempted anywhere the method of throwing this excellent pack hitch.

The volume closes with a list of references to published literature on the various species of deer and predatory animals treated in this work.

We believe that Sheldon has prepared a most interesting and useful booklet that will be of entertainment and value to all California deer hunters, whom we urge to study it in its original form.—*James Moffitt, Division of Fish and Game, San Francisco, December 29, 1933.*

## GRINNELL'S REVIEW OF CALIFORNIA MAMMAL FAUNA

A publication entitled, "Review of the Recent Mammal Fauna of California," * by Professor Joseph Grinnell, Director of the University of California Museum of Vertebrate Zoology, was issued September 26, 1933. This paper consists of a short introduction and an account of all the mammalian species and subspecies known to occur, or to have occurred within the confines of this State up to the time of publication.

* Univ. Calif. Publ. Zool., Vol. 40, pp. 71-235, September 26, 1933. Copies may be purchased from the University Press, Berkeley, Calif. Price $1.25.

The introduction advises that the first attempt to catalog California mammals was made by the pioneer California naturalist, Dr. J. G. Cooper, in 1868 when he listed 115 kinds of mammals for the State. Frank Stephens published in 1906 his "California Mammals" which listed 276 kinds. In 1913, Grinnell published "A Distributional List of the Mammals of California" (Proc. Calif. Acad. Sci., Vol. 3, pp. 265–390) which listed 337 species and subspecies. The same author in 1923 published a nominal list of 417 species and subspecies of mammals for California (Univ. Calif. Publ. Zool., Vol. 21, pp. 313–324). The author states that the present Review is in no sense to be considered more "final" than any of the similar preceding contributions and it may therefore be considered in the nature of a progress report upon the classification of mammals in the State.

The present Review lists 460 species and subspecies of mammals for California. The account of the species commences with the introduced Virginia opossum. The treatment of each species is as follows: First, its order, family and scientific name are provided, next vernacular name, then reference for the animal's original description. Type locality is next provided and then vernacular synonyms. The mammal's range in the State is then provided in some detail, including its altitudinal range and the life zones it inhabits.

Following the account of the opossum, moles, shrews and bats are treated. Next, two kinds of black bear and seven kinds of grizzly bear are ascribed to the State. The latter are all now thought to be extinct and the last positive record of a grizzly bear in California was for one shot at Horse Corral Meadows, Tulare County, in August, 1922. Fur bearers are next listed as follows: coons (3 kinds), ring-tailed cats (3), marten (2), fisher, weasels (6), mink (2), wolverine, river otter (2), sea otter, spotted skunk (7), striped skunk (4), badger (2), red fox, kit fox (3), gray fox (3), Island foxes (6), mountain, valley and desert coyotes, and plains wolf. The last wolf taken in California was secured in Lassen County, in 1924.

The following cats are ascribed to California: the Mexican jaguar, which historical evidence indicates once occurred as far north as the region between Monterey and San Francisco, two kinds of mountain lion and four wild cats.

We learn from this review that California waters are, or were once, inhabited by two kinds of sea lions, the Pribilof and Guadalupe fur seals, the California harbor seal and the elephant seal.

Grinnell presents a novel, but doubtless logical, innovation to lists of mammal fauna on pages 118 and 119 of the report when he lists the subspecies of man inhabitating the State. Four subspecies are recognized, the Causasian, American Indian, Mongolian and Negro. The author, in his account of the status of the Caucasian, provides the following, almost facetious, statement: "Nonnative, but now thoroughly established and spreading and increasing, chiefly by immigration, at an amazing rate. First came, as voluntary pioneers, in year 1769, settling in a few coastal localities. Increased but slowly until about 1850 when great numbers arrived from many parts of the world. Disposition aggressive and tendencies destructive, especially of natural habitats, as result of which much of native mammal life, including the endemic race of man (*H. s. americanus*), has been reduced; * * *"

The introduction advises that man is included in the list because he came into the State voluntarily. Domestic mammals are not included because man brought them in. On this basis, wild horses, which entered eastern California voluntarily, should be included and the Virginia opossum should be excluded from the list because man introduced it.

The order RODENTIA follows the order PRIMATES in which man is classified. Among the order RODENTIA, marmots, ground squirrels, chipmunks, chickarees, gray squirrels, flying squirrels, gophers, mice and rats are treated. Sportsmen will marvel at the fact that no less than 37 different kinds of gophers are ascribed to California, 31 kinds of pocket mice and 34 kinds of kangaroo rats.

The beaver and muskrat are members of the order RODENTIA and three kinds of beaver are ascribed to California, the golden beaver which inhabits the Sacramento and San Joaquin valleys, the Shasta beaver of the Pit River basin of northeastern California, and the Sonora beaver of the Colorado River and Imperial Valley. Two subspecies of muskrat inhabit California, the Nevada muskrat, which is native to the larger streams and lakes tributary to the Great Basin along the extreme eastern border of the State from Eagle Lake south to Mono County. Curiously, this rodent appears never to have been native in the basin of the Pit River. The Colorado River muskrat is indigenous to that river and since 1911 has spread into irrigation canals throughout the Imperial Valley.

The porcupine and coneys are included in the order RODENTIA. The following rabbits are ascribed to California: two kinds of white-tailed jack rabbit, or Sierra hare, two varieties of snowshoe rabbit, five kinds of jack rabbits, six cottontails, four brush rabbits and the Idaho pigmy rabbit of the Great Basin region.

Sportsmen will no doubt take greatest interest in the classification of the elk, deer, antelope, bison and mountain sheep which are members of the order ARTIODACTYLA. Two elk, the Roosevelt and dwarf, or tule, elk are native to this State. The former ranged from Marin County north through the coastal belt to the Oregon line and at the present day exists only in small numbers in Del Norte and northern Humboldt counties. The dwarf elk formerly occupied nearly the entire San Joaquin and Sacramento valleys and occurred in the southern coast ranges in San Luis Obispo, Santa Barbara, Monterey and Santa Clara counties. It has now been reduced to a herd of approximately 140 animals on the State elk refuge near Buttonwillow, Kern County, and several smaller herds that have been transplanted from this point. The eastern, or Canada, elk has been planted in California, and a small herd appears to be thriving in Shasta County and a lesser number of animals in Lassen County.

Two subspecies of black-tailed deer occur in California. The Columbian black-tailed deer ranges south from the Oregon line, from the coast east to the Sacramento Valley, south to the north side of San Francisco Bay. Grinnell states that this subspecies also occurs southeast along the Sierra to both sides of Mt. Shasta and Lassen Peak, at least south to the lower Feather River region on the west flank of the Sierra Nevada. The reviewer believes that more intensive study of the deer population of the western flank of the Sierra will show that

this deer occurs south at least into the Yosemite region. The southern black-tailed deer occupies the coast ranges from the south side of San Francisco Bay, south through Monterey and San Benito counties into northwestern San Luis Obispo County.

Four subspecies of mule deer are ascribed to California. The Rocky Mountain mule deer Grinnell properly ascribes to the northeastern corner of the State, but we think that his statement that this deer's range continues south through the main Sierra Nevada to Tuolumne County will not be borne out when more evidence is secured. According to our observations, the typical Rocky Mountain mule deer is a rather rare animal south of the vicinity of Truckee. South of that point, a few bucks appear to migrate each spring from Nevada westward toward the summits of the Sierra Nevada, and in the fall again return to the eastern deserts to winter.

The Inyo mule deer (see CALIFORNIA FISH AND GAME, Vol. 19, 1933, p. 274) occupies the eastern slope of the southern Sierra Nevada in Inyo and probably Mono counties.

Grinnell states that the range of a third subspecies, the California mule deer, extends west from the western margins of the Colorado and Mojave deserts, northwest from the Mexican line in San Diego County, through Santa Barbara County into San Luis Obispo County, and northeasterly from Ventura County through the Tehachapi and Piute mountains at least to the vicinity of Walker Pass. He states that this race probably occurs north along the western flank of the southern Sierra Nevada, and we feel quite certain that it is this subspecies that occurs northward in this region into the Yosemite region, in which region this deer seems to interbreed with the Columbian black-tailed deer, and probably even considerably further northward.

Reference to page 81 in this issue of CALIFORNIA FISH AND GAME will indicate that another subspecies of mule deer has been named from California and this new deer, the San Diego mule deer, occupies part of the southern range ascribed to the California mule deer above.

The burro deer is another subspecies of mule deer which Grinnell states occupies the Colorado desert region, north along the Colorado River, through the Chocolate and Chuckawalla mountains to the Granite Mountains, and, formerly at least, from the Mexican line south of Salton Sea through the Imperial Valley into central Riverside County.

Grinnell ascribes the western white-tailed deer to California on the basis of a very definite record of a buck taken in January, 1922, on Observation Peak, in eastern Lassen County. He also lists another, but not quite satisfactory, record for this deer from Topaz, Mono County, in 1930 (see McLean, CALIFORNIA FISH AND GAME, Vol. 17, 1931, p. 342).

Under the range of the prong-horn antelope, Grinnell advises that this species apparently occurred nearly throughout the State south and east of the humid coast belt and below the main timber line. Considerable numbers of antelope still exist in several separate bands in Modoc, Siskiyou and eastern Lassen counties. A small herd still occupies the western side of the San Joaquin Valley, four individuals are known to yet exist in Antelope Valley, Los Angeles County (see page 91, this issue), a small herd is said to exist in northwestern San Bernardino County, and a few individuals on the Colorado Desert

near the Mexican line in eastern San Diego, or western Imperial counties.

Many readers will doubtless be surprised to learn that Grinnell states that the Oregon bison without any doubt formerly occurred in the northeastern corner of California, where it apparently traversed the semidesert valleys of eastern Modoc and Lassen counties.

Four varieties of bighorn, or mountain sheep, are ascribed to California. The lava beds bighorn formerly ranged this region in the extreme northeastern portion of the State, where it is now thought to be extinct as the last individuals are said to have died in eastern Siskiyou County in the winter of 1913. The Sierra Nevada bighorn still occupies the higher portion of the southern Sierra from the vicinity of Mammoth Pass, Mono County, south to the vicinity of Olancha Peak, in Tulare County. Under this form, Grinnell notes that ascriptions of the mountain goat to this region of the Sierra Nevada are apparently erroneous and are now thought to have been based on the presence of bighorns. This author states that the range of the desert bighorn is in general the mountain ranges of the Mojave Desert and Inyo regions, north to the lower slopes of the White Mountains, Mono County, south to the Chocolate Mountains and west to the San Bernardino and San Gabriel mountains.

The fourth variety of mountain sheep treated in this Review is the Lower California bighorn, which occupies the mountains bordering the west side of the Colorado Desert from the Mexican line, northwest to the lower northern slopes of the San Jacinto Mountains, in San Gorgonio Pass. Considerable discussion has recently arisen regarding the number of sheep of this subspecies now inhabitating the State. Investigations by M. Hall McAllister, Edmund C. Jaeger and State game wardens seem to agree in that there are between two and three hundred of these animals now ranging in Riverside and San Diego counties.

Grinnell's account of mammalian species ends with the aquatic mammals, of which he lists nine whales, four porpoises, the dolphin, cowfish, killer, grampus and blackfish.

The paper closes with a very complete index.—*James Moffitt, Division of Fish and Game, San Francisco, December 22, 1933.*

## THE PRONGHORN ANTELOPE IN LOS ANGELES COUNTY

This is a supplementary note to the account of the antelope of Antelope Valley, Los Angeles County, in the July, 1932, issue of California Fish and Game (Vol. 18, p. 258). The antelope herd at that time was composed of seven individuals—one male and six females.

On December 3 of this year, 1933, I again found the herd in the rolling low hills of Antelope Valley five miles north of Sandberg and counted four individuals, all females. I followed the herd in my car across country for two miles and got as close as one hundred and fifty yards on several occasions by approaching slowly. At this distance field glasses brought them into good view for study. My partner tried to attract them by waving a red bandana in the breeze on the end of a stick, but though their curiosity was aroused to the extent of their standing still to look, they would not come toward us. They could probably see all they wanted to at one hundred and fifty yards.

Various ranchers of this region have seen these animals recently and they too have seen only four in the herd. Inasmuch as it would be improbable that a herd as small as seven would split, it appears that three individuals, including the one male, have met their deaths. At this rate of depletion and with no male in the herd, antelope in Antelope Valley will shortly disappear unless conservation forces can introduce more antelope to bolster up this rapidly disappearing herd.—*Harvey T. Anderson, Jr., Junior Assistant Fire and Game Warden, County of Los Angeles, December 7, 1933.*

Fig. 18. M. E. Beatty and the mountain sheep "mummy" *in situ* with shells replaced on horns. Photo courtesy National Park Service.

## MOUNTAIN SHEEP FOUND MUMMIFIED IN YOSEMITE GLACIER

The Sierra Nevada bighorn, or mountain sheep (*Ovis canadensis sierrae*), has been rated as extinct in the Yosemite region for at least fifty years. That these animals once inhabited this area in fair number, is indicated by the fact that horns and fragments of skulls are often found by hikers in our high country.

On October 4, 1933, Park Naturalist C. A. Harwell and I were ascending the eastern slope of Lyell Glacier on our third annual

glacier measuring expedition. We paused at this point to regain our breath when I chanced to glance over to my right, where, to my great astonishment, I saw what appeared to be, at first glance, a living mountain sheep staring at us across the ice. I called Harwell's attention to this apparition when we immediately realized that the animal lacked both hair and horns, and in fact was a mummified specimen.

We discovered that the life-like position was due to the fact that the animal was supported in an upright position by a pedestal of ice that the body had shielded and thus prevented the sun from melting. The warm summer had melted the ice of the glacier sufficiently to expose all of the animal, with the exception of two of the feet.

The ram seemed to be in a perfect state of preservation, the flesh dried in the manner of "jerky"; the skin dry and taut as a drum's head. The missing horn shells were found with little difficulty in the moraine below, one at a distance of 30 feet and the other about 75 feet from the specimen.

A closer examination showed that the neck of the animal was broken, but none of the leg bones or other bones was broken. One front leg had come apart at the knee joint. We found the missing part intact near one of the horns, and we realized that we had discovered the first complete skeleton of a Sierra mountain sheep for the region.

After photographing the ram, we transported it, with some difficulty, to our base camp at Lyell Fork and ultimately back to Yosemite Museum where it is now being prepared for exhibition.

In attempting to piece together the story of the animal, it was found necessary to have more data, so a return trip was made with steel stakes and surveying equipment to measure distances and rate of flow of the glacier. We found that the glacier moved only one inch during a four-day period, or at the rate of seven and one-half feet per year. The ram was found 1936 feet from the head of the glacier. Now, assuming that the animal fed or was caught in a slide while feeding on the crest of Mount Lyell and was buried in the bergschrund, it would take close to 250 years for the glacier to carry the sheep to the spot where found. This great length of time is borne out by the aged appearance of the horns and the dehydrated flesh.

The animal shows a broken neck, probably sustained at the time of death, and a concave body, probably the result of varying ice pressure.

The only hair found on the body was directly back of the ears and in the folds of the neck.

This mountain sheep is a mature male specimen measuring 55 inches in length and 33 inches in height.

The circumference of each horn at the base is 12½ inches, and the length of the horns along outer curve 27 inches. Judging from the growth rings on the horns, the animal was a 7-year-old.

The weight, as is, is 45 pounds.

National Park officials feel that this find is one of the most important discoveries of the year in the whole park system.—*M. E. Beatty, Assistant Park Naturalist, Yosemite, December 18, 1933.*

## HERON CHOKED TO DEATH BY CATFISH

The accompanying photograph is of a black-crowned night heron (*Nycticorax nycticorax hoactli*) which was found dead at Hemet Lake, Riverside County, May 3, 1932. It had evidently choked itself to death in an unsuccessful attempt to swallow an eight-inch catfish, part of which can be seen protruding from the bird's mouth in the photo (Fig. 19).—*J. H. Gyger, Game Warden, Perris, June 15, 1932.*

Fig. 19. Night heron choked to death by catfish, Hemet Lake, Cal. Photo by J. H. Gyger.

## STATEMENT OF INCOME

**For the Period July 1, 1933, to September 30, 1933, of the Eighty-fifth Fiscal Year**

| License sales | Detail | Total |
|---|---|---|
| Departmental income: | | |
| Angling licenses, 1932 | $5,475 00 | |
| Angling licenses, 1933 | 80,671 50 | |
| Commercial Hunting Club licenses, 1933-34 | 125 00 | |
| Commercial Hunting Club Operators licenses, 1933-34 | 20 00 | |
| Deer tags, 1932 | 1,143 25 | |
| Deer tags, 1933 | 21,976 00 | |
| Fish Breeders' licenses, 1933 | 15 00 | |
| Fish Importers' licenses, 1933 | 5 00 | |
| Game Breeders' licenses, 1933 | 85 00 | |
| Hunting licenses, 1932-33 | 8,181 18 | |
| Hunting licenses, 1933-34 | 59,633 50 | |
| Market Fishermen's licenses, 1933-34 | 16,620 00 | |
| Trapping licenses, 1933-34 | 20 00 | |
| Wholesale Fish Packers' and Shell Fish Dealers' licenses, 1933-34 | 680 00 | |
| Total license sales | | $194,650 43 |
| Other income: | | |
| Contributions from importers | $15 00 | |
| Court fines | 6,866 74 | |
| Fish packers' tax | 21,413 12 | |
| Fish tag sales | 100 50 | |
| Game tag sales | 42 27 | |
| Interest on bank balances | 1,220 61 | |
| Income from Department of Agriculture Fund, Chap. 825-33 | 40,000 00 | |
| Miscellaneous sales | 64 75 | |
| Publication sales | 140 15 | |
| Dividends California National Bank, 20 per cent | 7,418 03 | |
| Total other income | | 77,281 17 |
| Total departmental income—current year | | $271,931 60 |

## STATEMENT OF EXPENDITURES

**For the Period July 1, 1933, to September 30, 1933, of the Eighty-fifth Fiscal Year**

| Function | Salaries and wages | Materials and supplies | Service and expense | Property and equipment | Total |
|---|---|---|---|---|---|
| Administration: | | | | | |
| Executive | $2,089 98 | | | | $2,089 98 |
| Clerical and office | 1,380 00 | $110 47 | $29 06 | | 1,519 53 |
| Automobile | | 69 93 | 19 10 | | 89 03 |
| Traveling | | | 301 16 | | 301 16 |
| Postage | | | 1,298 26 | | 1,298 26 |
| Telephone and telegraph | | | 623 25 | | 623 25 |
| Freight, cartage and express | | | 156 13 | | 156 13 |
| Rent | | | 3,389 96 | | 3,389 96 |
| Accident and death claims | | | 284 73 | | 284 73 |
| Accounting pro rata | 1,125 00 | | | | 1,125 00 |
| Legal | 493 56 | | 43 56 | $28 40 | 565 52 |
| Total administration | $5,088 54 | $180 40 | $6,145 21 | $28 40 | $11,442 55 |
| Bureau education and research: | | | | | |
| Chief | $975 00 | | | | $975 00 |
| Clerical and office | 480 00 | $25 81 | $8 77 | | 514 58 |
| Automobiles | | 107 81 | 26 95 | | 134 76 |
| Traveling | | | 777 53 | | 777 53 |
| Postage | | | 14 80 | | 14 80 |
| Photography | | | 6 81 | | 6 81 |
| Freight, cartage and express | | | 1 23 | | 1 23 |
| Library | 270 00 | 3 48 | 6 00 | $16 20 | 295 68 |
| Research | 900 00 | 24 43 | | 10 50 | 934 93 |
| Publicity | 750 00 | | 9 00 | | 759 00 |
| Total bureau education and research | $3,375 00 | $161 53 | $851 09 | $26 70 | $4,414 32 |
| Bureau patrol and law enforcement: | | | | | |
| Chief and assistants | $2,775 00 | | | | $2,775 00 |
| Clerical and office | 795 00 | $9 79 | | | 804 79 |
| Automobiles | | 2,116 27 | $1,722 81 | | 3,839 08 |
| Traveling | | | 11,707 06 | | 11,707 06 |
| Postage | | | 137 34 | | 137 34 |
| Telephone and telegraph | | | 340 15 | | 340 15 |
| Freight, cartage and express | | | 5 74 | | 5 74 |
| Rent | | | 83 00 | | 83 00 |
| Captains and wardens | 43,935 00 | 360 63 | 316 55 | $11 60 | 44,623 78 |
| Launches | | 288 09 | 161 96 | | 450 05 |
| Fish planting | 1,155 00 | 338 61 | 18 00 | | 1,511 61 |
| Cooks | 375 00 | | | | 375 00 |
| Game refuge guard | 90 00 | | | | 90 00 |
| Commercial fisheries patrol: | | | | | |
| Chief and assistants | 690 00 | | | | 690 00 |
| Captains and wardens | 3,465 50 | 50 | 6 16 | | 3,472 16 |
| Launches | 2,518 55 | 561 27 | 56 96 | 6 00 | 3,142 78 |
| Fish cannery inspectors—seasonal | 1,130 33 | | | | 1,130 33 |
| Traveling | | | 1,181 90 | | 1,181 90 |
| Rent | | | 174 00 | | 174 00 |
| Automobiles | | 27 53 | 58 47 | | 86 00 |
| Temporary help | 17 00 | | | | 17 00 |
| Total bureau patrol and law enforcement | $56,946 38 | $3,702 69 | $15,970 10 | $17 60 | $76,636 77 |
| Bureau commercial fisheries: | | | | | |
| Chief and assistants | $3,405 00 | | | | $3,405 00 |
| Clerical and office | 2,396 34 | $1 42 | $1 50 | | 2,399 26 |
| Automobiles | | 43 80 | 28 21 | | 72 01 |
| Traveling | | | 1,294 62 | | 1,294 62 |
| Telephone and telegraph | | | 114 55 | | 114 55 |
| Freight, cartage and express | | | 5 79 | | 5 79 |
| Rent | | | 24 19 | | 24 19 |
| Heat, light, water and power | | | 44 81 | | 44 81 |
| Research | 570 00 | 12 17 | | | 582 17 |
| Laboratory | 5,504 66 | 53 50 | 118 31 | $20 26 | 5,696 73 |
| Statistics | | 21 94 | 504 00 | 12 42 | 538 36 |
| Total bureau commercial fisheries | $11,876 00 | $132 83 | $2,135 98 | $32 68 | $14,177 49 |

## STATEMENT OF EXPENDITURES—Continued

### For the Period July 1, 1933, to September 30, 1933, of the Eighty-fifth Fiscal Year

| Function | Salaries and wages | Materials and supplies | Service and expense | Property and equipment | Total |
|---|---|---|---|---|---|
| Bureau fish culture: | | | | | |
| Chief and assistants | $1,740 00 | | $42 00 | | $1,782 00 |
| Clerical and office | 1,020 00 | | 1 50 | | 1,021 50 |
| Automobiles | | $1,145 36 | 327 08 | | 1,472 44 |
| Traveling | | | 2,953 18 | | 2,953 18 |
| Postage | | | 44 00 | | 44 00 |
| Telephone and telegraph | | | 290 82 | | 290 82 |
| Freight, cartage and express | | | 60 61 | | 60 61 |
| Rent | | | 338 50 | | 338 50 |
| Heat, light and power | | | 305 55 | | 305 55 |
| Hatcheries | 27,155 46 | 14,329 69 | 469 52 | $45 21 | 41,999 88 |
| Special field investigations | | | | 1 65 | 1 65 |
| Fish cars | 885 00 | 223 49 | 60 45 | | 1,168 94 |
| Blue printing | | | 1 52 | | 1 52 |
| Cooperative research | 795 00 | 98 14 | 633 26 | | 1,526 40 |
| Temporary help | 161 00 | | | | 161 00 |
| Fish hatchery assistant—seasonal | 8,365 76 | | | | 8,365 76 |
| Hydraulic engineering | 600 00 | | 263 05 | 29 21 | 892 26 |
| Special field | 1,834 98 | | | | 1,834 98 |
| Total bureau fish culture | $42,557 20 | $15,796 68 | $5,791 04 | $76 07 | $64,220 99 |
| Bureau game propagation: | | | | | |
| Chief and assistants | $1,365 00 | | | | $1,365 00 |
| Automobiles | | $127 72 | $118 98 | | 246 70 |
| Traveling | | | 525 78 | | 525 78 |
| Postage | | | 27 01 | | 27 01 |
| Telephone and telegraph | | | 28 58 | | 28 58 |
| Freight, cartage and express | | | 17 96 | | 17 96 |
| Heat, light and power | | | 480 45 | | 480 45 |
| Maintenance | 3,164 71 | 1,344 13 | 78 81 | | 4,587 65 |
| Temporary help | 243 43 | | | | 243 43 |
| Quail trapping and expansion of quail program | 1,200 00 | 95 65 | 390 79 | | 1,686 44 |
| Total bureau game propagation | $5,973 14 | $1,567 50 | $1,668 36 | | $9,209 00 |
| Bureau fish rescue: | | | | | |
| Chief and assistants | $1,200 00 | | $13 09 | | $1,213 09 |
| Traveling | | | 134 76 | | 134 76 |
| Temporary help | 13 00 | | | | 13 00 |
| Heavy truck service | | | 190 90 | | 190 90 |
| Total bureau fish rescue | $1,213 00 | | $338 75 | | $1,551 75 |
| Bureau game refuges: | | | | | |
| Chief and assistants | $2,124 99 | | | | $2,124 99 |
| Clerical and office | 480 00 | | $12 50 | | 492 50 |
| Automobiles | | $27 78 | 44 58 | | 72 36 |
| Traveling | | | 868 78 | | 868 78 |
| Laborers | 900 00 | | | | 900 00 |
| Lion hunters | 1,177 00 | | | | 1,177 00 |
| Refuge posting | 180 00 | | | | 180 00 |
| Predatory animal control | | | 1,110 00 | | 1,110 00 |
| Refuge maintenance | 1,140 00 | 391 47 | 271 41 | | 1,802 88 |
| Predatory animal hunters and trappers—seasonal | 1,200 00 | | | | 1,200 00 |
| Temporary help—seasonal | 885 00 | | | | 885 00 |
| Total bureau game refuge | $8,086 99 | $419 25 | $2,307 27 | | $10,813 51 |
| Bureau licenses: | | | | | |
| Clerical and office | $3,285 00 | $2 46 | $5 60 | | $3,293 06 |
| Traveling | | | 1 00 | | 1 00 |
| Postage | | | 240 50 | | 240 50 |
| Freight, cartage and express | | | 75 | | 75 |
| Premiums on bonds | | | 907 50 | | 907 50 |
| Total bureau licenses | $3,285 00 | $2 46 | $1,155 35 | | $4,442 81 |
| Total 85th fiscal year expense paid from support appropriations | $138,401 25 | $21,963 34 | $36,363 15 | $181 45 | $196,909 19 |

## STATEMENT OF EXPENDITURES—Continued

For the Period July 1, 1933, to September 30, 1933, of the Eighty-fifth Fiscal Year

| Function | Salaries and wages | Materials and supplies | Service and expense | Property and equipment | Total |
|---|---|---|---|---|---|
| Special items: | | | | | |
| Deer tight fences—Chap. 872-31, from July 1, 1933 to December 31, 1933 | | | | | $1,498 05 |
| License commissions | | | | | 7,131 25 |
| State Fair and other exhibits | | | | | 209 49 |
| Total special items | | | | | $8,838 79 |
| Permanent improvements: | | | | | |
| Construction, improvements and equipment | | | | | $3,793 88 |
| Prior year expense: | | | | | |
| Eighty-fourth fiscal year | | | | | $17,807 49 |
| Bureau of commercial fisheries, Chap. 825-33 | | | | | |
| Fresh fish marketing: | | | | | |
| Chief and assistants | $495 47 | | | | $495 47 |
| Clerical and office | 149 03 | | $11 55 | | 160 58 |
| Automobiles | | | 2 50 | | 2 50 |
| Traveling | | | 105 80 | | 105 80 |
| Telephone and telegraph | | | 66 | | 66 |
| Freight, cartage and express | | | 49 23 | | 49 23 |
| Rent | | | 1 15 | | 1 15 |
| Exhibits | | $99 84 | 2,013 70 | | 2,113 54 |
| Total bureau of commercial fisheries, Chap. 825-33 fresh fish marketing | $644 50 | $99 84 | $2,184 59 | | $2,928 93 |
| Grand total proprietary group | | | | | $230,278 28 |

## SEIZURES OF FISH AND GAME

July, August, September, 1933

| | |
|---|---|
| Fish: | |
| Abalones | 306 |
| Barracuda, pounds | 54 |
| Bass— | |
| Calico | 45 |
| Black | 307 |
| Striped, fish | 251 |
| Striped, pounds | 531 |
| White sea, pounds | 500 |
| Clams | 115 |
| Crabs | 39 |
| Catfish | 17 |
| Crappie, perch, sunfish | 233 |
| Lobsters | 294 |
| Salmon, pounds | 451 |
| Trout, pounds | 556 |
| Yellowfin, pounds | 2,904 |
| Sturgeon, pounds | 20 |
| Fish traps | 11 |
| Game: | |
| Deer | 55 |
| Deer meat, pounds | 1,018 |
| Ducks, geese | 87 |
| Doves | 118 |
| Pheasants | 12 |
| Quail | 31 |
| Rabbits | 17 |
| Shorebirds | 1 |
| Bear hides | 2 |
| Bear meat, pounds | 100 |
| Rifles | 2 |

## FISH CASES

**July, August, September, 1933**

| Offense | Number arrests | Fines imposed | Jail sentences (days) |
|---|---|---|---|
| Abalones; small; overlimit | 17 | $400 00 | 10 |
| Angling; no license | 24 | 430 00 | 10 |
| Barracuda; small | 1 | 5 00 | |
| Bass— | | | |
| Calico; overlimit | 1 | 25 00 | |
| Black; small | 3 | 10 00 | |
| Striped | 15 | 185 00 | 20 |
| White sea | 1 | 25 00 | |
| Clams; small; overlimit | 7 | 220 00 | 25 |
| Crabs; small | 13 | 165 00 | 20 |
| Crappie; perch; sunfish; overlimit | 7 | 165 00 | |
| Commercial fishing; no license | 47 | 110 00 | |
| Lobsters; closed season | 15 | 320 00 | 125 |
| Salmon; overlimit; untagged | 4 | 175 00 | 50 |
| Trout; overlimit | 10 | 325 00 | |
| Yellowfin; small | 3 | 25 00 | |
| Operating set lines | 1 | | |
| Night fishing | 1 | | |
| Fishing too near mouth of stream and from fish ladder | 5 | 75 00 | |
| Fishing with too many poles | 3 | 40 00 | |
| Seines; nets; illegal use of | 15 | 550 00 | |
| Miscellaneous fish cases | 4 | 40 00 | |
| Totals | 197 | $3,290 00 | 260 |

## GAME CASES

**July, August, September, 1933**

| Offense | Number arrests | Fines imposed | Jail sentences (days) |
|---|---|---|---|
| Deer; closed season; killing does, fawns; untagged deer | 126 | $4,305 00 | 1,020 |
| Bear; closed season | 4 | 60 00 | 50 |
| Ducks; closed season | 11 | 200 00 | 5 |
| Doves; closed season; overlimit | 17 | 307 00 | |
| Hunting; no license | 67 | 1,157 00 | 2 |
| Hunting in refuge | 28 | 265 00 | |
| Spotlight hunting | 22 | 1,230 00 | 320 |
| Killing non-game birds | 2 | 35 00 | |
| Pheasants; closed season | 7 | 260 00 | 25 |
| Shore birds; killing of | 1 | 25 00 | |
| Quail; closed season | 10 | 195 00 | 120 |
| Rabbits; closed season | 5 | 110 00 | |
| Trespassing | 5 | 75 00 | |
| Shooting from auto | 9 | 125 00 | |
| Totals | 314 | $8,349 00 | 1,542 |

## CALIFORNIA FRESH FISHERY PRODUCTS FOR THE MONTHS OF JULY, AUGUST AND SEPTEMBER, 1933

Compiled by Division of Fish and Game, Bureau of Commercial Fisheries

| Species of fish | Del Norte, Humboldt | Mendocino, Sonoma, Lake | Marin | Solano, Yolo | Sacramento, San Joaquin | Alameda, Contra Costa | San Francisco, San Mateo | Santa Cruz | Monterey |
|---|---|---|---|---|---|---|---|---|---|
| Albacore | | | | | | | | | 107 |
| Anchovy | | | | | | | 91,080 | | 29,605 |
| Barracuda | | | | | | | | | |
| Bonito | | | | | | | | 10 | |
| Carp | | 6,328 | | | 40 | 121 | | | |
| Catfish | | | | | 17,751 | 23,770 | | | |
| Cultus | 195,352 | 58,733 | | | | | 50,273 | 14,301 | 27,957 |
| Flounder | 172,833 | 2,810 | | | | | 48,000 | 583 | 118 |
| Flying fish | | | | | | | | | |
| Hake | 810 | | | | | | 1,750 | 479 | 13 |
| Halfmoon | | | | | | | | | |
| Halibut—California | | | | | | | 2,353 | 1,515 | 5,482 |
| Halibut—Northern | 120,253 | 24,025 | | | | | | | |
| Hardhead | | 2,735 | | | | | | | |
| Herring | | | | | | | 1,000 | | |
| Kelp Bass | | | | | | | | | |
| Kingfish | | | | | | | 3,769 | 6,627 | 37,252 |
| Mackerel—Horse | | | | | | | | | 5,536 |
| Mackerel—Pacific | | | | | | | 3 | 2,135 | 786,955 |
| Mackerel—Spanish | | | | | | | | | |
| Mullet | | | | | | | | | |
| Perch | | 1,475 | 2,892 | | | | 22,179 | 3,424 | 9,709 |
| Pompano | | | | | | | | 12 | |
| Ray | | | | | | | | | |
| Rock Bass | | | | | | | 5 | 10 | |
| Rockfish | 232,282 | 4,314 | | | | | 105,415 | 167,551 | 207,382 |
| Sablefish | 87,943 | 613 | | | | | 13,005 | 13,739 | 10,451 |
| Salmon | 1,700,273 | 424,041 | 1,321 | 28,312 | 87,962 | 89,073 | 144,925 | 964 | 6,466 |
| Sand Dab | 85,778 | 1,285 | | | | | 28,175 | | 8,513 |
| Sardine | | | | | | | 9,262,198 | | 61,252,651 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sculpin | | | | | | | | | |
| Sea Bass—Black | | | | | | | | | 30 |
| Sea Bass—White | | | 214 | | | | 39 | 5,034 | |
| Shad | | | | | 17 | 11 | 105 | | |
| Shark | 625 | | | | | | 3,698 | 200 | |
| Sheepshead | | | | | | | | | |
| Skate | 1,435 | | | | | | 4,770 | | 4,875 |
| Skipjack | | | | | | | | | |
| Smelt | 5,970 | 3,222 | 23,296 | | | 1,620 | 42,327 | 10,374 | 46,617 |
| Smelt—Jack | 86 | | 10,506 | | | | 1,252 | 104 | |
| Sole | 1,142,443 | 22,468 | | | | | 208,195 | 991 | 13,942 |
| Splittail | | 20 | | | | 932 | | | |
| Striped Bass | | | | | 3,784 | 7,491 | 6,815 | | |
| Sucker | | 655 | | | | | | | |
| Swordfish—Broadbill | | | | | | | | | |
| Swordfish—Marlin | | | | | | | | | |
| Tom Cod | 150 | | | | | | | | |
| Tuna—Bluefin | | | | | | | | | |
| Tuna—Yellowfin | | | | | | | | | |
| Turbot | | | 1,091 | | | | | | |
| Whitebait | 7,401 | 8,932 | | | | | 3,253 | 23 | 568 |
| Whitefish | | | | | | | | | |
| Yellowtail | | | | | | | | | |
| Miscellaneous | 36,564 | 125 | | | | 36 | 181 | 1,207 | 335 |
| Total fish | 3,790,228 | 561,781 | 39,320 | 28,312 | 109,554 | 123,054 | 10,044,765 | 229,283 | 62,454,870 |
| Crustaceans: | | | | | | | | | |
| Crab | 32,592 | 192 | | | | | 392,962 | 350 | 3,080 |
| Shrimp | | | 163,302 | | | 45,206 | 874,418 | 2 | |
| Spiny Lobster | | | | | | | | | |
| Mollusks: | | | | | | | | | |
| Abalone | | | | | | | | | 691,650 |
| Clam—Hardshell | | 932 | 5,613 | | | | | | |
| Clam—Mixed | 1,841 | 863 | | | | | | | |
| Clam—Pismo | | | | | | | | 115 | 3,100 |
| Clam—Softshell | | 813 | 47,804 | | | 330 | 63 | | |
| Mussel | | | | | | | | | |
| Octopus | | 72 | | | | | 3,350 | 62 | 10,151 |
| Oyster—Eastern and Japanese | | | 22,818 | | | | 49,995 | | 961 |
| Oyster—Native | | | 1,461 | | | | 1,740 | | |
| Squid | | | | | | | | | 75,770 |
| Totals | 3,824,661 | 564,653 | 280,318 | 28,312 | 109,554 | 168,590 | 11,367,293 | 229,812 | 63,239,582 |

All amounts shown in pounds unless otherwise specified. Skipjack and Albacore cleaned.

CALIFORNIA FRESH FISHERY PRODUCTS FOR THE MONTHS OF JULY, AUGUST AND SEPTEMBER, 1933—Continued

Compiled by Division of Fish and Game, Bureau of Commercial Fisheries

| Species of fish | San Luis Obispo, Santa Barbara, Ventura | Los Angeles | Orange | San Diego, Imperial | Total | Fish from south of the International Boundary brought into San Pedro | Fish from south of the International Boundary brought into San Diego | Total fish from south of the International Boundary brought into California |
|---|---|---|---|---|---|---|---|---|
| Albacore | | | | | 407 | | | |
| Anchovy | | 10,284 | 50 | | 131,019 | | | |
| Barracuda | 16,742 | 629,004 | 7,062 | 113,070 | 765,878 | 14,697 | 2,385 | 17,082 |
| Bonito | 913 | 928,481 | 1,879 | 504,795 | 1,436,078 | 73,680 | 31,035 | 104,715 |
| Carp | | | | | 6,489 | | | |
| Catfish | | | | | 41,521 | | | |
| Cultus | 20 | 16 | 17 | | 346,669 | | | |
| Flounder | | 419 | 1,015 | | 225,778 | | | |
| Flying fish | | 8,603 | | | 8,603 | | | |
| Hake | | 55 | 757 | | 3,894 | | | |
| Halfmoon | 26 | 3,051 | 266 | 65 | 3,408 | | | |
| Halibut—California | 102,602 | 53,905 | 7,592 | 301 | 173,750 | 29 | 33,179 | 33,208 |
| Halibut—Northern | | | | | 144,278 | | | |
| Hardhead | | | | | 2,735 | | | |
| Herring | | | | | 1,000 | | | |
| Kelp Bass | | 260 | | | 260 | | | |
| Kingfish | 80 | 66,891 | 3,023 | 435 | 118,077 | | | |
| Mackerel—Horse | | 154,531 | | 600 | 160,667 | | | |
| Mackerel—Pacific | 6,851 | 26,004,862 | 99,247 | 5,936,714 | 32,836,767 | | | |
| Mackerel—Spanish | | | | | | 410 | | 410 |
| Mullet | | 125 | 19 | 4,580 | 4,724 | | | |
| Perch | 26 | 5,470 | 4 | 309 | 45,488 | | | |
| Pompano | | 661 | | 32 | 705 | | | |
| Ray | | 215 | 731 | | 946 | | | |
| Rock Bass | 1,655 | 53,546 | 18,997 | 40,399 | 114,612 | 170 | 414 | 584 |
| Rockfish | 26,278 | 158,189 | 23,561 | 74,178 | 999,150 | | 11,475 | 11,475 |
| Sablefish | | 55,352 | 61,835 | | 245,941 | | | |
| Salmon | | | 13 | | 2,483,350 | | | |
| Sand Dab | 32 | 1,329 | 266 | | 125,378 | | | |
| Sardine | | 17,924 | 50 | 3,176 | 70,536,002 | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sculpin | 141 | 19,431 | 236 | 3,551 | 23,359 | | | |
| Sea Bass—Black | 621 | 11,482 | 555 | 8,610 | 21,298 | 37,066 | 20,840 | 57,906 |
| Sea Bass—White | 29,511 | 388,392 | 5,346 | 152,777 | 581,313 | 5,968 | 121,869 | 127,837 |
| Shad | | | | | 133 | | | |
| Shark | 4,101 | 39,380 | 40,192 | 15,990 | 104,186 | | | |
| Sheepshead | 573 | 4,236 | 644 | 141 | 5,594 | | | |
| Skate | | 2,423 | 436 | | 13,939 | | | |
| Skipjack | | | | | | 800,154 | 3,014,531 | 3,814,685 |
| Smelt | 6,754 | 21,933 | 8,092 | 5,782 | 175,987 | | 260 | 260 |
| Smelt—Jack | 213 | 335 | | 119 | 12,615 | | | |
| Sole | 194,254 | 12,085 | 459 | 34 | 1,594,871 | | | |
| Splittail | | | | | 952 | | | |
| Striped Bass | | | | | 18,090 | | | |
| Sucker | | | | | 655 | | | |
| Swordfish—Broadbill | 4,617 | 293,893 | 25,793 | 144,004 | 468,307 | | 3,985 | 3,985 |
| Swordfish—Marlin | | 3,848 | 1,451 | | 5,299 | | | |
| Tom Cod | | | | | 150 | | | |
| Tuna—Bluefin | | 316,914 | | 7,302 | 324,216 | 79,465 | | 79,465 |
| Tuna—Yellowfin | | | | 6,290 | 6,290 | 4,530,263 | 8,820,097 | 13,350,360 |
| Turbot | | | | | 1,091 | | | |
| Whitebait | | | | | 20,477 | | | |
| Whitefish | | 5,314 | 65 | 3,602 | 8,981 | | 2,366 | 2,366 |
| Yellowtail | | 99,932 | 2,713 | 428,734 | 531,379 | 107,116 | 1,654,650 | 1,761,766 |
| Miscellaneous | 58 | 2,556 | 1,180 | 780 | 43,022 | | 97 | 97 |
| Total fish | 396,068 | 29,375,327 | 316,546 | 7,456,370 | 114,925,478 | 5,649,018 | 13,717,183 | 19,366,201 |
| Crustaceans: | | | | | | | | |
| Crab | | 2,450 | | | 431,626 | | | |
| Shrimp | | | | | 1,082,928 | | | |
| Spiny Lobster | 48,820 | 50,858 | 4,969 | 33,418 | 138,065 | 715 | 4,709 | 5,424 |
| Mollusks: | | | | | | | | |
| Abalone | 213,100 | | | | 904,750 | | | |
| Clam—Hardshell | | 4,190 | | | 10,735 | | | |
| Clam—Mixed | | | | | 2,704 | | | |
| Clam—Pismo | 25,502 | | | | 28,717 | | | |
| Clam—Softshell | | | | | 49,010 | | | |
| Mussel | | | 405 | | 405 | | | |
| Octopus | | | | | 13,635 | | | |
| Oyster—Eastern and Japanese | | | | | 73,774 | | | |
| Oyster—Native | | | | | 3,201 | | | |
| Squid | | | 54 | | 75,824 | | | |
| Totals | 683,490 | 29,432,825 | 321,974 | 7,489,788 | 117,740,852 | 5,649,733 | 13,721,892 | 19,371,625 |

All amounts shown in pounds unless otherwise specified. Skipjack and Albacore cleaned.

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PIUTE TROUT SALMO SELENIRIS SNYDER

# CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

VOLUME 20 SACRAMENTO, APRIL, 1934 No. 2

## CONTENTS



## A NEW CALIFORNIA TROUT

*By* JOHN O. SNYDER

THE REMARKABLE galaxy of brilliantly colored California trout has been enlarged by the addition of another which takes a conspicuous place amongst its fellows. It is named *Salmo seleniris** for a fancied resemblance of its evanescent tints to the lunar rainbow. Piute Trout has been suggested as a common name, recalling other aboriginal inhabitants of the region in which it is found.

* A brief description of the species appears in the Proceedings of the California Academy of Sciences, Fourth Series, Vol. XX, No. 11, pp. 471–472, Nov. 16, 1933. In the parlance of trinomial nomenclature this form would be called *Salmo henshawi seleniris*. The writer can see no particular advantage in writing the name thus. Here it leads to no better understanding of relationships, and elsewhere if trinomials are used in relation to western trout their application will often have to be based on mere speculation.

The newly described species is an isolated variant of *S. henshawi*, differing markedly in the absence of spots from the body, the more slender form and the relatively small and more numerous scales.

The outstanding characteristic of this trout is the color, well portrayed in the reproduction of a painting by Chloe Lesley Starks. No two observers agree in a description of its colors, tints and shades, some of which seemingly come and go with every changing whim of the fish. Moreover, its swimming movements are often accompanied with opaline reflections of varied intensity, and the skin in some places has a peculiar translucent appearance, so much so that on the head some of the cranial bones are partly outlined through the overlying tissue. A sudden disturbance will occasion the appearance of much green color on the body, thus imparting a greenish olive to the dorsal surface and a paler green to the region below the lateral stripe. The ventral surface may at times darken considerably.

The normally clear white ventral surface is unusual, particularly on the throat where it forms an advantageous background for the extensive orange red areas beneath the mandible. As in the case of other cutthroats, an occasional example bears one or more small, golden, coin-like spots, located anywhere, but usually on the ventral surface. There are no dark spots on the body and they are not numerous on the dorsal and caudal. In some examples the caudal is almost immaculate. The major parr marks are ten in number, the first immediately bordering the gill opening, the last at the end of the caudal peduncle. All are crossed by the lateral line, the posterior ones bisected by it, the anterior ones two-thirds below. Of the secondary row, sixteen in number, every alternate spot dips between the nearby primary ones. The mid dorsal region is marked by a narrow dark line.

The body is comparatively long and slender, so much so as to attract attention at once. The fins are rather weak.

Proportional measurements were made of each of ten specimens of *S. seleniris* from its restricted habitat presently to be described, and also from a like number of *S. henshawi* from Silver King Creek, a tributary of Carson River. Averages of each ten are here given, the column marked "S" representing *S. seleniris*. Considerable difference appears, particularly in the depth of the body.

| | *S.* | *H.* |
|---|---|---|
| Standard length in millimeters | 160.4 | 161.7 |
| Length head in hundredths of standard length | .254 | .262 |
| Depth body | .198 | .235 |
| Depth caudal peduncle | .099 | .110 |
| Length caudal peduncle | .159 | .164 |
| Length maxillary | .141 | .147 |
| Length snout | .065 | .068 |
| Diameter eye | .05 | .049 |
| Interorbital width | .078 | .077 |
| Depth head | .163 | .165 |
| Snout to occiput | .172 | .167 |
| Snout to dorsal | .508 | .514 |
| Snout to ventral | .549 | .547 |
| Length base of dorsal | .123 | .144 |
| Length base of anal | .108 | .112 |
| Height dorsal | .155 | .160 |
| Height anal | .149 | .145 |
| Length pectoral | .166 | .179 |
| Length ventral | .138 | .145 |
| Length caudal | .198 | .215 |
| Dorsal rays | 10.0 | 10.8 |
| Anal rays | 10.6 | 10.3 |
| Scales lateral series | 170.9 | 167.6 |
| Scales above lateral line | 30.1 | 29.7 |

Scale counts from ten examples each from the following localities are given for comparison.

| | *Lateral series* | *Above lateral line* |
|---|---|---|
| Lake Tahoe near Tallac | 156 to 170 | 31 to 35 |
| Truckee River near Thisbe | 157 to 165 | 30 to 34 |
| Pyramid Lake | 153 to 162 | 29 to 35 |
| *Salmo seleniris* | 168 to 176 | 29 to 31 |

Fish 6 to 8¾ inches in length appear to be about three years old. The growth is rapid during the season of active feeding.

This trout is found only in the little streams of Fish Valley, a remote region in Alpine County east of the Sierra Divide. Its native habitat is restricted by Llewellyn Falls which form an impassable barrier between the waters above and Silver King Creek below, which in turn flows into Carson River. The waters of the latter eventually disappear in Carson Desert to the eastward. Carson River was once tributary to the Quaternary Lake Lahontan which covered a considerable area in Nevada. Its fishes are therefore related to or identical with those of other rivers as the Truckee, Walker and Humboldt which were also tributaries to the same ancient lake. This region or basin, the streams of which have not had any connection with the ocean for untold ages, contains native representatives of both the rainbow and cutthroat trouts. The rainbows are *S. regalis* of Lake Tahoe, *S. smaragdus* of Pyramid Lake, and *S. aquilarum* of Eagle Lake. *S. henshawi*, the more generally distributed trout is a cutthroat, and its relationships are apparently with similar trouts of the upper Columbia and Snake rivers and Salt Lake Basin. The native trout of the Colorado is related to these.

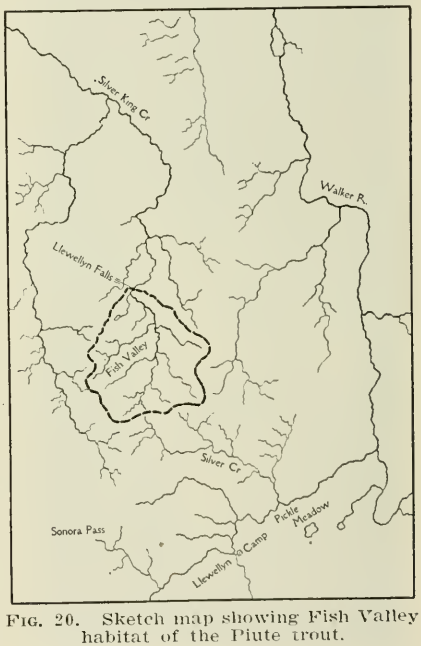


FIG. 20. Sketch map showing Fish Valley habitat of the Piute trout.

Trout from below the falls are different from those immediately above in that their bodies and dorsal and caudal fins are well covered with large and very conspicuous roundish black spots. They are also considerably deeper and more robust in appearance. The colors are not nearly so bright. An enumeration of the spots on several examples from the stream below the falls will be of interest.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Spots on side of head | 10 | 18 | 5 | 5 | 4 | 5 | 6 |
| On body above lateral line | 32 | 93 | 38 | 58 | 37 | 36 | 22 |
| Body below lateral line | 25 | 57 | 34 | 17 | 34 | 8 | 33 |
| On tail above lateral line | 20 | 36 | 26 | 24 | 12 | 19 | 17 |
| Tail below lateral line | 18 | 21 | 19 | 13 | 17 | 9 | 17 |
| On dorsal fin | 33 | 34 | 38 | 41 | 25 | 28 | 30 |
| Caudal fin | 55 | 66 | 67 | 21 | 33 | 13 | 43 |

All trout of this species found elsewhere in the Lahontan Basin are similarly spotted. An enumeration of the spots of several specimens follows:

| *Locality* | *Lake Tahoe* | | *Truckee River* | | | | *Pyramid Lake* | | |
|---|---|---|---|---|---|---|---|---|---|
| Spots on side of head | 55 | 60 | 16 | 12 | 44 | 68 | 65 | 20 | 13 |
| Body above lateral line | 95 | 103 | 100 | 44 | 115 | 92 | 102 | 51 | 43 |
| Body below lateral line | 113 | 53 | 45 | 49 | 175 | 159 | 121 | 16 | 0 |
| Tail above lateral line | 43 | 45 | 48 | 39 | 63 | 59 | 52 | 42 | 40 |
| Tail below lateral line | 59 | 44 | 25 | 31 | 57 | 82 | 56 | 28 | 7 |
| On dorsal fin | 36 | 42 | 86 | 103 | 55 | 45 | 66 | 52 | 41 |
| Caudal fin | 66 | 93 | 234 | 284 | 145 | 162 | 184 | 65 | 95 |

FIG. 21. Llewellyn Falls, the barrier which prevents the passage of trout of the species *Salmo henshawi* into the basin occupied by *Salmo seleniris*. Photo by E. L. Macaulay.

These fish measured from 14½ to 28½ inches in length. The spots of *S. henshawi* are so numerous, large and conspicuous that the species is commonly referred to by hatchery men as the black-spotted trout.

Recognizing that the trout above Llewellyn Falls may be regarded as members of a species which is different from that below, one asks concerning their origin and the means by which they arrived. The immediate and only answer is that they have been there as long as any trout have been in the Carson Basin. The falls are of more recent origin than the trout. Before the falls became a barrier to free migration, the trout of the streams of Fish Valley were not different from others in the river below. When the falls became an obstruction to the passage of fish those above became insular. Some of their number might occasionally drift down over the falls to be ultimately lost in a large population, but none from below could ever mingle with those above.

It is a well-known biological principle or law that insular or isolated animals tend to vary or change from the parent stock. Just why they may vary in any particular way is a matter for speculation. It is not possible at present and in this particular case to account for the unusual brilliancy of color, or for a loss of the black body spots. Whatever else may be said, the significant thing is that we have here an exceptionally good illustration of variation through isolation. The habitat of the species is sharply defined, the barrier which protects it is perfectly evident, and the parent stock from which the

species was derived is in an immediately adjacent region. Moreover, the principal distinguishing character, color, is evident at a glance. Furthermore and of particular interest is the fact that the differentiation of this trout from its parent form is parallel in some respects with that of the golden trouts west of the Sierra divide. The outstanding characteristics of these trouts, *S. roosevelti, S. whitei* and *S. aguabonita* are brilliant color with much yellow, a reduction in the number of spots, notably in *S. whitei,* and a very definite increase in the number of scales on the body. These trouts are presumably isolated variants of the coast rainbow, *S. irideus.* The scales of the latter number 120 to 150 or so in the lateral series, while those of the golden trouts are as high as 200.

Thomas R. Hanna first called my attention to the peculiar trout inhabiting Fish Valley in a letter which runs thus: "Fish Valley is the most southerly meadow on Silver King Creek, the most easterly tributary of Carson River. Silver King Creek is a small stream that may be crossed dry shod most times of the year. It has its source above Fish Valley from the deep snow banks that collect during the long alpine winters in the deep glacial cirques of the high Sierra summits. Small streams from these snow banks unite and flow down a steep and shaded glacial gorge for several miles before they emerge into the smooth, green and treeless meadow of the Valley. Fish Valley is about two and one-half miles long. The stream flows between overhanging sedgy banks over a granite gravel bottom for twice as far in its meanderings down the Valley.

"The Valley stream has a multitude of medium size trout that are native to the stream and differ from any that I have ever seen. They rise readily to any kind of fly, irrespective of the season or the amount of native food that may be available. Their basic color is lemon yellow with brown heads, tails and dorsal fins. They lack the characteristic spots that are on all trout, and instead they have a series of soft light brown vertical bars on their sides. Their bellies are ivory white with a brilliant patch of scarlet under their throat and gills. On each side a thread-like scarlet line runs from their gills to their tail. In their native water, they appear quite transparent and are difficult to see. When first caught, they are a rich bronze color with an iridescent sheen, reflecting their yellow, red and brown tones like the play of colors in a Mexican fire opal. They lose this beauty and tend to darken after they have been out of water. Their meat is white, of fine texture and very delicate. I believe they spawn in the fall of the year.

"That these fish live in such a small stream together with the fact that they are so easily caught dooms them all to an early extinction unless they are adequately protected. To protect them, I believe that all of Silver King Creek and tributaries above its junction with East Carson River in Silver King Valley should be closed at once."

Because of the inaccessibility of Fish Valley, it was found necessary to catch and transport living fish to some place where the artist might make a satisfactory study of them. In cooperation with the officials of Steinhart Aquarium, this was accomplished. As a preliminary, Roland Dobler and Walter Thornburg of the State Division

of Fish and Game successfully caught on August 23, 1933, and transferred upwards of 150 fish to the Alpine Hatchery near Markleeville. These were fed and held in troughs for a time without loss and ultimately preserved as the type and paratypes (September 17). Later the same men packed many more out of Fish Valley to Pickle Meadow and delivered them to William Martin of the Steinhart Aquarium who brought them to San Francisco (October 3). A few days later Dobler and Thornburg followed with a small truck of live fish and delivered them also to the Aquarium. At this date, these fish are still on display and in fine condition.

In a brief letter recounting the work, Dobler writes: "The trip from Pickle Meadow to Fish Valley, a distance of 14 miles, can be made in about five hours with pack stock. On arriving in the Valley we made our camp and later distributed our empty pack cans along the creeks. In fishing we placed the ones caught in a bucket until there

FIG. 22. Summit of the pass from Pickle Meadow, looking toward Fish Valley on the right. Photo by E. L. Macaulay.

were several and then carried them to the nearest pack can. The latter was then partly submerged in the creek to insure a circulation of water in the can, where it could remain until we were ready to come out.

"The fish strike the fly very hard, doing most of their fighting under water, darting every way in trying to get free, and not breaking water very often. When a fish missed a fly, it would break water, turning back on its side instead of moving on in a forward direction. A royal coachman No. 12 hook seemed best. They are game fish and one of the best flavored that I have eaten."

Thornburg writes: "Because of automobile trouble, I arrived at Pickle Meadow a little too late to join the pack train. Leaving the meadow at 2 p.m. with my bedding, I took up the trail leading along Silver Creek for some nine miles up the steep mountain sides. I stopped on the summit long enough for a sigh of relief, and then

headed down the opposite slope toward Fish Valley some six miles away. Arriving at seven, I found Dobler camped at the head of the Valley with preparations for dinner in full swing, certainly a most welcome sight to me. With a good meal disposed of and a hard hike of 14 miles behind me, a sound sleep followed.

"Arising early the following morning, we were soon out to get the fish. Fishing hard for some time and with little success was disappointing when around 10 o'clock they began to strike. By the middle of the afternoon, a rain drove us to cover and we spent some time by a little fire. The rain slacking, we were out again and by nightfall we had around 100 trout.

"Early Monday morning (October 2), we loaded the packs and fish cans on the horses and started fishing again, adding 20 or more fish to our catch. We left the Valley at noon and by three in the afternoon, we delivered the fish to the holding pond in the West Walker.

"We then went to Bridgeport for a night's rest. Leaving there early on Tuesday, we returned to Pickle Meadow from where we again packed over into Fish Valley to try our luck once more with the trout.

"Early Wednesday morning we found the fish striking well and it was not long before 10 or 12 trout would be in the pail and we would have to hurry for one of the cans which we had located along the stream.

"I used a fly most of the time although in one pool I baited it with pieces of grasshopper with good results.

"These trout strike the fly very well and seem to be a little faster than the regular black-spotted ones, but not so lively as the rainbows. They are not very easily frightened. Many times while walking along the banks, I saw a fish leave the shallows and move to deeper water, when after a few casts he would rise to the fly and even come back several times if not hooked. In one pool where there were six or so in sight, I hooked one about eight inches in length. It fell off on the edge of the bank and finally escaped into the water. After taking a couple from the pool, this same trout tried it again and before long managed to join the collection.. On this day, I succeeded in taking 77 trout, getting them safely into the cans.

"It seemed to make little difference whether a man led or was in the rear, he had about the same good luck. They seemed to take the fly as well in the bright sun as in the shady places.

"Upper Fish Valley is a wild mountain meadow through which the stream winds back and forth and has many pools. The sides of the Valley rise very steep to some two thousand feet. After leaving the Valley, the stream becomes much faster and the banks are lined with willows. There are many soda springs along the stream.

"The falls are over granite rocks and they have some 20 feet of perpendicular drop. The water falls on a sloping apron of granite and soon enters a narrow gorge after which the stream opens into Lower Fish Valley. Here the stream keeps to the west side and it is bordered by willows and has many fine pools. Fish are more plentiful here. On leaving the lower Valley, the stream narrows, presenting much very fast water and many splendid pools. When it reaches Silver King Valley, it slows up again to its entrance into East Carson River.

"We left Fish Valley October 5 and on the sixth we started for San Francisco with the fish on a small truck and delivered them at nine o'clock on the following morning without the loss of a fish. They were all full of pep."

Most of us will take off our hats to such anglers.

Some fishermen protest against a size limit, contending that hooked fish can not be safely returned to the stream. Here is presented a case where several hundred fish of various sizes were caught, transported considerable distances and finally kept for a long time under adverse conditions and without material loss.

As this region presents an apparently clear cut and unusual biological demonstration in nature, everything within reason should be done to preserve it so. As no trout have ever been introduced into Fish Valley, it is proposed to preserve the purity of the native stock by keeping it free from foreign introductions or artificial propagation. This policy will not prevent the transfer of fish of the species elsewhere if it seems desirable for practical or experimental purposes.

Fig. 23. Fish Valley above Llewellyn Falls, the habitat of *Salmo seleniris*. Photo by E. L. Macaulay.

# STREAM IMPROVEMENT

*By* A. E. Burghduff

Stream improvement is a phase of conservation that is receiving much attention at the present time. In a general way, the subject may be divided into two classes of endeavor: first, retardation of stream flow by the construction of weirs or erosion dams; second, storage of water near the source of streams, to be released in a continuous quantity sufficient to maintain stream flow during that portion of the year when streams would normally be very low or dry.

The first type of improvement is particularly adaptable to spring-fed meadow streams and undoubtedly the carrying capacity of such streams can be greatly increased by this method of improvement. It is this type of construction which makes possible effective stream improvement in the Eastern States. Improvements of this kind do not fit conditions existing in most of our western streams, where precipitous rock-bound streams fall thousands of feet in a score of miles. What the western type of stream needs is an equalizer to insure constant flow and this can be accomplished by the second class of improvement.

In many instances, and at moderate cost, water can be stored near the source of streams in sufficient quantities to insure ample flow during that part of the year when streams are dangerously low or entirely dry. Climatic conditions in California which cause streams to go dry during the late summer, entails the loss of millions of young trout, possibly more than our total hatchery output. If these annual losses are added to those brought about through agricultural and hydro-development, it indicates that every effort must be made to counteract these conditions wherever possible.

The Cherry Creek project in Tuolumne County demonstrates the possibilities of this method of stream improvement in this State. This is a typical granite area in the High Sierra, differing only in location from scores of similar areas where like results may be obtained. This area was originally barren of fish life. Many years ago settlers and stockmen carried trout from Laurel Lake, now included in Yosemite National Park, and placed them in some of the streams and lakes in this area. These fish throve and increased until excellent fishing was to be had in several of the lakes and streams in the early season. There are no springs in the high granite country and when the surface water runs off, the streams dry up and the lakes recede. As long as seasons of normal rainfall continued, conditions were favorable and the fish needed no assistance to maintain their abundance. When the prevailing dry cycle of years started in the early twenties, the normal run-off was gone long before the first fall rains commenced, with the result that fish in the streams were lost and the carrying capacity of the lakes greatly reduced.

Two sportsmen, F. W. Leighton and W. E. Burnham of Sonora, had a summer cabin near a small lake at the base of Mt. Gillett. They stocked this lake with fish carried there in old oil cans. Their problem

was to make the lake self-sustaining and this was accomplished by going up the canyon a few miles and building an earth and rock dam at the outlet of a group of lakes about fifty acres in extent. The storage water thus impounded was ample to insure a good flow of water below the dam and to permit the trout in the lake below to ascend the stream to spawn and insure that the young fish could find their way back into the lake. This lake thus became self-sustaining and a movement was started to have similar projects commenced on a more elaborate scale.

In the late summer of 1930, the writer together with F. W. Leighton and J. R. Hall, Supervisor of the Stanislaus National Forest, made a survey to determine the feasibility of constructing similar dams near the source of Cherry Creek tributaries. At this time, all of the upper

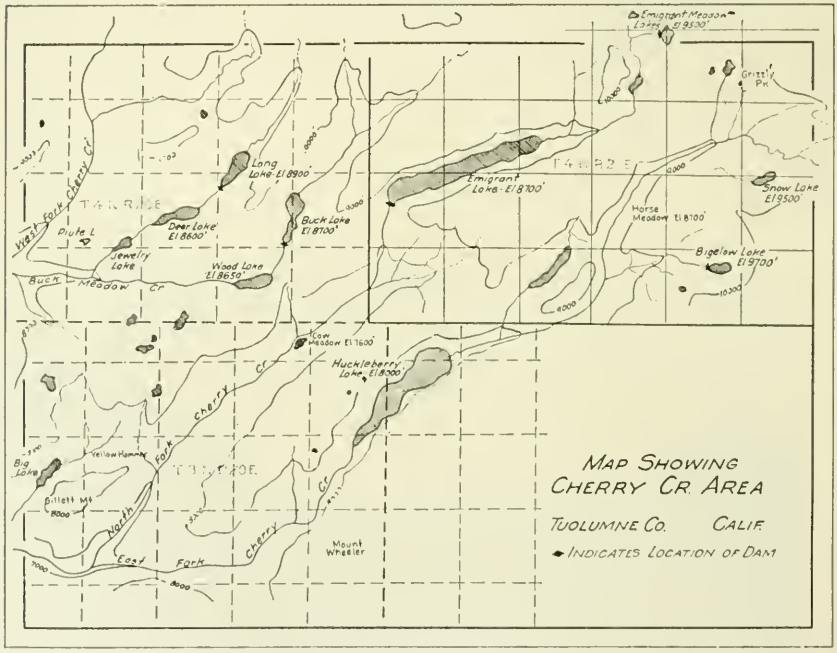


FIG. 24. Cherry Creek area, Tuolumne County, showing location of dams regulating stream flow.

tributaries to Cherry Creek were dry except for pools in some of the meadow sections. It was probable that even these pools would disappear before the first fall rains. Considerable numbers of trout of various sizes were stranded in these pools, an annual occurrence which resulted in heavy losses.

Cherry Creek divides into three main branches, the West, North and East forks. As a result of the 1930 survey, storage dams were built on each of these branches.

Control storage on the West Fork is accomplished by dams on Long and Buck lakes; the water released from Long Lake passes through Deer and Jewelry lakes. From Buck Lake it passes through Wood Lake and combining with water from Long Lake, flows two

FIG. 25. The Buck Lake Check Dam is eight feet high and 56 feet long. Photo by Louis Jensen.

FIG. 26. Main Check Dam on Long Lake, Cherry Creek project. This dam is eight feet high and stores 520 acre-feet of water. Photo by Louis Jensen.

miles into West Fork at the upper end of Louse Canyon. These storages maintain a constant water level in the lakes through which it flows and a good stream of live water from the storage lakes to the junction of the West Fork with the main Cherry. The flow through Louse Canyon September 18, 1933, was about 60 miner's inches. The lakes and streams in this chain are well stocked with trout and many small fingerlings of this year's hatch were observed. It is not known whether any available storage exists above Buck Lake. If so, an ideal permanent spawning area in the stream channel above this lake could be developed, where all natural spawn is now lost through lack of continuous stream flow.

The center or North Fork chain of lakes includes dams at Emigrant Meadow Lakes and Emigrant Lake. The latter, on account of its large storage capacity, is the key control to the entire watershed project; with the construction of a 24-inch top extension on this dam, the storage will provide a minimum flow of 80 miner's inches or more, the full distance to the junction of Cherry and Elinor creeks. Emigrant Meadow Lakes furnish sufficient storage to adequately protect the spawning areas above Emigrant Lake and to insure natural reproduction in the latter.

About three miles below Emigrant Lake the stream enters Cow Meadow. This meadow is several miles long and for much of the distance fine gravelly spawning beds exist. A canal-like lake about one mile long and ranging from 50 to 100 feet wide and up to 4 feet deep is situated at the lower end of the meadow. It is proposed to construct a low erosion dam at the lower end of this canal, to raise its water level 24 to 30 inches. In addition to deepening this canal, raising the water level 24 inches will connect up a 15 acre lake which is about 18 inches higher than the present water level in the meadow. This lake is now barren but will become a valuable stocking reservoir when connected with the creek system. The results of the 1931 construction are very pronounced in Cow Meadow. It has never been my privilege to see any section of stream better stocked with fingerlings and one and two year old trout than is this section. One has to see these results to fully appreciate the accomplishment.

The East Fork chain lacks sufficient storage. A dam at Bigelow Lake supplies live water into Huckleberry Lake at all times but the evaporation in Huckleberry Lake is greater than the inflow will replace, resulting in the stream below Huckleberry Lake to its junction with the North Fork going dry. Storage at Snow Lake, located 2½ miles northeast of Bigelow Lake, would supply the necessary water to offset evaporation in Huckleberry and would also open up two miles of excellent spawning area in Horse Meadow. In addition to a storage dam at Snow Lake, an erosion dam should be built at the lower end of Horse Meadow and a low flat dam at the lower end of Huckleberry Lake to prevent excessive early runoff of surface water.

Regulation of water discharge from these storage dams is accomplished in a simple manner which does not require frequent adjustments. A gate valve, which can be locked in any position, allows for an opening which will pass a predetermined flow of water. The valves are then opened to this extent and remain so at all times. When dams are full and water flowing over spillways, a portion of the surplus water

necessarily passes through the valve. This flow continues after water has receded below the spillway level and assures a continuous discharge.

The type of construction of these dams is determined by the character of the lake outlet, but in general it consists of a rock and concrete wedge built into the narrow lake outlet. Only lakes where the outlet is narrow and wedge-shaped are selected for storage in order that material requirements shall be limited. Rock walls are built up to the required height and each side of the wall is then tied in with concrete. Walls at the base are one-half as thick through as the height of the dams and taper to twenty-four inches at the crest. The valves are placed in the lower center with the locking control stem extending to the crest of dam.

From the nature of this project and its indicated success, it will likely become an example of what can be accomplished in the high

FIG. 27. Huckleberry Lake. Looking upstream. Photo by Louis Jensen.

granite areas of the Sierra in water storage and fish conservation. From its permanency, it insures economical administration and is undoubtedly an outstanding conservation achievement. If the recommended 1934 construction is done, the Cherry Creek area project can be considered completed. Additions and improvements to the system will present themselves from time to time, but the main objective, insuring a constant flow of water in Cherry Creek and its tributaries will have been accomplished, and about 70 miles of live trout stream restored.

During the 1933 season, a C.C.C. subcamp was established on the upper Clavey River at Bear Lake in Tuolumne County. This camp, under the jurisdiction of Supervisor Hall, constructed a rock-concrete dam at the outlet of Bear Lake and, at this date, September 23, 1933, is engaged in constructing another at Y Meadows, 3 miles above. The combined storage of these two projects will be about 500 acre-feet,

sufficient storage to keep this fork of Clavey River alive throughout the year. The meadow storage will insure natural spawning areas above Bear Lake while the combined release will provide for natural reproduction through about 17 miles of average spawning stream. This should result in good stocking of the lower portion of the Clavey River. The work done by the C.C.C. men is of excellent quality and is permanent in nature.

The following cost and operation chart indicates the moderate cost of these projects and the accompanying photographs show the general type of construction employed.

## COST AND OPERATION OF CHERRY CREEK DAM PROJECT

| Name of Lake | Elevation | Area in Acres | Release miner's inches | No. days protection | Storage capacity, acre-ft. | Valve opening number of turns | Cost | Days to build | Sacks of cement used |
|---|---|---|---|---|---|---|---|---|---|
| Bigelow | 9,800 | 59 | 80 | 100 | 460 | 9 | $1,128 | 17 | 51 |
| Emigrant | 8,850 | 213 | 150 | 120 | 1,491 | 12½ | 788 | 12 | 38 |
| Emigrant Meadow | 9,750 | 23 | 50 | 90 | 160 | 5 | 852 | 13 | 65 |
| Buck | 8,400 | 48 | 70 | 100 | 360 | 5 | 1,416 | 24 | 70 |
| Long | 8,700 | 67 | 80 | 130 | 520 | 7 | 1,016 | 15 | 56 |
| Totals | ---- | 410 | 430 | 540 | 2,991 | -- | $5,200 | 81 | 280 |

# NOTES ON THE FOOD OF TROUT*

*By* P. R. Needham, Ph.D., Associate Aquatic Biologist, United States Bureau of Fisheries

With seven photographs by the author

Trout foods are normally derived from two sources, the water itself, and the adjacent land. Any angler who has lifted stones or sticks from the bed of a permanent stream has seen the great array of organisms present. Underwater foods include a host of aquatic insects such as caddis-fly, mayfly, or stonefly larvae and nymphs, beside numerous shrimp, snails, and fishes. Counts of submerged trout foods from given areas have shown insect foods to average over 7835 in number per square yard in certain coastal streams in California. On the other hand, land foods eaten by trout are mostly insects or other terrestrial animals that are blown or fall into streams accidentally. Water living food organisms are available to trout the year round, while in localities where winter is severe, land foods will be abundant only during the warm summer months.

Many anglers open stomachs to see what trout have been eating and use their observations as a guide in the selection of lures. The varied assortment of bugs in most stomachs and the difficulty of identifying them properly due to their small size usually leads anglers to conclude that the trout are bottom feeding and hence, they should turn to bait or sunken fly to stimulate their gastronomic interests.

In the course of the work of the California Trout Investigations we have had occasion to examine microscopically many stomachs ** of rainbow and Loch Leven trout and below are presented a few of our observations along this line that may prove of interest to anglers. In no sense is this data intended to show how to overcome a trout's critical taste for our feathered offerings, but instead, may serve to point out a few interesting dietary idiosyncrasies along with some observations on the food organisms themselves.

In Table 1, it is shown that the dominant food of young steelhead trout from the coastal stream, Waddell Creek, were caddis-flies, over 50 per cent of all items eaten belonging to this group. Of the 557 eaten, only one was eaten in the adult stage at the surface of the water. All the rest were taken as larvae or pupae below the water surface where they normally live in their immature stages.

* Published by permission of the U. S. Commissioner of Fisheries.
** Thanks are due Francis Sumner of the staff of the Trout Investigations for his help in both field and laboratory work herein reported. Permission to collect trout for scientific purposes at all times was granted by the Division of Fish and Game.

Table 1. Foods Consumed by 22 Steelhead Trout from Waddell Creek, Santa Cruz County *

| *Class of food* | *Number found in 22 stomachs* | *Per cent of total* |
|---|---|---|
| Caddis-flies | 557 | 50.54 |
| True-flies | 400 | 36.29 |
| True bugs | 56 | 5.08 |
| Beetles | 53 | 4.82 |
| Ants, bees, wasps | 13 | 1.17 |
| Miscellaneous | 23 | 2.09 |
| Total | 1,102 | |

* Fish taken August 9, 10, 1933. Average length, 4 inches; maximum, 6.9 in., minimum, 2.6 in.

FIG. 28. Caddis-fly larva, *Limnophilus,* removed from its case. Natural size.

Caddis-flies (*Trichoptera*) are probably the most important single trout food in streams. They are abundant in coastal and Sierran streams. A few inhabit lakes.

The life cycle of a caddis-fly is as follows: the female flies lay their eggs in water. These hatch into larvae which live from several weeks to months in the stream bed and then change to pupae and emerge from the water as adults, thus completing the cycle. Large numbers of adults emerging from the water at the same time constitute the so-called "hatches" of anglers. "Salmon flies" which emerge in large numbers at times, are members of the stonefly group, though emerging caddis-flies and mayflies are often termed "salmon flies."

Caddis-fly larvae and pupae generally live in conspicuous fixed or portable cases (Fig. 28) made of bits of bark, sand grains, twigs, etc. The larvae may always be recognized either by their cases or by the pair of hooks found at the posterior end of the body. Trout often eat caddis larvae, case and all, and many stomachs contain large amounts of debris from materials that formed the cases. Many anglers collect caddis larvae, remove them from their cases, and fish them as bait.

The second most important item was the two-winged or true-flies (*Diptera*) which formed 36.29 per cent of the total foods eaten. These have a life cycle similar to the caddis-flies in that egg, larvae, and pupal stages are passed in the water. Only 20 of the 400 flies eaten were taken as adult or so-called "dry" flies, 380 being secured as larvae and pupae below water. These larvae are readily recognized by their worm-like form, lack of legs, and apparent lack of a definite head (Fig. 29). Most of the true-flies eaten belonged to the family *Chironomidae* or midges. Their aquatic stages are abundant in streams and lakes, cold or warm water, and furnish one of the staples in the diet of young fishes. In size they are usually from one-eighth of an inch to an inch in length. Many of the larvae are often blood-red in color whence they derived the name "Bloodworms."

True bugs (*Hemiptera*) were the third most abundant food eaten, forming slightly better than 5 per cent of their diet. Part of these organisms were aquatic "water striders" that skip about on the surfaces of pools and a portion of them were strictly terrestrial forms such as leaf hoppers that had fallen into the water from vegetation on the banks of the stream.

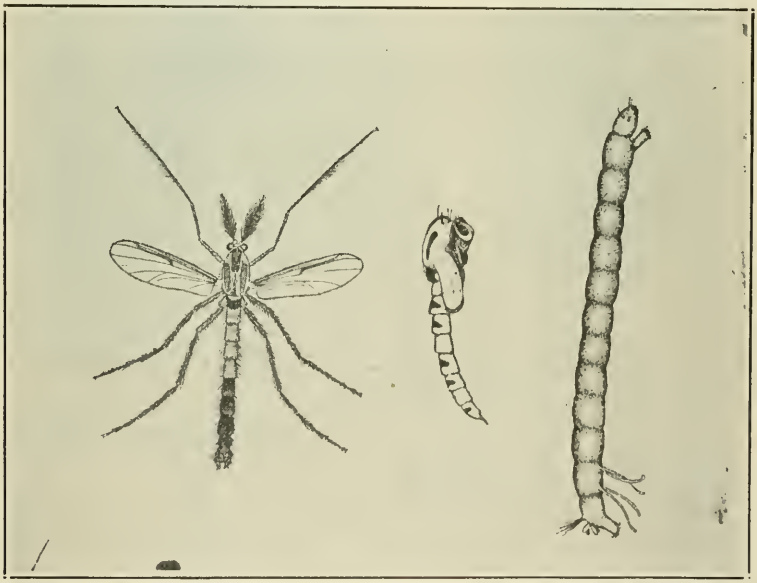

FIG. 29. Midge. Left to right, adult, pupa, larva. Six times natural size.

Of the 53 beetles eaten, 18 were aquatic forms—diving beetles, riffle beetles, etc.—and the remainder mainly ground and bark beetles that had fallen into the water. The few ants, bees, and wasps found in the stomachs were all typically terrestrial forms. Included in the "miscellaneous" column in Table 1 are five mayfly and four stonefly nymphs, one grasshopper, a few mites and spiders.

Of the total 1102 items eaten, over 87 per cent were aquatic in origin and consisted, as pointed out above, largely of aquatic insects

which normally live in the water. The remaining 13 per cent were terrestrial in origin that had fallen into the water accidentally.

If we now examine the food of trout from a typical mountain stream such as the Merced River, certain marked differences in the selection of food becomes evident.

In Table 2 is summarized the food of 10 rainbow trout taken recently in the Merced River on the floor of Yosemite Valley.* Instead of caddis-flies being numerically dominant in the stomachs, we found leaf hoppers to predominate along with beetles, there being almost as many of the latter as of the former in the ten stomachs.

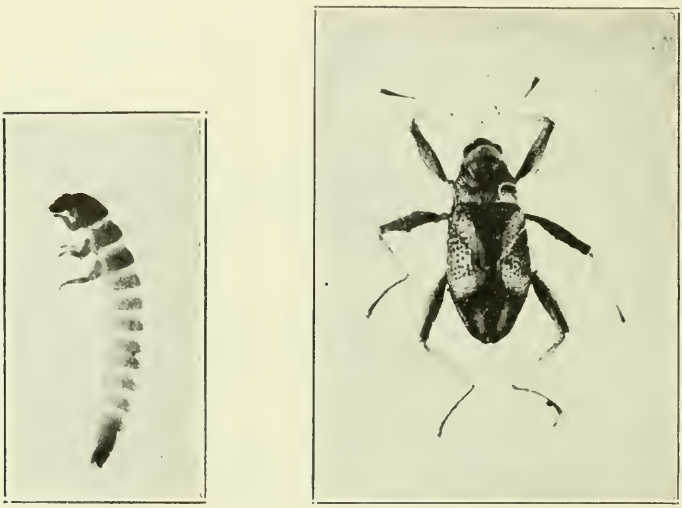

FIG. 30. Larva and adult of riffle beetle. Twelve times actual size.

**Table 2. Foods Consumed by 10 Rainbow Trout from the Merced River in the Floor of Yosemite Valley***

| *Class of food* | *Number found in 10 stomachs* | *Per cent of total* |
|---|---|---|
| Leaf hoppers | 294 | 35.46 |
| Beetles | 293 | 35.34 |
| True-flies | 108 | 13.02 |
| Caddis-flies | 61 | 7.35 |
| Mayflies | 22 | 2.65 |
| Stoneflies | 21 | 2.53 |
| Miscellaneous | 30 | 3.63 |
| Total | 829 | |

* Fish taken Oct. 31 and Nov. 2, 1933. Average length, 5.5 inches; maximum, 8.3 in., minimum, 4.05 in.

Leaf hoppers are small insects, usually less than a quarter of an inch long, often green in color, that live by the thousands on leaves of trees and grasses adjacent to streams. Naturally, when as abundant as they were this year, many fall or are blown into the water. As many as 104 occurred in a single stomach and only one failed to contain any at all.

* Thanks are due C. G. Thomson, Superintendent of Yosemite National Park, for his hearty cooperation in furthering our field investigations in the streams and lakes of the Yosemite region.

The great majority of beetles eaten were aquatic, most of them being either larvae or adults of riffle beetles (Fig. 30) that live in the gravel beds in swift water. A few, 35 of the 293 beetles eaten, were typical land forms and nonaquatic. This is a surprising find and is the only instance in the hundreds of stomachs I have examined where riffle beetles formed a major portion of the food. A few other aquatic beetles were eaten, such as diving and whirligig beetles, and are included in the figures given here.

True-flies found in these rainbow trout formed only 13.02 per cent of the total foods, while it will be recalled that in the young steelheads

FIG. 31. Nymph of stonefly (Salmon-fly), *Pteronarcys*. One and a half times natural size.

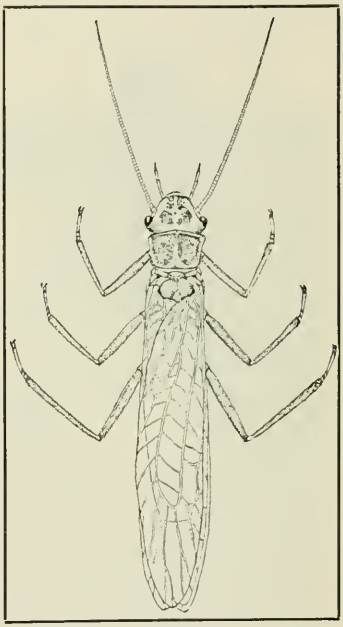

FIG. 32. Adult stonefly (Salmon-fly), *Pteronarcys*. Common in streams of northern California from early June to late August. Drawing by Miss Helen Thorsen. One and a half times natural size.

they formed approximately 36 per cent. Of the 108 flies, exactly 100 were typically aquatic larvae and pupae, only eight being secured as adults after they had left the water.

Caddis-flies which ranked first in numbers in the young steelhead trout, here rate but fourth place (7.35 per cent) and all of them eaten were immature larvae and pupae.

About equal numbers of mayfly and stonefly nymphs (Figs. 33 and 31) had been eaten and are surprisingly low, for members of both groups are abundant in the Merced River as shown by our bottom collections. Most anglers believe mayflies and stoneflies to be major foods of trout and large numbers of artificial flies are patterned after these insects. Mayflies often are eaten in large numbers but stoneflies or "salmon flies," as they are usually called, are extremely "spotty"

in their distribution and actually far fewer of these are eaten, on the average, than is generally supposed. In California, the large "salmon fly," *Pteronarcys californica* (Fig. 32), is abundant in streams north of Lake Tahoe and in coastal streams north of San Francisco, but is rare or absent in many of the drainage basins in the more southerly portions of the Sierra Nevada Mountains.

To attempt to introduce the large salmon fly, *Pteronarcys* into streams where they are not now present, would probably prove to be wasted effort by reason of the fact that being winged forms, they can, and probably would, have distributed themselves before now had the

FIG. 33. Mayfly nymph *Iron*. Note gill-plates on side of abdomen and depressed body and legs for living in swift water. Six times natural size.

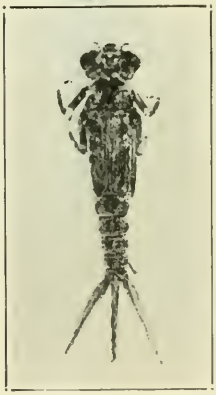

FIG. 34. Damselfly nymph. *Argia*. Note three gill-plates on end of abdomen. Three times natural size.

necessary environmental conditions that they require as home sites existed therein. Further, every cold-water, unpolluted stream invariably contains many smaller kinds of stonefly nymphs that are equally as good food if not of as large size as *Pteronarcys*.

Mayflies and stoneflies have similar life cycles. The eggs are laid in the water where they hatch into nymphs. When grown they emerge from the water as adults. They have no pupal stage. Mayfly nymphs can always be recognized by the presence of gills on the back of the abdomen (see Fig. 33). No other aquatic insect possesses gills in this position. Stonefly nymphs are easily distinguished by their two tails and tufts of filamentous gills at the bases of the legs. Many possess

very beautiful contrasting black and yellow bands on their dorsal surfaces.

Over 55 per cent of the total foods eaten by these rainbow trout from the Merced River were aquatic in origin and about 45 per cent terrestrial.

In Table 3 below are listed the foods eaten by eight Loch Leven and four rainbow trout from another quite different type of stream. These trout were taken from spring runs tributary to Hot Creek in Mono County. Three springs supply a large volume of water of even temperature the year round. Little run-off and no flood waters ever disturb the stream bed thus offering fairly stable environmental conditions to aquatics. As a result watercress and other aquatic plants have grown up in the runs in enormous abundance.

FIG. 35. Fresh-water shrimp, *Gammarus*. Common at Hot Creek, Mono County. Two times natural size.

**Table 3.—Foods Consumed by Eight Loch Leven and Four Rainbow Trout from Hot Creek, Mono County ***

| *Class of food* | *Number found in 12 stomachs* | *Per cent of total* |
|---|---|---|
| Snails and small clams | 392 | 55.60 |
| Shrimp | 235 | 33.33 |
| Caddis-flies | 56 | 7.94 |
| Damsel fly nymphs | 18 | 2.55 |
| Miscellaneous | 4 | .57 |
| Totals | 705 | |

* Fish taken November 15, 1933. Average length, 9.74 inches; maximum, 12.1 in., minimum, 8.4 in.

Here it is seen that snails and small clams ranked first forming 55.6 per cent while shrimp were second forming 33.33 per cent of the total numbers of organisms eaten. Bottom collections from the spring

runs have shown shrimp (Fig. 35) to occur in enormous numbers here, over 1000 being found in an area of one square foot. Snails and clams are likewise very abundant and the trout again prove themselves rank opportunists, eating what they can get, where they can get it. It is interesting to note that only one snail and 150 shrimp were eaten by the four rainbows from Hot Creek, this species apparently preferring shrimp to snails and clams. With the Loch Levens the reverse was true, the latter fish showing decided preference for snails and clams rather than shrimp. The shells of the snails and clams apparently pass through the digestive tracts of the fish without harmful effects.

Of the 56 caddis-flies eaten, only four were taken as adults, 52 of them being aquatic larvae and pupae. Damsel fly nymphs (Fig. 34) which formed 2.5 per cent of their diet, are usually absent from the swifter mountain streams, preferring rather the weedy margins of quiet or slowly flowing waters. Their life cycle is similar to that of the mayflies and stoneflies. They can always be recognized by three long slender plate-like gills on the tip of the abdomen.

In the case of the Hot Creek rainbows here reported on, 99 per cent of their foods were aquatic in origin, just five items being terrestrial in origin.

In summary it is to be noted that the dominant foods eaten by trout from the three streams reported on above, were mostly small in size, except for the shrimps, snails, and clams, and large numbers of each were consumed. Also, that the water supplied by far the majority of food, land forms being comparatively scarce, except for leaf hoppers found in the rainbows from the Merced River. It probably takes about as much effort for a trout to secure a large caddis-fly larva as a small leaf hopper, and when over 100 leaf hoppers or fly larvae are found in a single stomach, it is evident that that fish had been very busy just previous to his demise. It is generally conceded that small foods are eaten by small trout and though the average length of the three lots of fish reported on here was only slightly more than six inches, I have opened many trout up to fifteen and eighteen inches in length that contained only such foods as were found in the stomachs of these smaller fish. Larger fish will eat larger forms such as crayfish, minnows, fingerling trout, etc., if they can get them. In many streams, however, large food organisms are lacking and the fish are mainly dependent upon such everyday underwater staples as caddis-flies, mayflies, true flies and shrimp. Last opening date on the Truckee River the 8- to 12-inch trout I caught were packed with just such small underwater forms. One good-sized caddis larva will equal many small mayfly nymphs in body weight. The latter forms make up in numbers what they lack in size in most swift-water streams. Caddis-fly larvae and other large foods are scarce in many streams which makes it necessary for the fish in such streams to eat the smaller foods or go hungry. The above stomach examinations show that they do just this, eating hundreds of small forms in lieu of a lesser number of large foods.

In conclusion, the data presents a brief review of the food of a few trout from three streams. Due to lack of space, no attempt has been made to give any data on stomach examinations of trout from

lakes where their feeding habits are markedly different, or to correlate actual abundance of foods in streams with actual consumption by trout. We are doing this as a part of the work of the California Trout Investigations, the data obtained to be applied toward the development of a scientific stocking policy. The real basis of all economic progress is a detailed knowledge of life histories and habits. Applied to the conservation of trout, the more facts that can be discovered concerning their life histories and habits, the better fitted we shall become to develop intelligent methods of stream management.

# STREAM AND BAY POLLUTION STUDIES

*By* Paul A. Shaw

## INTRODUCTION

In order to deal intelligently with the important problem of maintaining California waters free from detrimental pollution, it is essential to have a clear picture of present conditions, based on accurate data collected in all areas affected. Such a picture would be valuable in formulating a general policy relative to pollution control, and in dealing justly with individual cases. The purpose of the present outline is to indicate the need of certain studies and the general program of activity that will be conducted relative to pollution.

## ORGANIC WASTES

Wastes containing oxidizable organic matter include discharges from dairies, tanneries, fibre board and paper plants, canneries, wineries, domestic sewage, slaughter houses, etc. While the relation of this important class of wastes to fish life has been the subject of extensive investigation in various eastern States, it has been given but slight attention in California.

The most dangerous feature of organic wastes lies in their ability to consume large quantities of dissolved oxygen. This process is relatively slow and the detrimental effect on fish life may pass unobserved, due to the fact that fish will avoid the area and fatalities occur only when high temperatures and bacterial activity result in a rapid depletion of oxygen. Thus, while heavy fatalities may be rare, the average condition of dissolved gases, bottom environment and aquatic life may be altered sufficiently to make the area undesirable for fish. With an increasing density of industries and municipalities discharging organic wastes, important water areas may become unsuitable for fish, reducing the normal incoming runs as well as causing fish within the area to seek a more suitable environment.

The ratio between the oxygen available from the diluting water and the oxygen demand of the waste is particularly valuable as an indicator of the intensity of pollution. When this factor is sufficiently high, natural purification will progress without appreciable oxygen depletion and beneficial nutrient material is furnished for aquatic life. In such instances, the streams and bays should probably be recognized as a legitimate means of disposal. However, where this factor is low, a detailed study of the intensity and extent of pollution may be required, while in certain cases immediate steps to abate the condition may be indicated.

The program for study of pollution from oxidizable organic wastes will include the following:

1. Inspect and list industries according to watershed, obtaining data on the quantity and kind of product, character of discharge, treatment if any, and point of disposal.

2. Obtain corresponding data on high and low stage stream or tidal dilution.

3. Correlate 1 and 2 with published or experimental data to estimate the ratio between oxygen available and the oxygen demand.

4. Conduct special studies to determine the dissolved oxygen and oxygen demand, preferably at times of low water and high temperature, in those areas where the above ratio is low.

5. Cooperate with industries to work out modified methods of disposal in areas definitely polluted, resorting to legal action only when absolutely necessary.

In view of the many California industries discharging wastes of an organic nature, the value of the above program in maintaining California waters reasonably free from pollution should be obvious. It will serve specifically as a basis for:

1. Immediate action in polluted areas.
2. Increased watchfulness in areas of potential pollution.
3. Evaluating and dealing fairly with reported complaints of pollution.
4. Showing the trend of pollution if the study is repeated in later years.
5. Progressive modifications in the pollution code.

### OIL POLLUTION

In the past, the most troublesome source of pollution in California waters has been from oil. Control of this type of pollution has been particularly emphasized and as a result marked progress has been made in the control of oil waste. However, continued watchfulness is essential and inspections at wharves, shipyards, refineries, sewer outfalls, etc., will be conducted at frequent intervals.

### OTHER POLLUTION WORK

The following items will be given attention in addition to the general program on organic wastes and oil pollution:

1. Pollution from hydraulic mining, particularly in the Klamath and Trinity District.
2. Pollution from sawdust, etc., in lumber mill areas.
3. Pollution from plants discharging toxic chemicals.
4. Study of current literature on pollution control.
5. Study possibility of special code to apply to fish hatchery water supplies.
6. Investigate specific complaints.
7. Keep the importance of clean streams before the public through: published articles; local newspaper accounts of control activities; personal contacts; and through cooperation with other organizations interested in abating, or having jurisdiction in regard to pollution.

### CONCLUSION

It is to be hoped that conditions which have caused numerous complaints, such as exist in the Eel and Klamath river districts and others which may or may not have been brought to the attention of the Division of Fish and Game, will be cleared up satisfactorily as this study progresses. The task is not a simple one, and the writer will appreciate receiving all data on which game wardens, sportsmen and others have definite information.

# THE LAKE ALMANOR HATCHERY

*By* J. H. Vogt

The new Lake Almanor Hatchery, situated on Clear Creek, was located at this point after many unsuccessful attempts to construct a hatchery in this district where fish cultural operations could be properly conducted. This hatchery was sufficiently completed January 20th of the present year to permit placing eggs in the troughs and the hatchery was in operation a few days following this date. All indications point to the approach of a satisfactory solution of our fish cultural problems in the district with the completion of the new hatchery.

Fig. 36. First Lake Almanor Hatchery located near Big Meadows Dam. Photographed in 1917.

The Fish and Game Commission, realizing the importance of the fishing that would be developed by the construction for power and irrigation purposes by the Great Western Power Company in the reservoir known as Lake Almanor, decided to begin fish cultural operations in that district in the spring of 1916. So many unforeseen difficulties presented themselves before a satisfactory hatchery site could be procured in this area that a brief history of operations in the district is deemed advisable as a matter of record.

The work during 1916 was conducted in a crude way and with very little equipment. The plans were to prove the value of the district for collecting rainbow trout eggs before beginning extensive developments. Operations were carried on below Big Meadows Dam where over 1,750,000 rainbow trout eggs were collected. Investigations made during the late spring and summer indicated that additional developments would be justified on the North Fork of the Feather River near

Domingo Springs and on Hamilton Branch, both of which are tributary to Lake Almanor. During the fall of this year, a small hatchery was constructed near Big Meadows Dam (see Fig. 36). Racks were installed below the dam to trap fish, rack and trap were constructed in Rice Creek a short distance below a falls in the stream, and an experimental hatchery was built near Domingo Springs.

Operations were conducted for a few years at Domingo Springs without satisfactory results when the hatchery was moved to its present location near the egg collection station on Rice Creek. This hatchery has since been operated with excellent success.

The water supply at the hatchery located near Big Meadows Dam proved to be unsatisfactory for fish cultural purposes, so hatching operations were transferred to a site on Clear Creek, near Westwood. After conducting operations in this small hatchery for a number of years it became evident that the hatchery equipment was inadequate to properly supply the district tributary to Lake Almanor and the adjacent territory in Plumas and Lassen counties. Plans were then made for the construction of a larger hatchery, but its construction was delayed for some years pending selection of a suitable site.

The Division was unable to purchase or lease a site on Clear Creek, where operations were being conducted in the small hatchery, so it was finally determined to build a new and larger hatchery on Benner Creek near Chester, where the water supply originated from this creek. A new hatchery containing ninety-six troughs and other necessary buildings were constructed here in the fall of 1930 by the Division of Architecture of the Department of Public Works. Operations on Clear Creek were suspended and all buildings and equipment belonging to the Division there were moved to the new hatchery.

Construction work on the new hatchery was completed in January, 1931, and it was immediately prepared for fish cultural operations. Eggs were transferred from Clear Creek during the early part of February. However, this site did not prove favorable. Difficulties in operations were encountered immediately after placing eggs in the hatchery. The water supply line, troughs and tanks froze solid, making it necessary to return the eggs to the Clear Creek site. After repeated attempts to overcome this defect it was decided to hold the Loch Leven and eastern brook trout at Clear Creek until later in the season when they were placed in the hatchery at Benner Creek.

Rainbow egg collections were conducted at the tributary egg collection stations and over 5,000,000 rainbow eggs were eyed in the hatchery during June. The water supply, however, began to rise in temperature and the quantity of water became insufficient to care for the eggs and fish on hand. This condition continued until it was necessary to plant all fish during the month of July.

A well over fifty feet deep was dug near the hatchery during 1931 with the view of developing a supply of water to care for the hatchery during the cold winter months. This effort failed to develop enough water to operate a sufficient number of troughs for winter service. The following winter the supply from Benner Creek again froze and it was once more necessary to discontinue operations which necessitated hatching the quota of Loch Leven and eastern brook trout for the district in other hatcheries.

FIG. 37. New Lake Almanor Hatchery. Photo by Wm. Berrian, December, 1933.

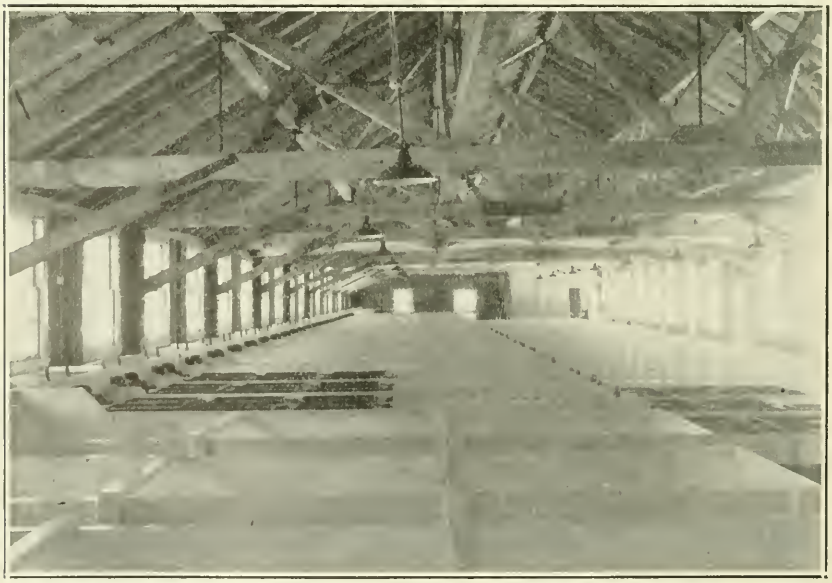

FIG. 38. Interior view of new Lake Almanor Hatchery. Photo by Wm. Berrian, January, 1934.

Operations during the late spring of 1932 developed conditions similar to the spring of 1931. Insuffieient water and its high temperature made it necessary to move a large number of fish to tanks and ponds temporarily constructed on Last Chance Creek, and the balance were distributed to nearby waters as rapidly as possible.

The efforts made to operate the hatchery located on Benner Creek fully demonstrated that successful fish cultural operations could not be carried on there. Extensive investigations failed to indicate that a satisfactory water supply could be developed, so as a last resort, investigations were made of other possible sites.

After considering all the advantages and disadvantages of different sites, it was determined to locate on or near Clear Creek, using water from Clear Creek, a spring fed stream, for supplying water to the hatchery. An agreement was entered into with the Red River Lumber Company covering a twenty-year lease of a site and water supply. Plans for moving the buildings from the Benner Creek site to Clear Creek were made and work of razing the buildings and reconstructing them at the new site commenced in August, 1933, under the direction of the Division of Architecture. The new hatchery building was enlarged, making room to hold ten tanks and to provide space for a food preparing room. Additional quarters will be provided for the employees and ample garage and storage space allowed. All buildings are set on concrete foundations and it is believed the new construction will last for many years (see Figs. 37 and 38).

The Division of Architecture was unable to complete the new structures within the estimates and the money available, so the project is being finished by labor furnished by the C.W.A. and is under the supervision of Ernest Varnum of the Bureau of Fish Culture.

The district adjacent to the Lake Almanor Hatchery has gradually developed into one of the most important trout fishing areas in the State. Every year an increasing number of sportsmen visit the vicinity for vacation purposes. This increased fishing makes it necessary to increase the output of the hatcheries.

During the years of operations at the small hatcheries at Domingo Springs and Clear Creek, several rainbow trout egg collection stations have been established on the streams tributary to Lake Almanor, and these at the present time constitute one of the most important sources of supply of rainbow trout eggs for our State hatcheries. With the completion and increased output of the new Lake Almanor Hatchery available for the 1934 season, the Division believes that satisfactory fishing conditions can be maintained in the district for many years.

# CHANGES IN SARDINE FISHING GEAR IN THE MONTEREY REGION, WITH A NOTE ON EXPANSION OF FISHING GROUNDS*

*By* J. B. Phillips

## NUMBER OF BOATS

The 1933–34 sardine season at Monterey found a greater number of purse seine boats fishing out of this port than any previous season. About 53 purse seine boats fished consistently throughout the greater portion of the season. The total number of purse seine boats that delivered at this port was 61. The number of launch and lighter combinations showed a decrease from previous seasons. About 15 launch

Fig. 39. Sardine boats anchored off some of the Monterey processing plants, unloading or waiting to unload by means of suction pumps. Photo by J. B. Phillips, September, 1933.

and lighter combinations fished rather steadily throughout most of the season, whereas the total number that fished was 23. Several launch and lighter captains chartered purse seine boats during the course of the season. In all, 84 different boats made deliveries in the 1933–34 season. Of these, 68 may be considered to have fished consistently throughout most of the season.

## CHARTERED BOATS

A number of the purse seine boats (about 17 of the total number that fished) were chartered by the local owners or crews of launch and

* Contribution No. 135 from the California State Fisheries Laboratory, February, 1934.

lighter combinations. Most of the chartered boats were from Washington waters, the balance from southern California waters. Ordinarily, the original captain and engineer accompanied the chartered boat, the balance of the crew being made up by the charterer. (The crew usually consists of 10 men and the captain.) The charterer usually furnished the net. However, sometimes only the engineer accompanied the chartered boat but occasionally several of the original crew went along with the captain.

### PURSE SEINES AND RING NETS

All deliveries of sardines to processing plants at Monterey were made by boats using purse nets, except in one case at the beginning of the season when a small delivery was made to one of the plants by a market crew that used a lampara net. The purse nets are of the purse seine type used largely by the purse seine boats, and of the ring net type that the launch and lighter combination crews adopted a few seasons ago in place of the lampara net formerly used.

During the current season, only two of the purse seine boats used a ring net instead of the purse seine. These were two of the smallest purse seine boats that can not be readily adapted to the use of the heavier purse seine. Since the ring net was adopted in a wholesale manner by the launch and lighter combinations and by many of the purse seine boats at Monterey in the 1929–30 season, it has come to resemble the purse seine to a very great degree, especially when used on the purse seine boats. Now that tanned purse seines are gaining favor with the purse seine crews at Monterey in place of tarred purse seines, about the only remaining difference between the purse seine and the ring net is in the rounded or tapered ends of the latter, the cork and lead lines being joined to form a single pull rope in the latter. In the purse seine the ends are square, the cork line and the lead line extending parallel beyond the ends of the net to form separate pull ropes. Ordinarily, the ring net is also constructed of lighter webbing.

Ring nets have been losing favor steadily with the crews of the purse seine boats since the 1930–31 season, when almost 50 per cent of these crews were using the ring net. Fishermen have found that the lower initial cost of this net does not offset the constant care and repair required because of the lighter construction.

### TANNED VS. TARRED PURSE SEINES

Purse seine boats at Monterey are finding that tanned purse seines are not only cheaper to operate than the conventional tarred purse seine but are also easier to handle and thereby speed up hauling operations. The only objection is that the tanned purse seine requires a periodic tanning treatment so as to lengthen its lasting qualities. During intensive fishing the tanning treatment should be performed at least once a month. The logical time for this is during the few days' lull in fishing activities at full moon period, when hard-working crews like to take a well-earned rest on shore. Nevertheless, the double life of the tanned net over the tarred net and the easier operation and the speeding up of hauling operations are becoming the deciding factors.

A few crews experimented with tanned purse seines last season, and this season about one-quarter of the fleet used the tanned seines,

either wholly or partially. In some cases, tarred seines are being replaced with tanned webbing in place of tarred webbing, and in some instances a whole net has been substituted for the tarred net when the latter has worn out. Although it is evident at this time that the tanned purse seine is gaining favor, its universal adoption in succeeding seasons will depend upon facilities for tanning and drying these large nets. Also, whether all crews believe that the added life and speeding up of hauling operations offsets the periodic treatment that must be given a tanned net. The tanning of a purse seine is simplified by removing the bulky cork line and by splitting a large net into two sections.

Near the end of the 1933–34 season, the crew of the purse seine boat *Ranger* of Monterey had two large wooden tanks constructed aboard a floating barge to facilitate treatment of tanned purse seines during future seasons. The original purpose in building this tank was to treat nets with a minimum amount of trouble after the crew had encountered anchovies instead of sardines. A school of anchovies makes the same characteristic luminescence at night that a school of sardines does. The capture of anchovies in sardine nets is annoying because the anchovies often times gill in large numbers necessitating hand-picking, and also it is claimed that the slime from this fish has a detrimental effect upon the net unless it is thoroughly cleansed at the time.

### COST OF WEBBING GREATLY INCREASED

Lasting qualities in a net have become a very important factor this season since the price of webbing has increased more than two and one-half times over that for last season. American webbing (9-thread) has increased from 40¢ a pound at the beginning of last season to $1.07 a pound at the beginning of this season. Japanese webbing has increased a corresponding amount and sells for about 85¢ to 90¢ this season. Most of the crews have found that it is cheaper in the end to buy American rather than Japanese webbing because of the longer lasting quality of the American-made product. There is also less knot slippage in the American webbing.

One or two of the crews have been experimenting with English and Dutch webbing but do not know of their respective lasting qualities at this time.

### HOLD CAPACITIES OF SOME PURSE SEINE BOATS INCREASED

During the past two seasons, a few of the purse seine boats have increased their hold capacities for carrying sardines by rearrangement of fuel tanks or forward cross-wall below deck. For example, the hold capacity of the *New Admiral* was increased from 75 to 85 tons, *Pal* from 65 to 83 tons, *Portola* No. 1 (formerly *Agnes S.*) from 75 to 80 tons, *Ohio* No. 3 from 55 to 68 tons.

### NETTING OPERATIONS OF PURSE SEINE BOATS SPEEDED UP

The universal adoption by purse seine boat crews of labor and time saving devices, such as the power roller on the turntable, the long bag dip nets for unloading from net into hold, submarine light-scare, and now the gaining popularity of tanned purse seines, and in general

a familiarity with the fishing areas in this region has increased the average efficiency of purse seine boats over that of several seasons ago, when the purse seine boats first seriously threatened the launch and lighter combinations. Several years ago, it took the average purse seine boat fishing in the Monterey region about three hours to lay out, haul in the net, and load a catch of 50 tons of sardines. Now the same can be accomplished in two hours by the average boat using a purse seine.

### LIGHTED BUOYS

The lighted buoy has not gained favor as a marker for sardine schools in the Monterey Region. The schools of sardines during the greater part of the season are readily located and judged by the luminescent areas that they produce. However, in the San Francisco region, marker buoys are more popular due to the much reduced or entire absence of luminescence (due to Golden Gate drainage). With reduced or absence of luminescence, schools are located mainly by the splashing that accompanies sardines feeding at the surface of the ocean.

### SUCTION PUMP TRIED EXPERIMENTALLY ON FISHING BOAT

A suction pump as an aid to unloading the catch from the net into the hold of the purse seine boat was first experimented with in the Monterey Region during the latter part of the 1931–32 season on the purse seine boat *Pal.* The apparatus did not prove satisfactory and was revised by the inventor. It was tried again during the early part of the 1933–34 season on the purse seine boat *Olympic,* but again found unsatisfactory. The principle of this apparatus is the same as that of the centrifugal suction pumps that are used by all but one of the Monterey sardine plants for unloading boats in deep water.

The long bag dip-net (see Fig. 2), now common equipment of purse seine boats, is a simple, inexpensive, fool-proof means of unloading the catch from the net into the hold of the boat. These large dip nets can hold as much as $2\frac{1}{2}$ tons and will unload as much as 80 tons per hour from net into boat. This long bag dip-net, however, is not used in unloading the boat at the processing plants. The shallow dip-net or "brail" (see Fig. 3) is used alike for this purpose by purse seine boats and launch and lighter combinations. The shallow dip-net or "brail" is emptied in a manner opposite to that used with the long bag dip-net. The former is emptied by allowing the weight of the contents to force open the bottom of the net when the purse chain is slackened. The bottom of the net is kept closed while the net is being dipped full, by pursing the bottom of the net by means of the chain that runs through a series of small rings around the bottom edge of the net. On the other hand, the long bag dip-net is emptied through the same opening by which it is filled. After the long bag has been filled by guiding the mouth or hoop of the dip net into the bunched fish, the hoop is placed perpendicular to the edge of the hold of the boat and the end of the bag hoisted. The hoisting is accomplished when the rope, that is fastened to the end of the bag and which passes through an overhead block at the end of the boom, is reeled in on a revolving drum.

ELECTRICAL SHOCKING DEVICE TRIED EXPERIMENTALLY ON FISHING BOAT

An electrical device which the inventor hopes will be an aid to fishermen in controlling the movements of sardines as the net is being laid around them was given a preliminary trial on the purse seine boat *Olympic* during the latter part of the 1933–34 season. The movements of fish were to be controlled by shocking them by means of electrodes spaced at intervals around the net, receiving charges from a large generator on the boat. This apparatus did not prove very successful during the trial period. It is highly improbable that the electrical device could replace the simple but effective submarine light that can be lowered to any depth and flashed intermittently as a scare to keep the fish back in the bag of the net while the bottom is being pursed. A scare that the fish can see, such as the flashing light, is more effective than something which is unseen.

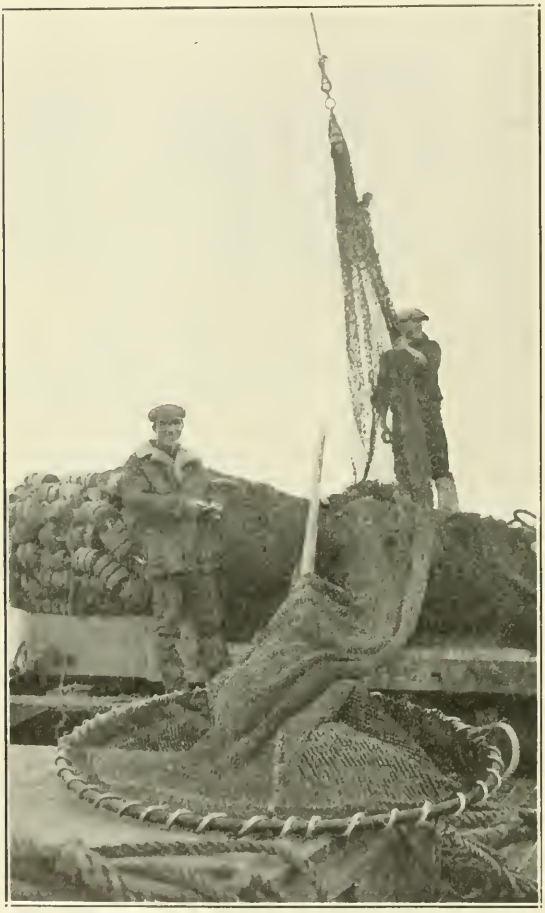

FIG. 40. Long bag dip net such as is used by purse seine boats for unloading catch from net into hold of boat. Note that the end of the bag is closed and fastened to hoisting rope, by means of which the net is emptied. Photo by J. B. Phillips, February, 1932.

EXPANSION OF FISHING GROUNDS IN THE MONTEREY REGION

Until the season of 1924–25, sardine fishing activities in the Monterey region were conducted in waters adjacent to Monterey. Beginning with the 1924–25 season, the seining area extended gradually northward until in 1928–29 the boats fished as far as Half-moon Bay, a distance of some 70 miles northward of Monterey. With the advent of a large number of purse seine boats into the Monterey sardine fishery in the season of 1929–30, the area fished was extended still farther northward to Point Reyes, a distance of about 115 miles from Monterey. This fishing area remained constant until the 1933–34

season when it was extended southward of Monterey to Pfeiffer's Point, some six miles south of Point Sur and about 28 miles southward of Monterey.

The southern area between Point Sur and Pfeiffer's Point was first fished by a portion of the fleet between January 15 and 19, when schools of sardines became scarce to the northward of Monterey. The area to the southward of Monterey was not fished again until February 11, when a portion of the fleet again fished between Point Sur and Pfeiffer's Point. The catches during the last trip were composed mainly of medium small fish which the processing plants were reluctant to handle, so that operations in the southern area again ceased. Probably about 2000 tons of sardines were taken during fishing operations in the area to the southward of Monterey (Point Sur and Pfeiffer's Point).

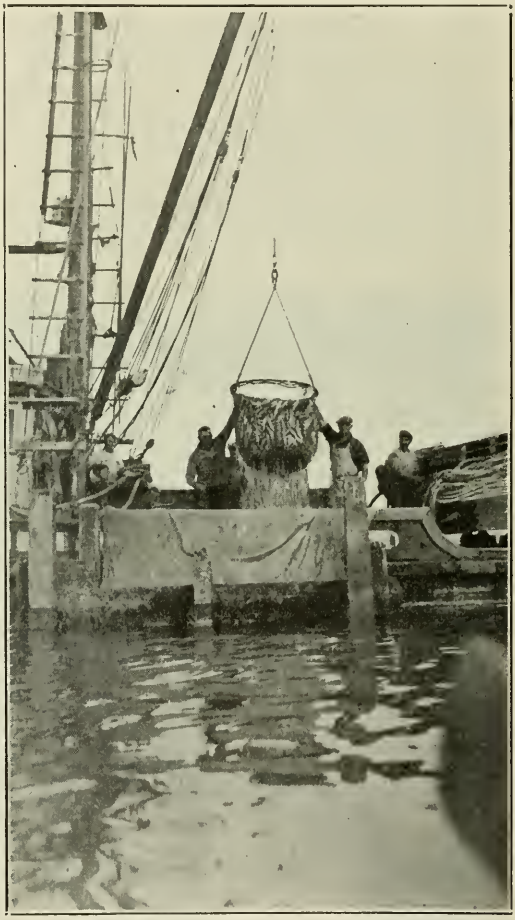

FIG. 41. Shallow dip net or "brail" with approximately 500 pounds of sardines about to be emptied into the suction line hopper or "sump" alongside of boat. The weight of the contents will force open the bottom of the net when the purse chain is slackened. Photo by J. B. Phillips, February, 1932.

Sardine crews in the past have been reluctant to try the coast southward of Monterey because of the rugged nature of the mountainous coast, reports that wicked currents at various points interferred with laying out and hauling nets, and the lack of safe anchorage in case of a sudden blow. Furthermore, landmarks are scarce; for example, there are only two lighthouses to guide a boat along the 80 miles of coast immediately southward of Monterey, whereas, the 80 miles of coast immediately northward of Monterey has four guiding lighthouses. The crews that have fished the southward area successfully do not relish the northward trip back to port when loaded because the sea is running against them.

# THE KERN COUNTY ELK REFUGE

*By* Lewis A. Burtch, Agricultural Commissioner, Kern County

With three photographs courtesy of Wharton Huber

The tule, or valley, elk (*Cervus nannodes*) is a species peculiar to California which made its last stand in the southern end of the San Joaquin Valley. They originally roamed in vast abundance throughout the great interior valley and large herds inhabited the marshes and sloughs of Tulare, Buena Vista and Kern lakes and those bordering the San Joaquin and Sacramento rivers. The survivors of these bands inhabited the foothills above Buena Vista Lake and Button-

Fig. 42. Bull tule elk along slough in Kern County Elk Refuge. June, 1933.

willow and for many years raided the cultivated fields of the Kern County Land Company and of Miller and Lux, who were farming in that area.

Many of these animals were killed by residents for their teeth. This was a common practice at the time the Elks Lodge was first organized in Kern County.

Henry Miller, founder of Miller and Lux, feared that the species would be exterminated and was instrumental in securing legislation,

both State and Federal, making it a felony to kill an elk. Though fewer elk were killed after this law became effective, the herd continued to diminish in numbers. These animals had no regard for fences and were doing considerable damage to the cultivated crops of Miller and Lux and the Kern County Land Company.

A letter written to James Ogden, manager of the Miller and Lux Ranch at Buttonwillow, in 1904, by F. T. Hittett indicates that the elk were given to the government by Mr. Miller. He states in this letter: "I have a very large pasture enclosed for these elk in Sequoia National Park and would like to be able to get these elk there as soon as possible."

C. Hart Merriam, then Chief, United States Bureau of Biological Survey, described an attempt in that same year to drive this elk herd into a corral which had been especially constructed for the purpose (*The Scientific Monthly*, Nov., 1921, pp. 465–475). The plan was to drive the main band from their nightly feeding grounds to the corral, a distance of six and one-half miles. The date had been set for November 12, 1904. About 35 expert riders and cattle ropers had volunteered, among them our State Senator, James I. Wagy, who did such splendid work in securing the refuge which has recently been built. The drive was in charge of Superintendent of the Ranch James Ogden, who reported that the riders were out long before daylight in order to get behind the elk, between them and the foothills, before daylight. Members of the Biological Survey went to the corral with cameras, expecting to photograph the incoming herd. While waiting they reported that a cloud of dust was seen moving steadily westward at some distance. From a water tank tower, one spectator stated that he could see the elk in front of the moving dust, but suddenly the dust disappeared and it was more than an hour before a rider finally arrived with the depressing news that the elk had broken and scattered to the hills and could not be turned. They had turned and charged the riders, broken through the line and escaped to the hills. A few had been pursued, roped and hog-tied and a horseman had been sent to the ranch for wagons in which to bring them in.

After a long wait, the first wagon arrived at the corral bearing three elk, an old bull, a two-year old male and a calf which was already dead. All had been injured in the roping and fighting before they were thrown and tied and the two survivors were nearly paralyzed from lying so long hog-tied. When the bindings were released and the animals freed in the corral they had great difficulty in getting up and standing. It was some time before they recovered the use of their legs. Nevertheless, the old bull, although scarcely able to stand on his feet, charged the men in the corral as soon as his fetters were loosened, driving them over the fence. He then attacked the two-year old bull, driving his brow tines into its side. The younger animal soon began to bleed from his nose and mouth and later died. To prevent further harm, the old bull was again caught up and his antlers were sawed off close to his head.

Shortly after noon, a second wagon, which had been obliged to travel a long distance to pick up the widely scattered hog-tied elk, arrived bearing five animals. Three of these were already dead, only an old cow and a bull calf reaching the corral alive. Thus eight elk were captured, of which four reached the corral alive and four dead

The skins and skulls of the elk that died during the drive were preserved for the U. S. National Museum and these specimens, when later examined by Dr. Merriam, proved to be a new species which he named *Cervus nannodes* (*Proc. Biol. Soc. Wash.*, vol. 18, 1905, pp. 23–26).

The cow, calf and the wounded young bull were then moved, without great difficulty, from the corral into a cattle car. The utmost difficulty, however, was encountered in attempting to similarly load the old bull. Merriam's account goes into some detail regarding the

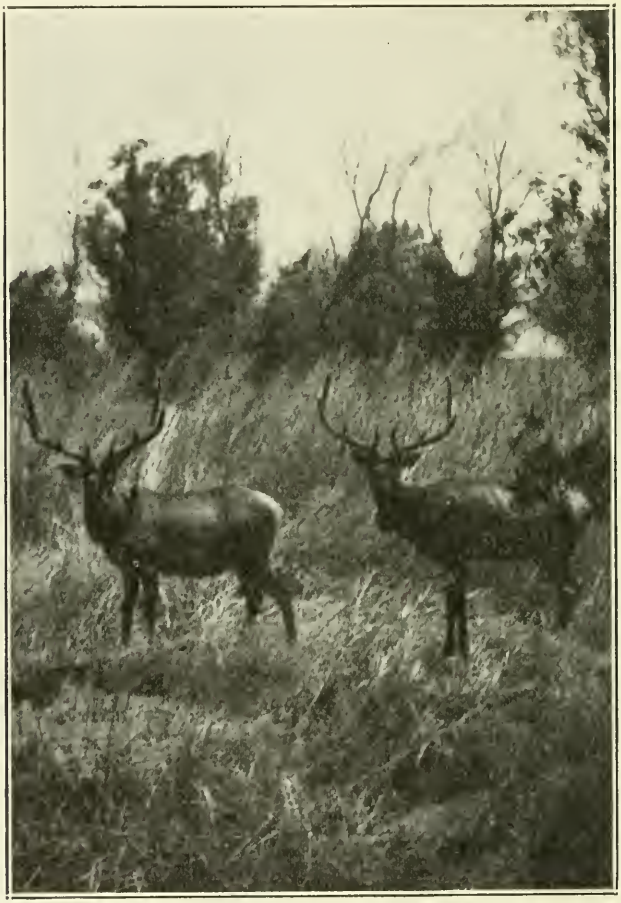

FIG. 43. Two fine bull tule elk photographed on the Kern County Elk Refuge in June, 1933.

terrific battle that this splendid animal, already hornless and much weakened from previous fighting, waged against horses and men before he was finally loaded into the car.

The elk were shipped in the car by rail to Exeter and on arrival there it was found that the young bull and the old cow had died, leaving only the old bull and the calf alive. The latter was here loaded without difficulty into a crate for wagon transportation 35 miles to Sequoia Park. Not so with the old bull, who again put up a tre-

mendous struggle before he was finally dragged with ropes from car to wagon crate. He continued to fight in his crate throughout the trip to the Park, necessitating two stops to reinforce it against the effects of his kicking. The following day, the wagon reached the enclosure that had been prepared for the elk on the Middle Fork of the Kaweah River, where the two survivors were liberated. The old bull had finally reached the limit of his endurance and he could scarcely hobble from his crate. When liberated, he slowly staggered to the river, where he drank, crossed to the far side to lay down on its low bank. Here he was found in the same spot the next day—dead. Thus the only animal to survive the original transplanting efforts was the solitary bull calf.

In the following year, different methods were employed which proved much more successful. Instead of attempting to drive the elk into a corral they were chased and roped by vaqueros. On October 15, 1905, 28 elk were thus captured near Buttonwillow. Three of these died before shipment and of the 25 shipped, 20 reached Sequoia Park alive, where they formed the nucleus of what was then thought to be a promising new herd.

There were no more attempts to move elk from the Buttonwillow herd until 1914 when it had increased considerably and the animals were doing much damage. Different methods were used this time; a large corral a quarter of a mile long was built in an alfalfa field where the elk had been coming to feed nightly. Here 150 animals were captured the night of October 11, 1914, but the next day, 90 fought their way out. Three days later, 25 more were captured and during the month 54 were distributed to seven localities in the State (Evermann, California Fish and Game, vol. 1, pp. 85–96).

In 1915, the same corral was used when 92 more elk were distributed to 14 additional places (Evermann, California Fish and Game, vol. 2, pp. 70–77). Dr. Evermann estimated that there still remained in Kern County between 350 and 400 animals. In most instances, the animals did not do well in their new localities so no further attempts were made to move elk from the Buttonwillow herd.

The elk continued to raid agricultural crops in Kern County but no complaints were heard regarding their depredations until Miller and Lux subdivided their large holdings and sold many pieces of property to small ranch operators comprising 40, 80 and 160-acre tracts. These farmers complained considerably of damage caused by the animals but it was not until 1929 when their demands became insistent that the agricultural commissioner's office in Kern County was petitioned by the growers for relief. Recitations of damage which had cost some growers their entire year's work were made, some of them stating that if something were not done it would be necessary for them to abandon their places.

The agricultural commissioner took the matter up with the Fish and Game Commission and demanded some action from them. A plan was proposed by the Commission to remove the entire herd from Kern County to public parks in other parts of the State, Los Angeles County already having made a request for this band of elk. When this was announced publicly a storm of protest was made by the Elks lodge, the Fish and Game Protective Association of Kern County, and many

individuals who were interested in the preservation of native species and who were not desirous of seeing the last remaining band of a species of animal native to this county exterminated within its borders. Many editorials and newspaper articles were written protesting against the removal or destruction of this herd of animals. Articles headed in large type read, "Remember the Fate of the Bison." Not wishing to incur the enmity of so large a representative group of the people as was making these protests, other means of solving this agricultural problem were considered. Among them was the suggestion that Kern County should purchase a tract of land in the vicinity of Elk Hills, where this band had taken up their last stand, to be given to the State for an elk refuge. This proposal was made to the Board of Supervisors

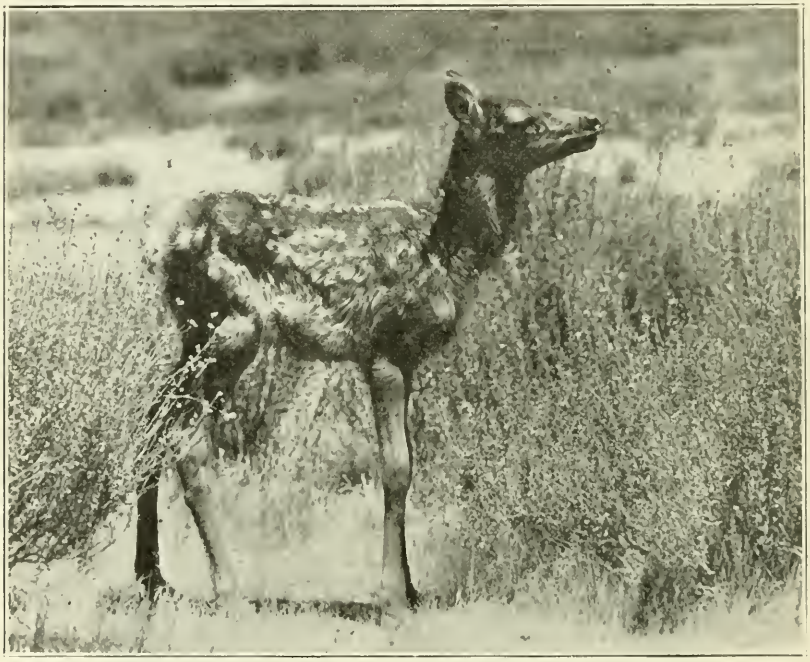

FIG. 44. A new arrival at the Kern County Elk Refuge. June, 1933.

at a meeting in January, 1930, by a group of citizens representing the Elks lodges of Kern County, the Bakersfield Civic Commercial Association, the Fish and Game Protective Association, the American Legion and others. The agricultural commissioner and members of the county farm bureau were present and demanded that some action be taken to relieve the damage to farmers whether it be the purchase of a refuge, the destruction of the herd or its removal from Kern County.

The Board of Supervisors appointed a committee at this meeting to investigate the cost of sufficient land for a refuge and to recommend to the board the amount of money that Kern County should spend on this problem. This committee represented most of the civic organizations of the county and made a very careful and thorough investiga-

tion of the matter, making a tour of the farms in the vicinity and noting the losses suffered by the farmers involved. The investigation showed a cost of approximately $100,000 to purchase and fence 1000 acres of land.

The committee felt that Kern County should not stand the entire cost of this enterprise but that the State of California and the Fish and Game Commission should participate equally with Kern County. Their recommendations to the board were that an elk refuge should be established and that the county of Kern should contribute not more than $35,000 for this purpose.

Following this report, the Fish and Game Commission and the elk committee attempted to get the State Park Board to assist in the purchase of this refuge. The Fish and Game Commission had already pledged $35,000 as the maximum amount which could be supplied by the Division of Fish and Game. It was therefore necessary to get the State of California to participate to the extent of the other one-third of the expense. Considerable work was done by the committee in an effort to get the State Park Board to take over this project. After spending much effort and time in this regard, it was the opinion of the committee that the State Legislature should be requested to make an appropriation for this work.

In the meantime, complaints were coming in from the farmers and considerable damage was taking place.

Miller and Lux agreed to furnish a piece of ground near where the refuge would likely be established and furnish fencing for it if the Fish and Game Commission would fence it and corral the elk pending final decision on the refuge. Authorization was received in September, 1930, from the Fish and Game Commission to proceed with this program.

After the fence was erected on this temporary refuge a big elk drive was put on by the members of the Division of Fish and Game and the interested ranchers. The result of this drive was very similar to that of the first drive recorded in 1904. When the elk neared the corral, they broke and ran toward the horsemen, past automobiles, dodging and jumping everything in their way and scattered like a band of quail to the mesquite brush. Attempts were made to follow them and try to drive them but they were so wild by this time that there was no chance to get near them. Finally, a lone rider with a number of dogs succeeded in gathering up a small band and driving them into the refuge. This man was an experienced cowhand who knew how to handle wild cattle, so he was employed to attempt the corralling of the elk herd. He was successful in getting about 75 head into this enclosure but the balance of them had taken to the hills where they defied all further efforts to approach them.

This somewhat alleviated the trouble for the time being, but in a short while those animals remaining outside the corral were back in the cultivated fields again. They were chased out of the fields with dogs and shotguns, in spite of which they returned to them at night to feed. At the request of the farmers in that district, the Fish and Game Commission put on a night patrol to ride between the hills and the cultivated fields. This patrol continued until after the fall harvest of crops was completed.

The San Joaquin Valley Elks Association interested themselves in the refuge project and through the efforts of Frank H. Pratt, District Deputy Grand Exalted Ruler, a bill was introduced into the Legislature by Assemblyman Jewett, Hanford, Kings County, on January 22, 1931. This measure, known as Assembly Bill No. 973, asked for an appropriation of $50,000 for the creation of a game refuge for tule elk in Kern County. The Elk Conservation Committee of the California Elks Association assisted greatly in getting this bill through the Legislature and in seeing that the elk refuge was completed. The bill was referred to the Fish and Game Committee and when first considered by this committee, it was rejected.

Following this, a long battle, headed by the committee from the Elks Lodge was waged in an attempt to get this measure out of committee. The bill was amended on April 24, 1931, reducing the amount of the appropriation from $50,000 to $35,000. Governor Rolph was contacted and he agreed to sign the bill if it was passed by the Legislature.

A group from the Elks lodges of the San Joaquin Valley and other interested organizations appeared before the Fish and Game Committee asking for consideration of this bill. They received a very cool reception by this committee and were given but little opportunity to express themselves on its merits. Members of the committee referred to the animals as "mangy critters" and very quickly turned the bill down and dismissed the delegation that went to Sacramento.

We were quite discouraged after this reception and felt that it would be necessary to seek other means of handling the problem. Senator Wagy, who had been working with us constantly on this problem, introduced a bill into the Senate on April 23, 1931, known as Senate Bill No. 951, entitled "An act to provide for reimbursement of persons suffering loss by reasons of the act of tule elk during the closed season." Senator Wagy agreed to withdraw this bill provided the committee would pass Assembly Bill No. 973, which called for the appropriation to take care of the problem. After the above-mentioned group once more went to Sacramento where they had another session with the Assembly Committee on Fish and Game, the bill was finally passed out of committee with the recommendation "do pass." It experienced no difficulty then in passing both the Assembly and Senate and in due time it was signed by the Governor.

Considerable discussion followed the signing of the bill as to which division of the State government should purchase the land. It was finally determined that the State Park Commission should do so and on March 15, 1932, this Division purchased a tract of approximately 1000 acres near the original site east of Tupman, Kern County. The Division of Fish and Game, which is charged with the administration of the refuge, prepared plans for enclosing the area with a seven-foot fence of steel construction. Contract for its erection was let by the Department of Public Works on May 1, 1932, and was completed August 29, 1932. All construction costs were borne by the Division of Fish and Game out of the Fish and Game Preservation Fund.

The elk which were held in the temporary refuge were then transferred to the new enclosure. Members of the Division of Fish and Game then commenced gathering up those animals remaining on the

outside and after many months of hard work, the last was finally enclosed in the refuge. About 140 elk comprised the herd thus established in the refuge.

Administration of the Kern County Elk Refuge is in the hands of the Bureau of Patrol of the Division of Fish and Game. Captain O. P. Brownlow of that unit is in charge and Game Warden Lester Arnold, Bakersfield, is handling its direct supervision. James Culp, Tupman, is guardian and caretaker of the refuge.

The final establishment of this refuge was a source of considerable gratification to the members of the committees who worked so long and so hard for its accomplishment.—*January 12, 1934.*

# PORCUPINE CONTROL ON FORESTS OF CALIFORNIA*

*By* JOSEPH KEYES, Leader, Rodent Control,
Bureau of Biological Survey

For years many sportsmen, hunters and lovers of outdoor stories believed that the porcupine was protected by law. Even today, when statements are made that the Federal Government is actually engaged in the control of porcupines, many comments are heard that would indicate that there are still some who believe these animals to be protected. The fact is, however, that these rodents are not protected in the United States, and, moreover, that two Eastern States have been paying bounties on them for several years.

Losses occasioned by the attacks of porcupines on our national forests have been recognized for several years, and it has been reported in the Southwest that the damage caused by these animals exceeds that resulting from fires. The peculiar type of attack wherein the tree may be completely girdled, especially near the top, may be seen on many areas of the Modoc, Lassen, and Plumas National Forests in California — especially along the eastern slopes. Damage is also apparent on the Tahoe, Eldorado, and Mono Forests.

Porcupines consume succulent plants of many species, and the buds, leaves, inner bark, and cambium of numerous kinds of trees. In general, during summer they feed on juicy ground vegetation. Their fall and winter diet consists largely of bark and leaves of coniferous trees, especially the western yellow pine and several species of juniper.

During the late summer, fall, and winter months, porcupines, in their efforts to get at the inner layer of bark, often partly or completely girdle the main leaders, or boles, of the trees. Many of the small seedlings are completely consumed, while larger ones frequently suffer injuries serious enough to cause their death, but more often this injury results in a weakened bushy-topped or spike-top tree that is useless for commercial purposes. Deep snow may hold these animals to individual trees for periods of one to three months, in which time the tree may be completely ruined.

Fortunately, the rate of reproduction of porcupines is not rapid. They breed but once a year and produce one young (rarely two), born fully quilled. Many attain the weight of 30 pounds and live to a ripe old age. The quills are white, with dark tips, sharp, and finely barbed at the tip, and are used as a means of defense, the greatest damage being inflicted by the porcupine striking an object with its powerful tail. The quills are not thrown. Many domestic and wild animals have

* This paper is published to acquaint the readers of CALIFORNIA FISH AND GAME with the reasons for and methods of Federal porcupine control work in California. The Division has, as yet, taken no definite stand regarding this work, but is watching its results closely, especially as regards the incidental poisoning of harmless or beneficial species of animal life. No evidence of the destruction of such species incident to this campaign has been procured to date.—*Ed.*

been tortured by these quills working into their muscles, and when they lodge in the mouth of an animal, death often results.

Control operations as now conducted on the forests of the north-

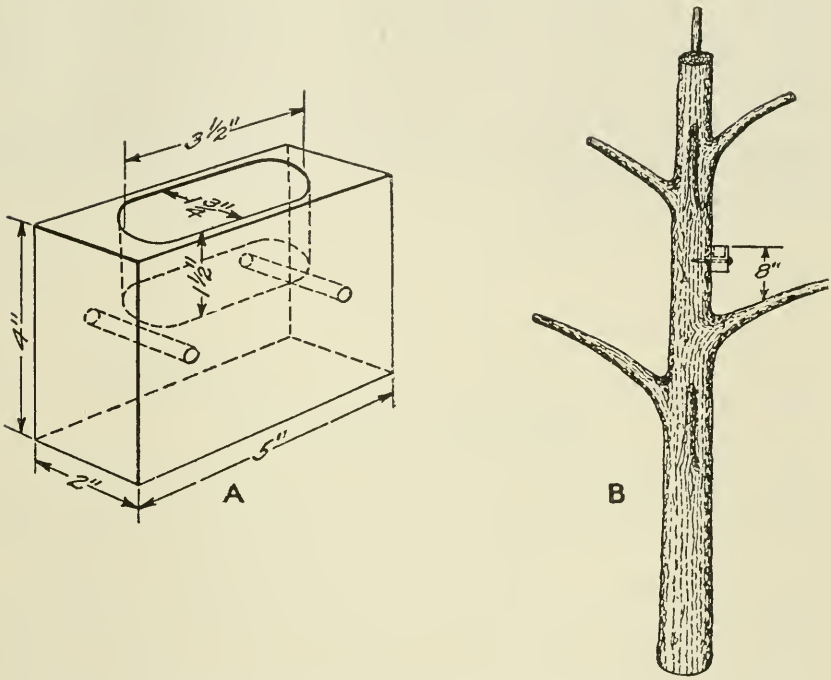


Fig. 45. A. Diagram for preparing a wooden cup for use in exposing poisoned salt for porcupines; B. Method of attaching poison block to pine tree.

eastern section of the State involve methods that have been worked out during the past several years. Salt, of which the animals are very fond, is treated with strychnine and exposed in small wooden blocks five inches long cut from two-by-four-inch lumber. Holes are bored into each block and filled with about three tablespoons of the strychnine-treated salt to which a small amount of dextrine has been added to make it firm.

These blocks are nailed to trees frequented by porcupines, and are securely held in place by 30-penny nails above a limb on which a porcupine may rest while eating the salt (Fig. 45). Such trees are clearly marked with a yellow-tin poison sign (Fig. 46). This tree-blocking method is supplemented by den poisoning, in which the poisoned

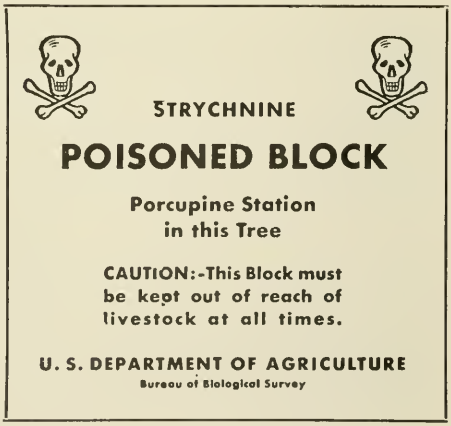


Fig. 46. Facsimile of tin poison sign placed on each tree blocked. Black letters on a yellow background. Actual size 3½ inches square.

salt is placed far back in the rock dens under lava, where porcupines occasionally concentrate, especially during the breeding season, stormy weather, or during the extreme heat of summer. Members of crews carrying on these operations are also provided with a twenty-two rifle or pistol, supplied with ammunition, and instructed to shoot such porcupines as they may locate. Hunters and sportsmen can render their forests a valuable protection in localitities where these animals are destructively abundant by likewise keeping a lookout for these animals and destroying them when found. Porcupines can generally be located in the daytime, resting high in a pine or juniper, or asleep several feet out on a limb.

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## G. D. NORDENHOLT APPOINTED DIRECTOR, DEPARTMENT OF NATURAL RESOURCES

George D. Nordenholt was appointed by Governor Rolph to the Directorship of the Department of Natural Resources on February 5, 1934. Mr. Nordenholt has an enviable career behind him that seems to fit him particularly for his present position.

Born in Illinois in 1884, Mr. Nordenholt spent his youth in that State until he completed two years of study at the University of Chicago. He then went to Colorado where he attended that State's School of Mines for four years and incidentally won all-American recognition for playing fullback on its football team. After graduation from college, Mr. Nordenholt came to Los Angeles in 1908 where he became tunnel foreman on the Los Angeles Aqueduct and broke a world's record in tunnel driving. Since that time he has devoted his energies to mining engineering and petroleum geology, which work has carried him from Alaska to Central America.

While mining and oil have been Mr. Nordenholt's business, fishing and hunting have formed his favorite recreation. He had his first shotgun at the age of ten and has ever since been an enthusiastic hunter. A gun and fishing rod formed important items in the equipment for his wide travels and wherever these led him, he always found wild life and the conditions affecting it of the greatest interest. Mr. Nordenholt has been a successful big game hunter, but he now prefers duck and quail shooting. He shoots a 20-gauge double-barreled gun on waterfowl and a 28-gauge on quail.

Mr. Nordenholt is also an enthusiastic fisherman. He has enjoyed much ocean fishing in southern California in addition to his favorite sport, trout fishing, which he has been so fortunate as to have followed in Alaska, Canada and in many states besides California. The Klamath River is his favorite stream in our State and he is intimately acquainted with conditions on this river. The new Director ties his own flies and confesses that he has one or two variations of his own invention that he likes best. He has taken an active part in matters affecting fish and game for a great many years.

There is no doubt that Mr. Nordenholt's life and activities preeminently fit him for his newly acquired position. The direction of the Department of Natural Resources embraces supervision of the State Divisions of Mines, Oil and Gas, Forestry, State Parks, and Fish and Game. The new Director's business and recreational life, his wide travels and experience, continued interest in the out of doors and fish and game matters seem to assure California sportsmen that their problems will receive sympathetic and understanding attention.

The Department and this Division are also fortunate in being able to retain Mr. D. H. Blood, whom Mr. Nordenholt succeeded as Director, as Deputy Director and Chief Accounting Officer of the Department. Mr. Blood's loyal and friendly help during his three years as Director of the Department will long be remembered by this Division.

## NEW ANGLING AND HUNTING LICENSE BUTTONS

The Fish and Game Commission adopted an identification button to accompany the 1934 angling licenses, effective January 1, 1934. The reaction to these buttons was so favorable that the Commission decided to issue similar buttons with the 1934–1935 hunting licenses.

These buttons are manufactured of metal and are one and three-quarter inches in diameter. The face is celluloid covered and varies in color in accordance with the kind of license issued. In addition to stating the type of license, there is printed on the face of the button its classification, whether resident, nonresident, alien, etc., and license number to correspond with the number of the usual paper license. In the back of the button, there is a pocket in which the paper license is to be carried and a heavy brass safety pin for securely fastening the button to the clothing.

The colors of the angling license buttons are as follows: resident citizens and Indians, red; non-residents, light green; aliens, orange; duplicate buttons are blue.

The colors of the hunting license buttons are: resident citizens, dark green; non-residents, purple; aliens, light blue; declarant aliens, yellow; duplicate buttons are pink. A button, dark green in color, similar to that of a resident citizen's is provided for juveniles, with the word "junior" added.

Section 432 of the Fish and Game Code provides for the issuance of duplicate hunting or sporting fishing licenses upon the payment of a fee of 50 cents and furnishing of an affidavit showing the loss or destruction of the license previously issued.

Visible licenses have proved to be satisfactory in several eastern states where they have been employed and leading California sportsmen's organizations have advocated their adoption here for some time. It is hoped that the new buttons will result in a greater sale of angling and hunting licenses and there is no doubt that they will greatly assist the game wardens in checking bearers of licenses.—*O. L. Warner, February 15, 1934.*

## NOTES ON THE CALIFORNIA TROUT INVESTIGATIONS

The new experimental weir constructed on Waddell Creek last summer for use in detailed studies of life history and habits of the sea-run steelhead trout has proven very satisfactory to date. This was specially constructed to count downstream as well as upstream migrating fish and while it catches all the latter fish, during periods of high floods only a portion of the former fish can be caught. So far during the present season approximately four hundred silver salmon and two hundred steelhead have been handled at the weir, and the steelhead run is still in progress. For the same period several hundred cottoids and some immature trout were taken while migrating downstream. The new weir is proving to be a great asset in working on problems relating to the conservation of steelhead trout.

Environmental studies made in Sierran streams such as the Merced River in Yosemite Valley have shown that this stream averaged about 103 pounds of food per acre of riffle area in the month of February. Food samples from the same areas in August showed an average of 85 pounds per acre. These are significant figures. They indicate that contrary to the usual belief that foods are scarce in streams in the winter time, there is at least as much food at this season of the year and there may be more than in the summer time. Further investigations will be necessary to verify these findings.

Waddell Creek, a coastal stream near Santa Cruz, was found to average 198 pounds of food per acre of riffle area over all seasons of the year, or more than twice as much as was found in the Merced River. Lagoons of coastal streams are very rich in food. Waddell Creek Lagoon was found to average over 250 pounds per acre of bottom area. In this connection it is interesting to note that while aquatic insects compose the bulk of foods in coastal and Sierran streams, lagoon foods are largely shrimps and isopods. These are organisms which can withstand extreme changes in salinity and other environmental conditions and at the same time find ample food for themselves in such areas.

Plans are rapidly being developed for an intensive stream survey of the better fishing areas in California next summer. Through funds allotted by the Public Works Administration to the United States Bureau of Fisheries it is planned to operate several four-man field parties to carry on intensive biological investigations in both streams and lakes. This work is to be done in cooperation with the Division of Fish and Game and the National Forest Service as an integral part of the program of the California Trout Investigations. The object of the work is to gather such facts on the waters investigated as will assist in the formulation of well-balanced stocking policies. Detailed plans for the work will be published later.

In brief, excellent progress is being made on the problems upon which the staff of these investigations are working, and this is due, in no small part, to the splendid cooperation extended to us by officials of the Division of Fish and Game, sportsmen, wardens, fish hatchery men, and others.—*P. R. Needham, Associate Aquatic Biologist, U. S. Bureau of Fisheries, Stanford University, California, February 16, 1934.*

## COMMERCIAL FISHERY NOTES

### PACIFIC COAST WHOLESALE FISH DEALERS CONVENTION

On February 5 and 6, 1934, the wholesale fish dealers of the Pacific Coast met in convention at San Francisco. The delegates represented the various dealers' associations of the coast, including:

California Producers and Wholesale Fish Dealers' Association.
California Fish Trades Industry.
Northwest Wholesale Fish Dealers' Association.
Commercial Fisheries Association of Oregon.
North Pacific Oyster Growers' Association.
North Pacific Crab Fishermen Association (represented by proxy).

At the convention the delegates approved a set of articles of association and by-laws for an "association of associations" which is to be known as the Pacific Coast Fisheries Association. A model code of fair trade practices, prepared by R. H. Fiedler, Acting Deputy Administrator for the National Fisheries Code, was presented to the delegates, and with minor changes was adopted as a regional code for all associations on the coast. This, then, except for minor details to take care of purely local conditions, will assure a uniform code for the various groups on the Pacific Coast, each under local management.

A temporary board of directors, subject to the approval of their various associations, was elected and a secretary chosen. Temporary offices of the association will be at 556 Clay Street, San Francisco. Several committees (price, publicity, legislation, credit, trade classification) will be appointed at the first meeting of the board of directors.

The convention was well attended by wholesale dealers from the entire Pacific Coast of the United States. The formation of a Pacific Coast association will bring the dealers into closer contact and their various problems can be discussed and solved with lasting benefit to the trade as a whole. In addition, the convention afforded an opportunity for the dealers from the various localities on the coast to meet each other and become acquainted.

During the meetings several interesting talks were given. Among the speakers were Arthur S. Coffin of the Sardine Institute, Daniel W. Hone, Attorney for the California Producers' and Wholesale Fish Dealers' Association, and Major John L. Farley, Executive Officer of the California Division of Fish and Game. N. B. Scofield, Chief of the Bureau of Commercial Fisheries of the Division, and other members of the Bureau were in attendance at the meetings.—*G. H. Clark, March 1, 1934.*

### TWO MACKEREL RECORDS BROKEN

On February 2, 1934, the San Pedro fishing boat, *I. O. Y.*, brought ashore the largest mackerel ever recorded by the California State Fisheries Laboratory. This fish was 21½ inches (545 mm.) in length, measured to the fork of the tail. It was not possible to weigh the fish but its calculated weight was in the neighborhood of 3¼ pounds. All the fishermen and cannerymen who saw it pronounced it the largest mackerel they had ever seen. The size of this fish is all the more remarkable when it is realized that the average length of the Pacific

mackerel (*Pneumatophorus diego*) delivered to San Pedro canneries is about 14 inches and their average weight is a trifle over 1 pound. Previous record breakers were no more than 18 inches in length and 2½ pounds in weight. This remarkably large fish was caught in a ring net haul off Huntington Beach in company with 1600 pounds of average sized fish.

The other record to be established was of an entirely different nature. During 1933, California fish canneries packed more mackerel than in any previous year. They produced about 740,000 standard cases; over 8 times the 1932 pack and 145,000 cases more than in 1929, which showed the best previous pack. Although the bulk of the output was produced at San Pedro, the canneries at San Diego and Monterey also put up heavier packs than ever before. The large production resulted from the increased prices of competitive grades of salmon and a growing consumer demand. Most of the canned mackerel was sold in the United States although considerable quantities are still exported, principally to the Philippine Islands and Italy.

Canners are planning a large pack for 1934 and are making ready for the coming season which will swing into full stride during the early summer. In the meantime they are taking what quantities they can get although mackerel are scarce at present as is usual during the period from February through April.—*Richard S. Croker, California State Fisheries Laboratory, February 15, 1934.*

### AN UNUSUAL SARDINE

One of the largest sardines ever taken in the San Pedro fishing region was brought to the California State Fisheries Laboratory by Mr. H. J. Langdon, Cannery Inspector, Division of Fish and Game, on February 22, 1934. The fish, taken in local waters the previous night, was 14 inches total length, 300 mm. body length, and weighed 14 ounces. Age determination indicated that it was nine or ten years old. This sardine was exceptionally fat, and anatomical examination showed an entire absence of sex organs. This lack of sex organs probably caused the unusual size and fatness of the fish, since the energy normally expended to mature sex products was devoted to growth in length and weight.—*Frances N. Clark, California State Fisheries Laboratory, February 23, 1934.*

### GROUND FISH

In September, 1933, additional work was started on the fishes taken by the paranzella trawlers which operate principally out of San Francisco. This is the largest fresh fish fishery of northern and central California, producing and marketing 12 to 13 million pounds of fish a year. Of this total about 11 million pounds consists of the various species of soles and sand dabs. The rest of the catch is made up of rockfishes, cultus cod, sablefish, hake, rays and sharks. Large numbers of people are dependent upon this supply as a source for their fish needs and it is important that the Division have a more intimate knowledge of the fishery. As a consequence, work was instigated to gather more information on these fish and on the fishery, and the work will continue until the major problems are solved.

In the short period the work has been in progress the Division has, with the full and utmost cooperation of the dealers who own the paranzella boats, adapted and put into operation a ship's log book on these boats. These logs are furnished by the Division and are made out daily by the captains of the boats, the dealer receiving a copy, the boat a copy, and the Division a copy. On the logs are shown the detailed operation of the fishing boats, the number and time of drags, location of grounds, and the catch of various species for the drags and day. Not only are these logs invaluable to the Division for use in statistical and biological work but they are of equal value to the dealers who will be able to operate their equipment more efficiently and economically with the knowledge gained from the log records.

In addition constant observations are being made in the markets and on the boats themselves on the proportion of species in the catch, the sizes of fish taken by the gear, and material is collected which will lead to a knowledge of the life history of the important species in the catch.

The dealers and operators of the paranzella boats have most willingly cooperated in all phases of the work. They realize that it is to their advantage to do anything in their power to conserve the fish upon which the fishery depends and upon which their business is founded.—*G. H. Clark, February 28, 1934.*

### THE PISMO CLAM IN 1933

The condition of the population of Pismo clams (*Tivela stultorum*) on Pismo-Oceano Beach is somewhat better than it was a year ago. For many years the clams have been showing every evidence of serious depletion due to excessive digging. However, the economic depression caused a slacking off of digging, and as a consequence the mortality of clams was probably at a minimum in 1933.

As previously reported by Clark (California Fish and Game, vol. 18, no. 2, pp. 170–180, 1932) the spawning seasons of 1929, 1930 and 1931 were very successful and resulted in good sets of young clams. However, the first-year survival of these sets was but 36 per cent, as compared with an average of over 80 per cent prior to 1929. In other words, these three good spawnings were not given much chance to repopulate the beach. Large clams had become so scarce that diggers took even those less than a year old.

Due to the diminution of digging in 1933, the survival of clams of all ages has been good since 1932. More clams of the 1927 and 1928 seasons are on the beach than had been expected. These clams are just attaining legal size (5 inches). The 1929 and 1930 sets are holding out much better than expected, considering the heavy mortality during their first two years on the beach, but for some reason the 1931 set is showing very poorly. Not much can be hoped for from the 1932 set which was too small to be of any importance, but there are indications that its first-year mortality was low.

The 1933 set was fairly good, in fact better than any since 1924 with the exception of the three referred to above. As usual, the set of young clams was poorest in the area closed to digging at the south end of the beach. The young clams were very small when observed in November, probably due to the cold summer and a late spawning.

The average size of the 1933 clams was 15 mm. as compared with 22 mm. for the 1931 clams at a comparable date.

New laws prohibiting digging or the possession of digging tools on the beach at night and prohibiting the possession of digging tools at any time in the closed area are expected to facilitate patrol work on the beach.—*Richard S. Croker, California State Fisheries Laboratory, December 12, 1933.*

## THE LIFE HISTORY OF THE BAY SMELT

Three species of the Atherinidae, or silversides, family are taken in California waters. The jack smelt plays the most important role in the commercial fisheries of the entire State. Bay smelt, however, are taken in important numbers in the San Francisco and Monterey regions and small quantities occur in the southern California catches. The grunion, the third of these three silversides, is renowned because of its unusual habit of depositing the eggs at high tide line on the southern California beaches. The life histories of the jack smelt and grunion have been studied previously and published by the California Division of Fish and Game.* Dr. Leonard P. Schultz now contributes the life history of the bay smelt in a recent publication, "The age and growth of *Atherinops affinis oregonia* Jordan and Snyder and of other subspecies of bay smelt along the Pacific coast of the United States." † Schultz's work, which is revised in the following paragraphs, is of special interest because of the problems which have arisen as a result of the size limit placed on smelts by the last California State Legislature.

Three subspecies of bay smelt are recognized as inhabiting the mainland bays of the Pacific coast from Oregon to San Deigo, California. *Atherinops affinis oregonia* ranges from Oregon to Humboldt Bay, California. *A. affinis affinis* is found from San Francisco to Monterey Bay and intergrades with *A. affinis littoralis* from Monterey to Santa Barbara. The latter species occurs in bays as far south as San Diego.

Schultz's paper covers in greatest detail the life history of *A. a. oregonia* but also comprises studies of the life history of *A. a. littoralis*. Calculations of the age and rate of growth are based on length frequencies and scale readings. Scales proved satisfactory for age determination through the third year for the Oregon bay smelt. For the southern California species, scales were not satisfactory because 15 per cent of the fish failed to form an annulus in the first year and in other instances the scale structures were so indistinct that in only 72 per cent of the total could the annuli be identified.

The approximate average standard length in millimeters at the end of each year for the two species was found to be as follows:

| Age | I | II | III | IV | V | VI |
|---|---|---|---|---|---|---|
| *A. a. oregonia* | | | | | | |
| Male | 98 | 185 | 215 | 230 | 240 | 255 |
| Female | 100 | 190 | 220 | 240 | 260 | 280 |
| *A. a. littoralis* | | | | | | |
| Both sexes | 60 | 100 | 115 | --- | --- | --- |

* Clark, Frances N. 1925. The life history of *Leuresthes tenuis*, an atherine fish with tide-controlled spawning habits. Fish Bull., no. 10, 51 pp.
Clark, Frances N. 1929. The life history of the California jack smelt, *Atherinopsis californiensis*. Fish Bull., no. 16, 22 pp.
Thompson, William F., and Thompson, Julia B. 1919. The spawning of the grunion (*Leuresthes tenuis*). Fish Bull., no. 3, 29 pp.

† Univ. Washington, Publ. Biol., vol. 2, no. 3, pp. 45–102, 1933.

The maximum length for the Oregon bay smelt was 299 mm. and the oldest specimens were in their seventh or eighth year. The largest specimen of the southern California subspecies was 169 mm. and the oldest specimen in its seventh or eighth year. The rate of growth of *A. a. littoralis* is much slower than of *A. a. oregonia* and yet the maximum age is probably the same for both subspecies.

About 5 per cent of the Oregon bay smelt reach maturity in their second year and the remainder in their third, but at least two-thirds of *A. a. littoralis* mature in their second year and the remainder in their third. *A. a. oregonia* spawns in Coos Bay, Oregon, in May, June and early July. *A. a. littoralis* spawns in Anaheim Bay and San Diego Bay in April, May and June and possibly as late as July. Little material was available for a study of *A. a. affinis,* but its life history apparently occupies an intermediate position between *A. a. oregonia* and *A. a. littoralis.*

*A. a. oregonia* migrates during the spring to the upper part of Coos Bay, where spawning takes place. In the late summer this bay smelt occurs only in the lower part of the bay. Between October and February it is not taken in Coos Bay by commercial fishermen, who say these fish have entered the ocean.—*Frances N. Clark, California State Fisheries Laboratory, February 21, 1934.*

## NOTES ON THE SARDINE FISHERY

The sardine season which closed at Monterey and northern California on February 15 and which will close at San Pedro and southern California on April 1 will be recorded as the most successful in the history of the industry so far as the size of the catch is concerned. When the figures are all in, the catch for the season, including the floating plants operating outside the 3-mile limit beyond the control of the State, will exceed 350,000 tons. This amount exceeds by more than 25,000 tons the previous greatest season of 1929–1930. Roughly, 125,000 tons of the sardines taken this present season were used for canning, while 225,000 tons were used in reduction plants. The number of cases of sardines packed this season was less than half that of the big season of four years ago. The reason for the greatly increased catch was the liberal granting of reduction permits by the Fish and Game Commission.

Similar permits were granted to sardine plants during the previous season to relieve actual distress among the fishermen and to enable the sardine plants to operate in the face of the great slump in foreign demand for California canned sardines. As the prices for the reduction products, oil and meal, were also very low, the fishermen received only $4 per ton for their fish. Quite a number of the plants did not open and most of the plants which operated did not exhaust the amount of their permits. The catch was therefore light and the season was an unprofitable one, especially for the fishermen.

The present season opened with much better prospects. There was a better market for canned sardines and the prices for sardine oil and meal had advanced nearly 50 per cent over the previous season. After considerable bickering and a strike of a month on the

part of all sardine fishermen, the price was set at $7 per ton. All plants in the State operated and two or three new ones started up, so that all told the season has been a very satisfactory one to both the fishermen and the canners.

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The increase in the amount of sardines caught this season does not mean that sardines are becoming more abundant. The fact is that the sardines were less abundant this season and the increased catch was made by increasing the fishing effort. Many more and larger boats are now fishing than in the past and the fishermen are working harder and longer with this increased equipment to make their catches. That the increase of the present season's catch over the past season is due to a greater fishing effort is well illustrated by the operations of the two largest of the floating reduction plants operating off the California coast. During the present season the weather conditions were better and the fishermen and the two plants were more experienced but, with a 56 per cent increase in the number of large purse seine boats, they were able to increase their catch but 21 per cent. This means that sardines were not so abundant this season as last. During the present season the average catch per haul of the net was only half that of last season.

This decrease in the sardine supply was expected and predicted at the opening of the present season. The following communication from the State Fisheries Laboratory, dated August 29, 1933, predicting conditions to be expected during this sardine season, was distributed to the members of the sardine industry.

During the past year various members of the laboratory staff have formulated predictions about the 1933–1934 sardine season. As the season is now opening, we wish again to call your attention to the possibilities for the coming season.

In discussing the California sardine fishery, it is necessary to distinguish between the fall and winter fisheries, and our predictions are made on this basis. By fall fishery we mean at Monterey and San Francisco the fishing carried on from August through November, and at San Pedro fishing in November and December. The winter fishery includes December, January and February at San Francisco and Monterey, and January, February and March at San Pedro.

In the 1933–1934 season we expect that fall fish in Monterey Bay will be scarce and large in size; at San Pedro fall fish will probably be fairly abundant and of small size. In all localities the winter fish will be less numerous than in the immediatey preceding winters and of unusually large size.

In December, 1932, we pointed out that in the past four years only two relatively abundant year classes have entered the California sardine fishery. These year classes have supplied the major portion of the sardines taken in the fall months during these past four seasons. In the winter months the fishery has been maintained by older fish which at the present time (August, 1933) have largely disappeared from the fishery because of intensive fishing and natural mortality.

On the bases of these facts, in February, 1933, tentative predictions were made for the 1933–1934 sardine season. After the close of the 1932–1933 season and after the spring conditions at San Diego were determined, final predictions for the coming season were forwarded to you in July, 1933.

No abundant group of sardines has entered the fishery since 1930. As the sardine contributes materially to the commercial catch only up to its seventh year, the year classes which entered previous to 1929 no longer play an important role in the fishery. The year classes which entered the fishery in the fall of 1929 and 1930 supplied the bulk of the sardines in the 1932–1933 season and played an important role in the fisheries for the previous three seasons. It is clear that the sardine fishery is and has been largely dependent upon the year classes which entered the fishery in 1929 and 1930. In the coming season, 1933–1934, the industry

will still have to depend on these two groups. It is certain that both groups have been diminishing and will continue to diminish in numbers from now on.

### San Francisco and Monterey Fall Fishery

### (August to December)

The outlook for the Monterey 1933 fall fishery, therefore, is not promising. Our studies show that no new abundant year class will enter this fishery this season. The fishery will have to rely on the older year classes (groups entering the fishery in 1929 and 1930) which have been the mainstay of the fall fishery throughout California for the past three and four years. These year classes can no longer furnish a large supply of fish to the Monterey fall fishery. Therefore, the Monterey boats will have difficulty in obtaining fish in the Bay and will have to go farther north for their fish. This will lengthen the trips, decrease the total deliveries, and prevent the smaller boats from participating heavily in the fishery. San Francisco will have a fairly abundant supply of large sardines and the boats in that region will experience less difficulty in making catches than will the boats in Monterey Bay.

The bulk of the Monterey fall sardines for 1933 will be of large size, roughly eleven inches in total length. San Francisco sardines will be the same or slightly larger in size.

### San Pedro Fall Fishery

### (November to December)

The prospects for the San Pedro fishery in the fall of 1933 are more promising. In the spring of 1933 observations made at San Diego indicated a fairly abundant group of quarter-oil sizes. These sardines should enter the San Pedro fishery in the fall of 1933. If this group appears, the San Pedro fall fishery will be supplied by moderately abundant fish of small size (8 to 9 inches, total length). These sizes will comprise the major part of the catch.

If this year class does not enter the San Pedro fishery in the expected magnitude, the fall fishery in this region will experience a scarcity similar to that for Monterey. The fish will be irregular in size, varying from 9 to 11 inches in total length.

The abundant year class, which is expected to enter the San Pedro fishery in the fall of 1933, will have to support the 1933 San Pedro fall fishery and the 1934 Monterey fall fishery; possibly also the 1935 fall fisheries in all localities if no other abundant group enters the fishery. For this reason the fish supplying the 1933 San Pedro fall fishery should be relieved of as much strain as possible. To accomplish this, the industry at San Pedro should be urged to concentrate on the winter fishery (January 15-April 1).

### Winter Fishery for All Localities

### (January-February-March)

The abundance of the winter fish along the entire coast will presumably be somewhat less than in the 1932–1933 season. This fishery is supplied by older fish than the fall fisheries, and in 1933–1934 will chiefly depend on the year classes which entered in 1929 and 1930. As pointed out above, these year classes have been subjected to heavy fishing in the past three years and they probably will not be able to maintain an abundant winter fishery in 1933–1934. The sizes of sardines in the winter of 1933–1934 will be large, the bulk of the catch exceeding eleven inches in total length.

It may be well to point out at this time that because a high percentage of the winter fish are quite large, at present, and are rapidly passing out of the fishery, also because there have been only two comparatively abundant groups entering the fishery in the past four years (and these two groups, 1929 and 1930, have been intensively fished during this period), that two or three years hence the winter fish will be rather seriously reduced in numbers. Perhaps this reduction will be so great that the fishermen will not be able to supply the cannery demand.

Explanations

"Abundance," as used in the above predictions, means relative numbers of sardines only. When we speak of an abundant supply we refer to more than average, and when we mention "scarcity" we mean less than average. During a season when we predict a scarcity of fish, boats may and probably will experience good fishing for short periods. On the other hand, when we predict abundant fish for a season, there will be time intervals in the season when the boats will have difficulty in locating fish.

Under present conditions of the industry, we are not able to predict the actual tonnage to be expected for a given season. This is due to the fluctuating effort expended by the canneries and the fishermen. In a season when fish are scarce, the fishermen may exert greater effort and the total tonnage caught may equal or exceed a season when fish are abundant. Predictions of total catch can not be made unless an industry is stabilized and exerts the same amount of fishing effort each year.

These predictions were borne out to a remarkable degree of accuracy. The fishery is entering a period of comparative scarcity of fish and it is the prudent thing to take good care of the present supply of sardines. It was due to this warning that the Commission cut down the amount of the reduction permits issued to each plant by 1500 tons under that of last year. Sardine shore plants naturally object to having their reduction activities curtailed while the floating plants, operating offshore outside the State's jurisdiction, can operate without any restrictions.

The sardine industry of California was about the first of the fishery industries to formulate a code of fair competition acceptable to the code committee at Washington, D. C. The object of the N. R. A. is not only to eliminate unfair competition but also to conserve natural resources, and, as members of the sardine industry believed the floating reduction plants are unfair competitors and are a menace to the future supply of sardines on our coast, they sought to include those plants within the scope of the code and thus bring them under the jurisdiction of the State, the same as the shore plants. This was naturally opposed at Washington by the floating reduction plant interests.

The Division of Fish and Game aided the sardine canners in their move to bring these plants under the same State control as the shore plants by submitting a brief by N. B. Scofield for the final Washington hearing on the sardine code pertaining to the effect of floating plants on the sardine conservation program of the Division. This brief was presented and defended at the Washington hearing on January 29 by John L. Farley, Executive Officer of the Division. The code has not as yet been signed (March 5) although, to hurry its acceptance so as to curb the immediate evils of price cutting, it was agreed to let the matter of including the floating plants in the code go over for further investigation and future action on the part of the executive committee of the regional code.

The Bureau of Commercial Fisheries has been of considerable assistance to different fisheries groups which have been formulating codes. From the records of the Fisheries Laboratory, charts were prepared giving the daily sardine landings at Monterey and San Pedro, to be used in showing fluctuations in the sardine supply and their effect on the hours of labor of cannery employees. Similar information for salmon, shad, striped bass and albacore for the region from

Monterey to the Oregon line is being furnished for the wholesale fish dealers' organization.—*N. B. Scofield, March 5, 1934.*

## FRESH FISH MARKETING ACTIVITIES

The Bureau of Commercial Fisheries is cooperating with over five thousand fresh fish dealers in creating a greater consumer acceptance and demand for fresh food fish. The principal bars to wider distribution of fishery products are the price, or rather the lack of public knowledge as to the factors that influence prices, and the lack of public knowledge of proper methods of preparation of fresh fish for human consumption.

The price question is well illustrated at any gathering where a representative of the fish industry talks on the marketing of its products. For whenever the question of price comes up, the inevitable question is asked: "Why does fish cost as much and sometimes more than meats? The ocean teems with them, they cost nothing to feed and require no care; while live stock, on which we depend for our meat supply, have to be fed, housed and cared for almost as carefully as we care for ourselves. This expense, of course, has to be absorbed by the ultimate buyer of the meat. With fish there are no such costs to be considered."

While it is true that fish are self-sufficient and do not depend upon man's efforts to feed or raise them, the process of getting them from their native element to our table is a good deal more complicated than is the case with live stock. Ask any angler sport fisherman who has spent a day in a mountain stream endeavoring to catch trout and he will tell you that though the fish are there, it is not always so easy to catch them.

Men who fish commercially encounter the same difficulty in securing catches of fish that the amateur angler does. They often go out for days at a time and return with nothing. Naturally their expenses for gear, boats and living go on just the same. These expenses are not small, particularly when we realize that the average fisherman has invested in his gear and boat between $1,000 and $10,000, with larger fishing gear costing as high as $125,000. The fish he catches must help pay for this gear and also pay his wages.

Fish are highly perishable unless properly refrigerated. They must be handled by experienced and skilled men and if sent from distant points must be cleaned, boxed, iced and shipped by fast transportation at high rates. All of these charges must be added to the cost of the fish before the wholesaler or retailer can take his profit.

Also while the average person would not expect to get fresh peaches in December unless prepared to pay a premium for them, the same individual will buy fish not available in local waters, fish that are in all likelihood expressed from some distant point, and become indignant at the price asked. This indignation will find its expression in the conclusion that all fish are high-priced with the result that fish is passed by in future purchasing of food products.

Over fifty different species of excellent food fish are produced from the waters of the State. The average housewife buying fish only knows

or calls for three or four kinds and consequently nearly seventy-five per cent of the fish sold are of these four species. Depletion of these species and high prices are the natural result of such concentration of consumer demand. The lack of knowledge of the housewife of the great number of varieties of food fish and sea foods, and the many ways to properly prepare them, has led us to compile our cookery book "Five Hundred Ways to Prepare California Sea Foods."

The recipes used in our fish cookery book were contributed by leading chefs and cookery experts and were thoroughly tested before including them in the book. The index contains all the varieties of fish and sea foods taken in California. It indicates the most popular ways of preparing and refers the reader to the page whereon the recipe is found. It also gives the seasons of each variety and the months in which they are in greatest abundance.

Copies of this cookery book can be procured without charge by writing to the Bureau of Commercial Fisheries of the Division of Fish and Game, 450 McAllister Street, San Francisco.—*A. A. Alstrom, March 2, 1934.*

## FEDERAL WILD-LIFE RESTORATION PROGRAM

Momentous developments with reference to the Federal Government's interest in alleviating unsatisfactory wild-life and game conditions throughout the Nation transpired in Washington in January of this year. Never, in the history of our country, has the Federal Government displayed such an interest in this problem and at no time have official branches of the Government, conservation, farm and sportsmen factions been in such unanimity of opinion as was recently evidenced in Washington.

On January 2, 1934, Secretary of Agriculture Wallace appointed the so-called President's Committee on Wild-life Restoration consisting of Thomas H. Beck, Wilton, Connecticut, chairman; J. N. Darling, Des Moines, Iowa, and Professor Aldo Leopold, Madison Wisconsin. This committee, which was charged with the consideration of a national wild-life restoration problem of the broadest scope, met continuously from January 6 to February 8 when their initial report comprising conclusions and recommendations was transmitted to the Secretary.

This committee concluded that: "A national wild-life restoration program is economically justifiable and immediately practical by utilizing submarginal and commercially unprofitable agricultural lands now contributing so largely to the surplus of agricultural projects."

Projects comprising approximately 5,000,000 acres were selected by the committee and submitted in their report for consideration. Nineteen projects embracing the restoration of migratory waterfowl breeding grounds and totaling 198,000 acres were herein included for the State of California. Foremost among these is the restoration for migratory waterfowl breeding grounds purposes of Lower Klamath Lake. In fact, so important does the committee consider this matter, that the following quotation is made from the introduction to that portion of their report relating to migratory waterfowl:

"An ironic commentary on our neglect of waterfowl nesting areas is had in the proclamation of President Theodore Roosevelt

setting aside Lower Klamath Lake, Oregon, as a sanctuary, in which he said, 'this is one of the greatest wild fowl nurseries in the United States. * * * An outdoor museum * * * which will prove of great educational value.'

"And in the report of F. L. Lathrop in 1932 which states, 'Lower Klamath Lake was drained after much difficulty and expense and dried up—devastated by numerous fires and abandoned as unfit for agricultural development.'"

Another specific project recommended by this committee that will improve migratory waterfowl conditions for California is the proposal to retire from agricultural development a large portion of the submarginal lands adjacent to Malheur Lake, Oregon, and permit them to revert into waterfowl breeding grounds.

The restoration of migratory waterfowl nesting areas throughout the Nation is the first and most immediate concern of this committee. They recommend the speedy acquisition of 4,000,000 acres of land potentially or actually suitable for this purpose, same to become inviolate when acquired. To insure immediate possession and control and still provide time for careful surveys, proper selection and construction work, the committee suggested one-year leases at 5 per cent of the purchase price with options to buy at an agreed price any time during the lease period.

The committee recommended the purchase of 5,000,000 acres of submarginal land suitable for development and management as upland game (grouse, quail, wild turkey, rabbits, etc.) areas, and advocated the ultimate acquisition of 10,000,000 acres for this purpose. Such land would not necessarily become inviolate, but regulated shooting under State supervision might later be permitted on it at such a time as the game populations become sufficient.

The purchase of at least 1,000,000 acres of areas known to comprise the nesting grounds of such song, insectivorous, ornamental and nongame birds as are becoming scarce was urged by the committee. Some instances in this connection related to the nesting sites of herons, cranes and the long-billed curlew, many of which have been encroached upon by agricultural development.

The committee recommended the acquisition of 2,000,000 acres needed for the restoration of big game animals and fur bearers, which should include the purchase of outlying farms or ranches where grazing privileges interfere with the protection of wild-life ranges. There are undoubtedly many instances in California where our deer, elk, antelope and mountain sheep may be enormously relieved under this plan.

The President's Committee also advocated the withdrawal of grazing privileges on extensive tracts of public domain, and in the national parks and forests where the acreage necessary to graze a head is too great to permit of any profit, and the repurchase of the water rights in such areas. It urged that the government take title to all reversion land in the public domain and retain same for the restoration of wild life and improvement of soil conditions.

It is the intention to carry out the above purchase program by the use of $25,000,000 emergency funds which President Roosevelt has made available for the purpose. The committee asked that an addi-

tional similar amount be allotted from P. W. A. and C. W. A. moneys to be used for restoration and improvement of the lands acquired.

The committee finally proposed consolidation and coordination of Federal departments and bureaus having authority affecting wild life into a businesslike administration set-up to carry the plan into successful execution.

In addition to this most comprehensive and tremendously important plan of the President's Committee many other important conservation measures are now being considered in Washington. Most of these matters are contained in a message which was adopted and signed by the Chairman of the Senate Committee on Conservation of Wild-life Resources, the Chairman of the President's Committee on Wild-life Restoration, and the representatives of 47 interested organizations, at the Senate Committee hearing on January 25, 1934, and presented to the President by a select committee the following day.

This message first stressed the enthusiastic appreciation and the hearty cooperation pledged by these 47 units including sportsmen, nature lovers and farmers' organizations, representatives of the Audubon Societies, and sportsmen's magazines, and conservation commissioners to the restoration plan of the President's Committee, the essential proposals of which were included in the text of the message.

The conference unanimously approved the following measures and recommendations which were also included in the message presented to President Roosevelt.

1. The duck stamp bill prepared by the Special Senate Committee on the Conservation of Wild-life Resources, Senate Bill 1658 and House Bill 5632.

2. Senator Joseph T. Robinson's wild-life refuge bill, No. 2277: A bill to establish fish and game sanctuaries in the National forests and on other public lands, approved by the Senate committee and now on the Senate Calendar.

3. The coordination bill, introduced by the Senate committee, to coordinate conservation activities of the several Federal departments, which passed the Senate and was approved by the House committee in the last session.

4. Your stimulating order setting aside the sum of $25,000,000 for the withdrawal of submarginal lands from commercial agriculture which suggests the use of certain portion of these lands for migratory waterfowl and upland game.

5. That appropriations should be made as authorized under the Norbeck-Andresen bill and the policy established therein for a period of 10 years (5 years have already gone) should be renewed.

6. The treaty with Canada established our duty to conserve migratory birds along their annual flight lanes within our country. When these birds reach the Mexican border, or the Gulf of Mexico, many of them cross into the domain of our sister republics to the south, particularly Mexico. We recommend that negotiations be entered into to bring about a treaty with Mexico similar in character to that with Canada.

This delegation received an enthusiastic reception from the Chief Executive, who commented with pleasure upon the novelty of its unanimity of opinion, an unprecedented occurrence in similar gatherings. Executive Officer John L. Farley and Nathan Moran, our member of the Federal Migratory Bird Advisory Board, were members of this delegation, having gone to Washington to represent California at the Senate committee hearings.

Subsequent to this meeting, there was formed in the House a Committee on the Conservation of Wild-life Resources that will operate in that body in the same manner in which the Senate committee of similar title functions. This committee is composed of 14 members. Repre-

sentative A. Willis Robertson, Virginia, is chairman, and California is fortunate in having two Representatives, Frank H. Buck, Vacaville, and A. E. Carter, Oakland, members of this committee.

At the time that this note is written, the Senate has passed the duck stamp bill, Senator Joseph T. Robinson's wild-life refuge bill, No. 2277, and the so-called coordination bill, No. 2529, which was introduced by the Senate committee. Telegraphic advice just received from Representative Carter states that the House passed these three bills on March 5 and that there is every indication that all three measures will receive executive approval inasmuch as each has received the President's endorsement.—*James Moffit, March 6, 1934.*

## 1933 DEER KILL STATISTICS

Provisional deer tag returns for the 1933 season appeared on pages 79 and 80 of the January, 1934, issue of CALIFORNIA FISH AND GAME. Final compilation of deer statistics and deer tag sales for the year 1933 have been made and are included under "Reports" in this issue. —*James Moffitt, March 6, 1934.*

## DEER HERD WINTERS WELL

Reports from many of the game wardens, notably from Siskiyou, Modoc and Lassen counties, and along the western flank of the Sierra Nevada indicate that the deer in these areas are coming through the winter in fine shape. This condition is due, no doubt, to the fact that the winter has been such a mild and open one with little or no snow or unusually cold weather.

Several recent reports from Modoc and Siskiyou counties indicate that in many instances the deer have not yet been driven down to their usual wintering grounds and on account of lack of snowfall, they have been able to winter at higher elevations than usual. The game wardens report from all sections that the deer are in excellent condition, and due to the open condition of the ranges loss from predatory animals has been unusually light.—*James Moffitt, March 6, 1934.*

## DIVISION IMPORTS QUAIL FROM MEXICO

The advisability of importing quail from Mexico for stocking in southern California areas has been considered for some time by the Fish and Game Commission. The decision to do so was made by the Commission in August, 1933, when negotiations were commenced with the Mexican Department of Agriculture at Mexico City to waive that country's customary 35 cents per live bird export tax in favor of the State of California. The birds were to originate in Baja California and by the time local problems there were ironed out and the free export permit obtained, 1934 had arrived.

The permit was issued for 100,000 birds, and stipulated they must originate from points south of San Telmo, which is about 160 miles south of the border by road. This fact embraced a serious transportation problem. Nevertheless, when this and other difficulties had been

overcome 8000 quail were secured during the first six weeks of 1934. The Division expects to receive considerable more birds before operations cease for the season. We anticipate that the unused portion of the permit for 100,000 birds will be received after the close of the coming nesting season.

All imported quail are received by Division employees at the border, where they are checked and then transported to the State Game Farm at Chino. Here they are held under observation for from two to three weeks after which each is banded with one of the Division's bands and the birds are then liberated in suitable areas. Under present plans these Mexican quail will only be liberated in California in areas south of the Tehachapi where types of country closely approximating their native habitat obtain.—*A. E. Burghduff, February 21, 1934.*

## REVISED ESTIMATE OF 1933 CALIFORNIA WATERFOWL ABUNDANCE

A preliminary note on waterfowl abundance in California during the 1933 season appeared on pages 78 and 79 of the January number of this quarterly.

It now appears in light of subsequent and more complete reports that this note, which was written before the close of the 1933 hunting season, was too optimistic.

Captain of Patrol William J. Harp reported that duck hunting in the Humboldt Bay district last season was the poorest during his six years' residence in that area. He believes that less than 25 per cent of the number of ducks present in that region three years ago were in evidence during the 1933 season. Harp reported that the widgeon was the commonest species throughout the entire past season and that the largest decrease in numbers appeared to be among sprig and mallard.

Late reports from the Sacramento Valley continue to confirm the concentration of a large number of ducks in the Butte Creek Basin region, but shooting elsewhere in the Valley, particularly in the so-called "West Side" area, between Williams, Colusa and Willows, was exceptionally poor last season due to a distinct shortage of ducks in that area. Our earlier report to the effect that Suisun Bay and marshes harbored more ducks in 1933 than in the previous year seems to be entirely confirmed by later reports. However, more recent advices from the Sonoma and Napa marshes and the San Pablo Bay region of San Francisco Bay indicate fewer ducks in that area last year than in the previous season.

Similarly later reports from the Wasco-Delano section of northern Kern County are contradictory to earlier reports we received, in that it appears that fewer birds were present there in 1933.

Game Warden E. H. Glidden, San Diego, provided a very careful check on the number of ducks killed on the City Water Department lakes and Sweetwater Lake in San Diego County which afford most of the duck shooting in that region. These reports indicate a total kill of 42,638 ducks on these lakes which formed an average of 4.3 birds per hunter. Glidden advised that in this area, the sprig is apparently the only species of duck that is holding up in numbers satisfactorily. He

states that a decided decrease in the number of the other species of ducks visiting San Diego County lakes was noted in 1933 over the previous season with the exception of redhead and ring-necked ducks, which latter species seemed to be more abundant than usual last year. With the exception of the three species named, he estimates a 50 per cent decrease in the number of ducks visiting the San Diego County lakes in 1933 over 1932.

Game Wardens J. W. Harbuck and W. S. Talbott provided detailed reports upon duck hunting success in the Salton Sea area. Harbuck's report for the southern end of the Salton Sea indicated that approximately the same number of birds were present and were bagged by sportsmen last year over the previous one. In that area, he considered widgeon and sprig to be about even in abundance and these species comprised 60 per cent of the duck population in that area. The balance was made up approximately of 15 per cent shovellers, 10 per cent teal, 5 per cent redheads and 10 per cent other species.

Game Warden Talbott reported on the Mecca section at the northern end of Salton Sea where he states that private and commercial duck clubs took more birds in the 1933 season than in the previous year, but that unattached shooters had poor success in this area. The species bagged in this area in order of abundance were sprig, widgeon, redhead and bluebill. Talbott believes that there were approximately the same number of ducks in this area in 1933 as in the previous season.

Later reports than those provided in our January issue fail to revise the statements therein contained relative to waterfowl abundance at Tule Lake and in the San Joaquin Valley, other than in the Delano-Wasco area.—*James Moffitt, March 6, 1934.*

## ADDITION TO LIST OF TOTALLY EXCLUDED ANIMALS STATE IMPORTATION LAW

In accordance with the provisions of section 9 of Chapter 76, Statutes of 1933, the Fish and Game Commission and the State Department of Agriculture have added the rodent family OCTODONTIDAE to the list of totally excluded species. Therefore, this rodent family is hereby added to the list of totally excluded species listed under Regulation 1, pages 3 and 4 of "Rules and Regulations Governing the Importation of Wild Birds and Animals Into the State of California and Conditions Under Which Same May Be Kept in Confinement."

The family OCTODONTIDAE includes the subfamily Capromyinae and the genus *Myocastor* in which the nutria or coypu, *Myocastor coypus,* is classified. This South American fur-bearing rodent is the species most likely to be offered for import into California and all applications for its importation or that of other members of this rodent family will be denied.—*James Moffitt, Division of Fish and Game, San Francisco, Cal., March 2, 1934.*

## STATEMENT OF INCOME

### For the Period July 1, 1933, to December 31, 1933, of the Eighty-fifth Fiscal Year

| | | |
|---|---|---|
| Departmental income—current year: | | |
| License sales— | | |
| Angling licenses, 1932 | $5,475 00 | |
| Angling licenses, 1933 | 144,761 50 | |
| Angling licenses, 1934 | 63 00 | |
| Commercial Hunting Club licenses, 1933-34 | 1,750 00 | |
| Commercial Hunting Club Operators licenses, 1933-34 | 390 00 | |
| Deer tags, 1932 | 1,143 25 | |
| Deer tags, 1933 | 64,038 00 | |
| Fish Breeders' licenses, 1933 | 20 00 | |
| Fish Importers' licenses, 1933 | 5 00 | |
| Game Breeders' licenses, 1933 | 130 00 | |
| Hunting licenses, 1931 | 261 30 | |
| Hunting licenses, 1932-33 | 8,387 18 | |
| Hunting licenses, 1933-34 | 169,726 00 | |
| Market Fishermen's licenses, 1933-34 | 23,290 00 | |
| Trapping licenses, 1933-34 | 911 00 | |
| Wholesale Fish Packers' Shell Fish Dealers, licenses, 1933-34 | 805 00 | |
| Total license sales | | $421,156 23 |
| Other income— | | |
| Contributions from importers | $159 15 | |
| Court fines | 15,544 01 | |
| Fish Packers' tax | 63,121 98 | |
| Fish Tag sales | 368 73 | |
| Game Tag sales | 73 62 | |
| Interest on bank balances | 2,911 55 | |
| Income from Department of Agriculture Fund—Chap. 825-33 | 45,131 65 | |
| Kelp Tax | 80 | |
| Lease of kelp beds | 1,025 60 | |
| Miscellaneous sales | 296 60 | |
| Publication sales | 218 85 | |
| Dividends, California National Bank (50%) | 18,545 08 | |
| Dividends, Trinity County Bank at Weaverville (12½%) | 88 75 | |
| Total other income | | 147,486 37 |
| Total departmental income—current year | | $568,642 60 |
| Income for the General Fund: | | |
| Filing fees, Section 710, Code of Civil Procedure | | 2 00 |
| Grand total, departmental income and income for the General Fund | | $568,644 60 |

## STATEMENT OF EXPENDITURES

For the Period July 1, 1933, to December 31, 1933, of the Eighty-fifth Fiscal Year

| Function | Salaries and wages | Materials and supplies | Service and expense | Property and equipment | Total |
|---|---|---|---|---|---|
| Administration: | | | | | |
| Executive | $4,179 96 | | | | $4,179 96 |
| Clerical and office | 2,760 00 | $271 24 | $82 98 | | 3,114 22 |
| Printing—general | | 630 99 | | | 630 99 |
| Automobile | | 177 74 | 132 10 | | 309 84 |
| Traveling | | | 1,587 07 | | 1,587 07 |
| Postage | | | 2,507 19 | | 2,507 19 |
| Telephone and telegraph | | | 1,625 58 | | 1,625 58 |
| Freight, cartage and express | | | 309 05 | | 309 05 |
| Rent | | | 6,962 28 | | 6,962 28 |
| Accident and death claims | | | 2,703 25 | | 2,703 25 |
| Accounting pro rata | 2,249 98 | | | | 2,249 98 |
| Legal | 493 56 | | 111 56 | $65 32 | 670 44 |
| Premiums on bonds | | | 15 00 | | 15 00 |
| Publicity | | | 93 97 | | 93 97 |
| Total administration | $9,683 50 | $1,079 97 | $16,130 03 | $65 32 | $26,958 82 |
| Bureau education and research: | | | | | |
| Chief | $1,079 85 | | | | $1,079 85 |
| Clerical and office | 960 00 | $29 73 | $22 24 | | 1,011 97 |
| Automobiles | | 208 82 | 128 83 | | 337 65 |
| Freight, cartage and express | | | 1 23 | | 1 23 |
| Traveling | | | 1,167 11 | | 1,167 11 |
| Postage | | | 14 80 | | 14 80 |
| Library | 540 00 | 3 48 | 21 07 | $29 18 | 593 73 |
| Photography | | 3 23 | 70 35 | | 73 58 |
| Research | 2,389 03 | 86 01 | | 10 50 | 2,485 54 |
| Publicity | 1,200 00 | | 16 29 | | 1,216 29 |
| Total bureau education and research | $6,168 88 | $331 27 | $1,441 92 | $39 68 | $7,981 75 |
| Bureau patrol and law enforcement: | | | | | |
| Chief and assistants | $5,550 00 | | | | $5,550 00 |
| Clerical and office | 1,590 00 | $29 67 | $9 45 | | 1,629 12 |
| Automobiles | | 8,848 73 | 4,345 77 | $2,098 80 | 15,293 30 |
| Traveling | | | 21,811 95 | | 21,811 95 |
| Postage | | | 271 97 | | 271 97 |
| Telephone and telegraph | | | 796 58 | | 796 58 |
| Freight, cartage and express | | | 9 20 | | 9 20 |
| Rent | | | 296 46 | | 296 46 |
| Captains and wardens | 88,020 00 | 760 71 | 535 66 | 11 60 | 89,327 97 |
| Launches | | 688 83 | 610 28 | | 1,299 11 |
| Fish planting | 2,310 00 | 425 53 | 961 00 | | 3,696 53 |
| Premiums on bonds | | | 207 00 | | 207 00 |
| Cooks | 750 00 | | | | 750 00 |
| Game refuge guard | 270 00 | | | | 270 00 |
| Commercial fisheries patrol: | | | | | |
| Chief and assistants | 1,380 00 | | | | 1,380 00 |
| Captains and wardens | 7,095 50 | 6 64 | 10 66 | | 7,112 80 |
| Launches | 5,368 71 | 2,776 62 | 1,355 58 | 165 75 | 9,666 66 |
| Fish cannery inspectors—seasonal | 5,150 33 | | | | 5,150 33 |
| Traveling | | | 2,436 50 | | 2,436 50 |
| Rent | | | 379 00 | | 379 00 |
| Automobiles | | 97 42 | 188 24 | | 285 66 |
| Temporary help | 17 00 | | | | 17 00 |
| Total bureau patrol and law enforcement | $117,501 54 | $13,634 15 | $34,225 30 | $2,276 15 | $167,637 14 |
| Bureau commercial fisheries: | | | | | |
| Chief and assistants | $6,810 00 | | | | $6,810 00 |
| Clerical and office | 4,796 34 | $25 01 | $17 00 | | 4,838 35 |
| Automobiles | | 102 08 | 60 43 | | 162 51 |
| Traveling | | | 2,437 82 | | 2,437 82 |
| Postage | | | 7 00 | | 7 00 |
| Telephone and telegraph | | | 256 80 | | 256 80 |
| Freight, cartage and express | | | 60 16 | | 60 16 |
| Rent | | | 73 18 | | 73 18 |
| Heat, light, water and power | | | 143 45 | | 143 45 |
| Research | 1,140 00 | 24 01 | | | 1,164 01 |
| Laboratory | 11,203 07 | 397 15 | 371 42 | $70 23 | 12,041 87 |
| Statistics | | 68 54 | 1,176 00 | 83 75 | 1,328 29 |
| Temporary help | 88 39 | | | | 88 39 |
| Total bureau commercial fisheries | $24,037 80 | $616 79 | $4,603 26 | $153 98 | $29,411 83 |

## STATEMENT OF EXPENDITURES—Continued

For the Period July 1, 1933, to December 31, 1933, of the Eighty-fifth Fiscal Year

| Function | Salaries and wages | Materials and supplies | Service and expense | Property and equipment | Total |
|---|---|---|---|---|---|
| Bureau fish culture: | | | | | |
| Chief and assistants | $3,555 00 | $13 20 | $160 50 | | $3,728 70 |
| Clerical and office | 2,040 00 | 6 55 | 1 50 | | 2,048 05 |
| Automobiles | | 2,709 66 | 783 94 | $22 73 | 3,516 33 |
| Traveling | | | 4,443 49 | | 4,443 49 |
| Postage | | | 99 16 | | 99 16 |
| Telephone and telegraph | | | 493 88 | | 493 88 |
| Freight, cartage and express | | | 226 35 | | 226 35 |
| Rent | | | 1,523 62 | | 1,523 62 |
| Heat, light and power | | | 705 90 | | 705 90 |
| Hatcheries | 53,547 72 | 24,721 86 | 602 87 | 144 61 | 79,017 06 |
| Fish cars | 1,770 00 | 274 39 | 635 85 | | 2,680 24 |
| Blue printing | | | 1 52 | | 1 52 |
| Cooperative research | 1,575 00 | 246 41 | 1,011 63 | 1 15 | 2,834 19 |
| Temporary help | 443 00 | | | | 443 00 |
| Fish hatchery assistant—seasonal | 11,753 88 | | | | 11,753 88 |
| Hydraulic engineering | 1,200 00 | 1 12 | 487 59 | 29 21 | 1,717 92 |
| Special field | 3,669 96 | 21 94 | | 94 79 | 3,786 69 |
| Total bureau fish culture | $79,554 56 | $27,995 13 | $11,177 80 | $292 49 | $119,019 98 |
| Bureau game propagation: | | | | | |
| Chief and assistants | $2,730 00 | | | | $2,730 00 |
| Automobiles | | $258 33 | $150 50 | | 408 83 |
| Traveling | | | 1,210 70 | | 1,210 70 |
| Postage | | | 39 01 | | 39 01 |
| Telephone and telegraph | | | 101 42 | | 101 42 |
| Freight, cartage and express | | | 17 96 | | 17 96 |
| Heat, light and power | | | 624 09 | | 624 09 |
| Maintenance | 6,455 71 | 3,539 50 | 242 95 | | 10,238 16 |
| Temporary help | 405 75 | | | | 405 75 |
| Quail trapping and expansion of quail program | 2,400 00 | 638 62 | 1,139 49 | $492 18 | 4,670 29 |
| Total bureau game propagation | $11,991 46 | $4,436 45 | $3,526 12 | $492 18 | $20,446 21 |
| Bureau fish rescue: | | | | | |
| Chief and assistants | $2,400 00 | | $13 59 | | $2,413 59 |
| Traveling | | | 50 82 | | 50 82 |
| Rent | | | 50 00 | | 50 00 |
| Temporary help | 69 00 | | | | 69 00 |
| Heavy truck service | | | 506 90 | | 506 90 |
| Total bureau fish rescue | $2,469 00 | | $621 31 | | $3,090 31 |
| Bureau game refuges: | | | | | |
| Chief and assistants | $4,249 98 | | | | $4,249 98 |
| Clerical and office | 960 00 | $2 10 | $12 50 | | 974 60 |
| Automobiles | | 183 03 | 97 33 | | 280 36 |
| Traveling | | | 2,136 45 | | 2,136 45 |
| Telephone and telegraph | | | 95 | | 95 |
| Lion hunters | 2,782 00 | | | | 2,782 00 |
| Refuge posting | 360 00 | | | | 360 00 |
| Predatory animal control | | | 2,460 00 | | 2,460 00 |
| Refuge maintenance | 4,065 50 | 1,543 15 | 873 32 | | 6,481 97 |
| Predatory animal hunters and trappers—seasonal | 2,600 00 | | | | 2,600 00 |
| Temporary help—seasonal | 1,755 00 | | | | 1,755 00 |
| Total bureau game refuge | $16,772 48 | $1,728 28 | $5,580 55 | | $24,081 31 |
| Bureau licenses: | | | | | |
| Clerical and office | $6,570 00 | $23 83 | $7 35 | | $6,601 18 |
| Printing—licenses and applications | | 7,368 14 | | | 7,368 14 |
| Traveling | | | 291 44 | | 291 44 |
| Postage | | | 580 98 | | 580 98 |
| Freight, cartage and express | | | 448 79 | | 448 79 |
| Premiums on bonds | | | 935 00 | | 935 00 |
| Total bureau licenses | $6,570 00 | $7,391 97 | $2,263 56 | | $16,225 53 |
| Total 85th fiscal year expense paid from support appropriations | $274,749 22 | $57,214 01 | $79,569 85 | $3,319 80 | $414,852 88 |

## STATEMENT OF EXPENDITURES—Continued

### For the Period July 1, 1933, to December 31, 1933, of the Eighty-fifth Fiscal Year

| Function | Salaries and wages | Materials and supplies | Service and expense | Property and equipment | Total |
|---|---|---|---|---|---|
| Special items: | | | | | |
| Claim of chief accounting officer of Department of Finance—Chap. 991-33 | | | | $2,259 11 | |
| Deer tight fences—Chap. 872-31 from July 1, 1933, to December 31, 1933 | | | | 1,498 05 | |
| Electro Metals Company's claim—Chap. 599-31 | | | | 18,750 00 | |
| License commissions | | | | 21,853 07 | |
| State Fair and other exhibits | | | | 432 44 | |
| Total special items | | | | | $44,792 67 |
| Permanent improvements: | | | | | |
| Construction, improvements and equipment | | | | | $43,780 82 |
| Prior year expense: | | | | | |
| 83d fiscal year | | | | $71 70 | |
| 84th fiscal year | | | | 25,943 52 | |
| Total prior year expense | | | | | $26,015 22 |
| Bureau commercial fisheries—Chap. 825-33: | | | | | |
| Fresh fish marketing— | | | | | |
| Chief and assistants | $1,710 47 | | | | $1,710 47 |
| Clerical and office | 479 03 | $2 15 | $11 55 | | 492 73 |
| Automobiles | | 6 50 | 2 50 | | 9 00 |
| Traveling | | | 238 88 | | 238 88 |
| Postage | | | 35 00 | | 35 00 |
| Telephone and telegraph | | | 2 61 | | 2 61 |
| Freight, cartage and express | | | 59 49 | | 59 49 |
| Rent | | | 5 15 | | 5 15 |
| Exhibits | | 133 39 | 2,623 39 | | 2,756 78 |
| Temporary help | 315 00 | | | | 315 00 |
| Total bureau commercial fisheries—Chap. 825-33, fresh fish marketing | $2,504 50 | $142 04 | $2,978 57 | | $5,625 11 |
| Grand total proprietary group | | | | | $535,066 70 |

## SEIZURES OF FISH AND GAME

**October, November, December, 1933**

| | |
|---|---|
| Fish: | |
| Abalones | 266 |
| Abalones, pounds | 4,500 |
| Bass, striped, pounds | 1,962 |
| Bass, striped (fish) | 44 |
| Clams | 3,178 |
| Crabs | 244 |
| Cockles | 254 |
| Catfish, pounds | 10 |
| Lobsters, pounds | 2,655 |
| Mussels, pounds | 208 |
| Salmon, pounds | 2,458 |
| Spears, fish | 4 |
| Traps, fish | 41 |
| Yellowfin, pounds | 3,619 |
| Halibut, pounds | 1,150 |
| Spotfin Croacker, pounds | 400 |
| Game: | |
| Antelope | 1 |
| Deer | 20 |
| Deer meat, pounds | 484 |
| Ducks, geese, mudhens | 90 |
| Doves | 33 |
| Non-game birds | 4 |
| Pheasants | 17 |
| Pigeons | 39 |
| Quail | 44 |
| Rabbits | 2 |
| Shorebirds | 151 |
| Swan | 4 |
| Bird nets | 2 |
| Guns | 2 |

## GAME CASES

**October, November, December, 1933**

| Offense | Number arrests | Fines imposed | Jail sentences (days) |
|---|---|---|---|
| Antelope; killing of | 1 | $100 00 | |
| Bear; closed season | 2 | 25 00 | |
| Deer; closed season; killing of does, fawns; spike buck; illegal deer tags | 67 | 1,485 00 | |
| Ducks; geese; closed season; selling of | 9 | 350 00 | 6 |
| Doves; overlimit | 6 | 55 00 | |
| Hunting; no license or with an illegal license | 54 | 727 50 | 135 |
| Non-game birds; killing of | 8 | 130 00 | |
| Pheasants; closed season | 26 | 455 00 | 100 |
| Pigeons; overlimit | 6 | 400 00 | |
| Quail; closed season; trapping of | 13 | 410 00 | |
| Rabbits; closed season; snaring of | 4 | 35 00 | 50 |
| Shorebirds; killing of | 10 | 235 00 | |
| Swan; killing of | 6 | 75 00 | |
| Shooting from auto, boat or highway | 14 | 179 50 | |
| Spotlight shooting | 19 | 392 50 | |
| Firearms in refuge | 5 | | |
| Trapping; closed season | 1 | | |
| Trespassing | 11 | 165 00 | |
| Totals | 262 | $5,219 00 | 907 |

## FISH CASES

October, November, December, 1933

| Offense | Number arrests | Fines imposed | Jail sentences (days) |
|---|---|---|---|
| Abalones; small; overlimit | 39 | $840 00 | 12 |
| Angling without license | 41 | 435 00 | 65 |
| Bass, striped; small; overlimit; closed season | 14 | 190 00 | 90 |
| Bass, white sea; small | 1 | 25 00 | |
| Catfish; small | 1 | 20 00 | |
| Clams; small; overlimit | 23 | 710 00 | 112 |
| Crabs; small | 4 | 125 00 | |
| Cockles; small | 3 | 75 00 | |
| Commercial fishing; no license | 31 | 75 00 | 22 |
| Halibut; small | 1 | 100 00 | |
| Lobsters; small; trapping of | 21 | 245 02 | 345 |
| Mussels; overlimit | 3 | | |
| Nets, seines; illegal use of | 13 | 650 00 | |
| Night fishing | 1 | | |
| Salmon; untagged | 9 | 110 00 | |
| Illegal fishing apparatus | 7 | 100 00 | 30 |
| Trout; closed season | 1 | 25 00 | |
| Totals | 213 | $3,725 60 | 676 |

## NUMBER OF HUNTERS KILLING TWO DEER—1933

| County of residence of hunter | Number of hunters | County of residence of hunter | Number of hunters |
|---|---|---|---|
| Alameda | 88 | Plumas | 29 |
| Alpine | 1 | Riverside | 23 |
| Amador | 7 | Sacramento | 46 |
| Butte | 43 | San Benito | 17 |
| Calaveras | 6 | San Bernardino | 21 |
| Colusa | 21 | San Diego | 21 |
| Contra Costa | 22 | San Francisco | 130 |
| Del Norte | 3 | San Joaquin | 30 |
| El Dorado | 10 | San Luis Obispo | 63 |
| Fresno | 79 | San Mateo | 28 |
| Glenn | 17 | Santa Barbara | 66 |
| Humboldt | 139 | Santa Clara | 57 |
| Imperial | 2 | Santa Cruz | 29 |
| Inyo | 22 | Shasta | 33 |
| Kern | 63 | Sierra | 10 |
| Kings | 11 | Siskiyou | 66 |
| Lake | 11 | Solano | 26 |
| Lassen | 21 | Sonoma | 99 |
| Los Angeles | 251 | Stanislaus | 20 |
| Madera | 9 | Sutter | 10 |
| Marin | 19 | Tehama | 20 |
| Mariposa | 3 | Trinity | 8 |
| Mendocino | 62 | Tulare | 42 |
| Merced | 13 | Tuolumne | 1 |
| Modoc | 1 | Ventura | 40 |
| Mono | 9 | Yolo | 20 |
| Monterey | 80 | Yuba | 9 |
| Napa | 20 | State of Nevada | 2 |
| Nevada | 6 | | |
| Orange | 33 | Total | 2,057 |
| Placer | 19 | | |

## HUNTING ACCIDENTS—1933*

| | 1933 | 1932 |
|---|---|---|
| Number of persons killed | 47 | 32 |
| Number of persons wounded, not killed | 99 | 124 |
| Number of self-inflicted accidents— | | |
| Fatal | 29 | 17 |
| Nonfatal | 58 | 64 |
| Number of accidents inflicted by others— | | |
| Fatal | 18 | 12 |
| Nonfatal | 41 | 53 |
| Occurred while hunting large game (deer, bear, etc.)— | | |
| Fatal | 9 | 10 |
| Nonfatal | 20 | 26 |
| Occurred while hunting small game (rabbit, duck, quail, etc.)— | | |
| Fatal | 19 | 12 |
| Nonfatal | 45 | 57 |
| Occurred while hunting unknown game— | | |
| Fatal | 19 | 10 |
| Nonfatal | 34 | 41 |

| 1933 Figures only | Fatal | Nonfatal |
|---|---|---|
| Occurred while hunting— | | |
| Ducks | 2 | 10 |
| Quail | 1 | 8 |
| Dove | 3 | 6 |
| Pigeon | 1 | |
| Deer | 9 | 20 |
| Rabbit | 11 | 18 |
| Squirrel | | 2 |
| Coyote | 1 | 1 |

*Figures compiled from newspaper clippings.

## CALIFORNIA FRESH FISHERY PRODUCTS FOR THE MONTHS OF OCTOBER, NOVEMBER AND DECEMBER, 1933

Compiled by Division of Fish and Game, Bureau of Commercial Fisheries

| Species of fish | Del Norte, Humboldt | Mendocino, Sonoma, Lake | Marin | Solano, Yolo | Sacramento, San Joaquin | Alameda, Contra Costa | San Francisco, San Mateo | Santa Cruz | Monterey |
|---|---|---|---|---|---|---|---|---|---|
| Albacore | | | | | | | | | |
| Anchovy | 70 | | | | | | 4,850 | | 13,515 |
| Barracuda | | | | | | | | | |
| Bonito | | | | | | | | | |
| Cabrilla | | | | | | | | | |
| Carp | | 12,700 | | | 2,639 | 23 | | | |
| Catfish | | | | 35 | 42,638 | 36,652 | | | |
| Cultus | 20,423 | 45,466 | | | | | 152,021 | 17,698 | 51,253 |
| Flounder | 4,116 | 1,340 | | | | | 42,281 | 894 | 43 |
| Hake | | 1,725 | | | | | 4,625 | | |
| Halfmoon | | | | | | | | | |
| Halibut—California | | | | | | | 9,822 | 687 | 670 |
| Hardhead | | 29,900 | | | 9,956 | | | | |
| Herring | | | 145,737 | | | | 32,658 | | 43,800 |
| Kelp Bass | | | | | | | | | |
| Kingfish | | | | | | | 3,684 | 1,271 | 71,500 |
| Mackerel—Horse | | | | | | | | | 4,121 |
| Mackerel—Pacific | | | | | | | | 70 | 247,366 |
| Mackerel—Spanish | | | | | | | | | |
| Mullet | | | | | | | | | |
| Perch | 1,079 | 427 | 15,846 | | | | 19,199 | | 3,137 |
| Pike | | | | | | 4 | | | |
| Pompano | | | | | | | | | |
| Ray | | | | | | | | | |
| Rock Bass | | | | | | | | | |
| Rockfish | 26,278 | 62,764 | | | | | 156,732 | 111,378 | 322,898 |
| Sablefish | 301,801 | 23,200 | | | | | 25,046 | 109,734 | 17,802 |
| Salmon | 25,479 | | | | | | | | |
| Sand Dab | 6,231 | 16,675 | | | | | 72,634 | 12,908 | 2,987 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sardine | | | | | | | 40,583,310 | 390 | 140,727,329 |
| Sculpin | | | | | | | | | |
| Sea Bass—Black | | | | | | | | | |
| Sea Bass—White | | | 27 | | | | 7 | 51 | 77 |
| Shark | | 260 | | | | | 29,315 | 1,245 | 2,085 |
| Sheepshead | | | | | | | | | |
| Skate | 260 | 3,405 | | | | | 42,614 | 700 | 3,292 |
| Skipjack | | | | | | | | | |
| Smelt | 4,206 | 1,968 | 14,152 | | | | 34,948 | 11,367 | 10,117 |
| Smelt—Jack | 356 | | 87 | | | | | 1,873 | |
| Sole | 131,189 | 571,000 | | | | | 1,163,670 | 126,913 | 8,818 |
| Splittail | | 8,300 | | | | 2,415 | | | |
| Sucker | | 9,800 | | | 127 | | | | |
| Swordfish—Broadbill | | | | | | | | | |
| Swordfish—Marlin | | | | | | | | | |
| Tom Cod | 288 | | | | | | 261 | | |
| Tuna—Yellowfin | | | | | | | | | |
| Turbot | | 650 | | | | | 7,569 | | |
| Whitebait | | | 121 | | | | 2,987 | | |
| Whitefish | | | | | | | | | |
| Yellowtail | | | | | | | | | |
| Miscellaneous | 15,189 | 6,016 | | | 90 | | 15,448 | 1,978 | |
| Total fish | 536,965 | 795,596 | 175,970 | 35 | 55,450 | 39,094 | 42,403,681 | 399,157 | 141,530,810 |
| Crustaceans: | | | | | | | | | |
| Crab | 7,352 | 670 | 1,490 | | | 4,236 | 742,574 | 37,098 | 1,356 |
| Shrimp | | | 163,116 | | | 89,995 | 123,670 | | 573 |
| Spiny Lobster | | | | | | | | | |
| Mollusks: | | | | | | | | | |
| Abalone | | | | | | | | | 601,375 |
| Clam—Hardshell | 90 | 204 | 6,557 | | | | 40 | | |
| Clam—Mixed | 6,188 | 668 | | | | | | | |
| Clam—Pismo | | | | | | | | 208 | 7,257 |
| Clam—Softshell | | 1,062 | 50,226 | | | | | | |
| Octopus | | 150 | | | | | 1,912 | 73 | 1,654 |
| Oyster—Eastern and Japanese | | | 37,422 | | | | 81,004 | | 54,205 |
| Squid | | | | | | | | | 336,935 |
| Totals | 550,595 | 798,350 | 434,781 | 35 | 55,450 | 133,325 | 43,352,881 | 436,536 | 142,534,165 |

All amounts shown in pounds unless otherwise specified. Skipjack and Albacore cleaned.

## CALIFORNIA FRESH FISHERY PRODUCTS FOR THE MONTHS OF OCTOBER, NOVEMBER AND DECEMBER, 1933—Continued

Compiled by Division of Fish and Game, Bureau of Commercial Fisheries

| Species of fish | San Luis Obispo, Santa Barbara, Ventura | Los Angeles | Orange | San Diego, Imperial | Total | Fish from west coast south of the International Boundary brought into San Pedro | Fish from west coast south of the International boundary brought into San Diego | Total fish from west coast south of the International boundary brought into California |
|---|---|---|---|---|---|---|---|---|
| Albacore | | 40 | | | 40 | | | |
| Anchovy | | 12,506 | 256 | | 31,197 | | | |
| Barracuda | 39,085 | 155,730 | 1,283 | 32,546 | 228,644 | 5,290 | 29,828 | 35,118 |
| Bonito | | 4,529 | 788 | 106,285 | 111,602 | 54,552 | 65,816 | 120,368 |
| Cabrilla | | | | | | 439 | | 439 |
| Carp | | | | | 15,362 | | | |
| Catfish | | | | | 79,325 | | | |
| Cultus | 261 | 334 | 41 | | 287,497 | | | |
| Flounder | 4 | 1,199 | 232 | | 50,109 | | | |
| Hake | | 100 | 42 | | 6,492 | | | |
| Halfmoon | | 90 | | | 90 | | | |
| Halibut—California | 77,816 | 17,191 | 6,112 | 4,002 | 116,300 | | 43,908 | 43,908 |
| Hardhead | | | | | 39,856 | | | |
| Herring | 109 | | | 4,419 | 226,723 | | | |
| Kelp Bass | | 387 | | | 387 | | | |
| Kingfish | 37 | 93,406 | 7,076 | 215 | 177,189 | | | |
| Mackerel—Horse | 3,357 | 719,971 | 488 | | 727,937 | | | |
| Mackerel—Pacific | 16,505 | 21,038,795 | 370,901 | 2,509,759 | 24,183,396 | | 689 | 689 |
| Mackerel—Spanish | | | | | | 2,602 | 795 | 3,397 |
| Mullet | | 355 | 19 | 889 | 1,263 | | | |
| Perch | 524 | 4,051 | 1,198 | 10 | 45,471 | 112 | | 112 |
| Pike | | | | | 4 | | | |
| Pompano | 2 | 272 | | | 274 | | | |
| Ray | | 125 | 428 | | 553 | | | |
| Rock Bass | 3,819 | 12,033 | 14,164 | 31,183 | 61,199 | 5,830 | 421 | 6,251 |
| Rockfish | 30,332 | 287,293 | 29,985 | 72,505 | 1,100,165 | | 15,603 | 15,603 |
| Sablefish | 63 | 85,336 | 85,630 | 704 | 649,316 | | | |
| Salmon | | | | | 25,479 | | | |
| Sand Dab | | 1,360 | 3,675 | | 116,470 | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sardine | 45 | 91,131,768 | | 193,863 | 272,636,705 | | | |
| Sculpin | 195 | 6,829 | 1,179 | 865 | 9,068 | | | |
| Sea Bass—Black | 44 | 1,258 | 727 | 5,891 | 7,920 | 71,988 | 69,228 | 141,216 |
| Sea Bass—White | 16,078 | 47,507 | 315 | 7,494 | 71,556 | 32,002 | 172,506 | 204,508 |
| Shark | 1,735 | 7,871 | 15,262 | 6,415 | 64,188 | | | |
| Sheepshead | 4,105 | 12,968 | 880 | 4,647 | 22,600 | | | |
| Skate | | 1,537 | 357 | 140 | 52,305 | | | |
| Skipjack | | | 10 | | 10 | 999,415 | 4,995,427 | 5,994,842 |
| Smelt | 68 | 41,920 | 7,927 | 7,289 | 133,962 | | | |
| Smelt—Jack | 128 | 663 | | 37 | 3,144 | | | |
| Sole | 74,461 | 1,256 | 198 | 427 | 2,077,932 | | | |
| Splittail | | | | | 10,715 | | | |
| Sucker | | | | | 9,927 | | | |
| Swordfish—Broadbill | 8,943 | 197,460 | 29,915 | 75,114 | 311,432 | | 36,078 | 36,078 |
| Swordfish—Marlin | | 954 | | 606 | 1,560 | | | |
| Tom Cod | | | | | 549 | | | |
| Tuna—Yellowfin | | | | 510 | 510 | 4,145,820 | 12,655,704 | 16,801,524 |
| Tarbot | | | 4 | | 8,223 | | | |
| Whitebait | | | | | 3,108 | | | |
| Whitefish | 189 | 17,985 | 396 | 7,285 | 25,855 | 803 | 2,531 | 3,334 |
| Yellowtail | | 13,327 | 190 | 91,894 | 105,411 | 185,734 | 450,991 | 636,725 |
| Miscellaneous | 68 | 1,400 | 53 | 480 | 40,722 | 138 | 268 | 406 |
| Total fish | 277,973 | 113,919,806 | 579,731 | 3,165,474 | 303,879,742 | 5,504,725 | 18,539,793 | 24,044,518 |
| Crustaceans: | | | | | | | | |
| Crab | | 2,097 | | | 796,873 | | | |
| Shrimp | | | | | 377,354 | | | |
| Spiny Lobster | 40,908 | 69,970 | 12,665 | 30,537 | 154,080 | 12,239 | 236,387 | 248,626 |
| Mollusks: | | | | | | | | |
| Abalone | 144,838 | | | | 746,213 | | | |
| Clam—Hardshell | | 6,397 | 80 | | 13,368 | | | |
| Clam—Mixed | | | | | 6,856 | | | |
| Clam—Pismo | 16,073 | | | | 23,538 | | | |
| Clam—Softshell | | | | | 51,288 | | | |
| Octopus | | | 25 | | 3,814 | | | |
| Oyster—Eastern and Japanese | | | | | 172,631 | | | |
| Squid | | | 3 | | 336,938 | | | |
| Totals | 479,792 | 113,998,270 | 592,504 | 3,196,011 | 306,562,695 | 5,516,964 | 18,776,180 | 24,293,144 |

All amounts shown in pounds unless otherwise specified. Skipjack and albacore cleaned.

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# 1933–ABSTRACT CALIFORNIA SPORTING FISH & GAME LAWS–1935

THIS ABSTRACT WILL BE VALID UNTIL 90 DAYS AFTER ADJOURNMENT OF THE 1935 LEGISLATIVE SESSION

## OPEN AND CLOSED SEASONS

WHITE SQUARES INDICATE OPEN SEASON. NUMBERS IN SQUARES ARE OPEN DATES

| GAME | DISTRICTS | JAN. | FEB. | MAR. | APR. | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC. | BAG AND POSSESSION LIMITS, ETC. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEER | 1½ | | | | | | | | | | 15 | | | No Does, Fawns or Spike Bucks<br>No Forked Horned Deer in Dist. 1¾<br>No sale of Venison or Deer Skins<br>Two Bucks per Season<br>except in 1¾ where limit is one.<br>See Notes 6-9-10-12 |
| | 2-2½-3 | | | | | | | | | 14 | | | | |
| | 2¼-4-4½ | | | | | | | | 16 | 15 | | | | |
| | 1-1¾-4½-23-25 | | | | | | | | | 16 | 15 | | | |
| Rabbits—Cottontail and Brush | ALL EXCEPT 4, 4¾, 19, 21 | | | | | | | | | | | 15 | 12 | 15 per day. 30 per week. Season always open in 4, 4¾, 19, 21 |
| Bear, Fur Animals | ALL | | | | | | | | | | | 16 | | See Note 7 |
| Ducks, Geese, Jack Snipe, Mud Hens | ALL — FEDERAL LAW | See Note → | | | | | | | | | | | | Federal regulations will be enforced in California and will be published as soon as announced by Federal authorities. |
| | ALL — STATE LAW | 15 | | | | | | | | | | | | 15 Ducks daily, 30 weekly, possession limit, 25 Snipe daily, possession limit. Geese & Mud hen limit see note 6. See notes 9 to 13, incl. |
| Quail—Valley, Desert and Mountain | ALL EXCEPT 1½ | | | | | | | | | | | | 15 | Valley - Desert - Mountain<br>Each Variety<br>10 per day. 10 in possession.<br>20 per week |
| | 1½ | | | | | | | | | | | | | |
| Dove | ALL EXCEPT 4-4½-4¾ | | | | | | | | | | | | | 15 Per Day 15 in possession<br>30 Per Week |
| | 4-4½-4¾ | | | | | | | | | | | | | |
| Pheasant | | | | | | | | | | | | 15<br>20 | | 2 Male birds per day<br>2 in possession |
| Pigeon | | | | | | | | | | | | | 15 | 10 per day 10 in possession<br>20 per week |

There is no open season on Elk, Antelope, Mountain Sheep, Sea Otter, Beaver, Tree Squirrel, Sierra Hare, Rail, Wood Duck, Swan, Shore Birds (except Jack Snipe), Grouse, Sage Hen, Imported Quail, Partridge, or Wild Turkey

| FISH | DISTRICTS | JAN. | FEB. | MAR. | APR. | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC. | BAG AND POSSESSION LIMITS, ETC. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Steelhead and all Trout (except Golden) Whitefish<br>Unlawful to take trout in waters closed by Governor's proclamation | 1-1½-1¾-2-2½-3-4-4½-4¾-15 Klamath River, Lake Almanor | | | | | | | | | | | | | Bag limit for taking and possession, 25 trout or 10 pounds and one trout. |
| | 2½ | | 28 | | | 30 | | | | | | | | |
| | 23-25 | | | | | 10 | | | | | | | | |
| | Truckee River | | | | | 15 | | | | | | | | |
| | See Note 22 | | | | | | | | | | | | | |
| | 1½-5 and Winter Klamath River | | 28 | | | | | | | | | | | 5 Trout regardless of weight |
| | Russian, Napa, Navarro, Eel in 2, 2-, 12a, Tidewater 2-3-15. | | 28 | | | | | | | | | | | 3 Trout regardless of weight |
| | Sacramento River between Vina Ferry and Middle Creek, Shasta County | | | | | | | | | | | | | 3 Trout regardless of weight |
| Golden Trout | ALL EXCEPT 1-4½ | | | | | | | | | | | | | 20 per day. None under 5 inches<br>Not more than 10 lbs. and one<br>See Note 22 |
| | 1-4½, Except Cot Isenwood Lakes group | | | | | | | | | | | | | |
| BLACK BASS | ALL EXCEPT 4¾ | | | | | | 29 | | | | | | | 15 per day<br>No closed season at 4¾ |
| | CLEAR LAKE | | | | | | | | | | | | | Clear Lake 10 per day<br>25 per day |
| Sunfish | ALL | | | | | | 29 | | | | | | | 25 per day |
| Sacramento Perch and Crappie | ALL EXCEPT CLEAR LAKE | | | | | | 29 | | | | | | | 25 per day |
| | CLEAR LAKE | | | | | | | | | | | | | 10 per day |
| Striped Bass | ALL | | | | | | | | | | | | | Feather River from mouth to Oroville, closed January 1st to April 30th<br>None under 12 inches, 5 per day 5 in possession None to be taken from Sutter Sea See Notes 19 and 28. |
| Crabs | ALL EXCEPT 1½-6-7-8-9 | | | | | | | | | | | | 15 | Season Districts 1½-6-7-8-9 December 15 to August 30<br>See Note 23, None under 7 inches, No Female |
| Abalones | | 14 | | | 16 | | | | | | | | | Only for food. Must be brought to shore alive in shell<br>Angling License Required. See Note 26 |
| Pismo Clams | 17 | | | | | | | | | | | | | None under 5 inches. No shipment. 15 per day<br>Angling License Required District 18a Closed |
| Spiny Lobster | ALL | | | | | | | | | | | | | No Sale of Meat. None under 10½ or over 16 inches<br>See Note 23 |
| GRUNION | ALL | | | | | | | | | | | | | |

| No Sale |
|---|
| No Spearing for other restrictions See Notes 12-15-16-20 21-22-27-28 30-32 On this Card |
| No Black Bass under 9 in. |
| No sale |
| Hook and line only |
| Hook and line only |
| No sale |

**SALMON, See Note A.** **STURGEON, No Open Season (possession prohibited).**

## NOTES

1. To hunt, kill, possess wild birds or mammals, to possess firearms, except under written permit from the Commission, in Dists. 1a, 1b, 1c, 1d, 1e, 1f, 1g, 1h, 1i, 1j, 1k, 1m, 1n, 1o, 1p, 1q, 1r, 1s, 1t, 2a, 2b, 3a, 3b, 3c, 3d, 3e, 3f, 3g, 3h, 4a, 4b, 4c, 4d, 4e, 4f, 4g, or General Grant Refuge, or Mt. Tamalpais Game Refuge, including Richardson Bay, or San Francisco Refuge, or Silver Lake Refuge (water fowl may be killed in 4a and 4e), or to hunt quail in Bolinas Quail Refuge, or to hunt or discharge firearms in Huntington Lake Refuge, San Leandro Bay Refuge, or Monterey Peninsula Refuge.

2. To hunt birds or mammals excepting predators without a hunting license. To hunt in areas closed by proclamation.

3. To possess any bird net or to net, trap or to hold protected game or birds of any kind, their nests or eggs except under written permit from the Commission.

4. To take more than 4 geese per day, 8 per week of all varieties, and 12 Canada geese and black sea brant. To take more than 25 mud hens per day, 50 per week. To have more than 1 daily bag limit of geese and mud hens in possession by 1 person in 1 day.

5. To take or kill nongame birds, except blue jay, butcher bird, English sparrow, sharp-shinned, Cooper or duck hawk, great horned owl, linnet, crow, black-billed magpie, white pelican, shag, and in Dists. 1, 2, 3, 4 and 4g, blackbirds.

## IT IS ALWAYS UNLAWFUL

6. To hunt deer without deer tag license. To fail to attach to horns of deer immediately on killing, properly filled out deer tag or at same time to send duplicate tag to Division. To carry deer into closed district without having deer tag countersigned, or to have untagged deer in possession. To fail to retain in possession during open season and for 10 days after, skin and portion of head bearing horns of deer killed and to produce upon demand. To use more than 1 dog to hunter in hunting deer or to allow dogs to run deer in closed season, or to possess doe or fawn skins, or deer skins not bearing evidence of sex.

7. To trap for profit without first procuring a trapping license bear, ring-tailed cat, coon, pine marten, skunk, fisher, wolverine, mink, river otter, fox or muskrat, or to kill game during closed season, except when destroying property. To interfere with traps of licensed trappers. To use saw tooth or spike-jawed traps for taking fur bearers.

8. To use any animal other than dog to stalk wild birds.

9. To shoot game from power boat, sailboat, auto, airplane, or to hunt waterfowl from scull boat in Dists. 8, 9, except on Wed. and Sun., or at any time in Dist. 12 or Napa River south of Edgerly Island, and in Mare Island Straits from the Napa River to Carquinez Strait, or to use shotgun larger than 10 gauge, or to possess an extension automatic or cane gun. To have in possession any device capable of or to be used in silencing the report of any firearm.

10. To shoot resident game between ½ hour after sunset and ½ hour before sunrise, or migratory game between sunset and ½ hour before sunrise. To use a spotlight in hunting game.

11. To drive game birds by means of auto, airplane, or power boat over shooters.

12. To hold game or fish longer than 5 days after close of season; venison 15 days.

13. To sell wild game, except cottontail and brush rabbits.

14. To make a false statement in applying for license. To fail to show license upon demand to any officer.

15. To take game fish from one district to another when season is not open in both. (Special law for deer, trout and black bass.) Trout legally taken may be transported from open district into closed district by the consignor making an affidavit in duplicate setting forth his name, address, number of angling license and name and address of consignee. Original must be attached to shipment; copy left on file with officer before whom sworn. Trout may be shipped into closed district when accompanied by written statement to effect that trout were legal, signed by shipper, countersigned by agent to whom offered for shipment. Black bass legally taken may be transported from open district into closed district.

16. To ship wild birds, mammals, or fish except smoked or dried fish other than trout by parcels post, or in concealed packages or without a tag bearing name and address of consignee and consigner and contents, or to ship game out of State.

17. To operate a commercial hunting club without license.

18. To place obstructions in streams in Dists. 1, 1½, 2, 2½, 2¾, 3, 4, 4½, 23 and 25 that will stop or impede fish.

19. To sell striped bass taken with hook and line; to transport or carry striped bass out of State. To ship striped bass less than 20 in. in length or more than 10 lbs. in weight. To possess more than 5 shad per day between June 1 and Feb. 14.

20. To take trout other than with rod and line held in hand or with lure with more than 2 attractor blades or more than 3 hooks. To take trout except by angling in such manner as to cause trout to voluntarily take hook in its mouth.

21. To have in possession any fish spear or gaff (except landing gaff) within 300 feet of any lake or stream when unlawful to spear salmon.

22. To take trout in any lake within 300 feet of mouth of any stream from Oct. 31 to Aug. 1, or in that portion of any stream flowing into any lake in Dist. 23 within 2 miles from its mouth, upstream, from Oct. 31 to Aug. 1. To take golden trout in Cottonwood Lakes group, including South Fork Cottonwood Lakes group and ½ mile of stream below the lower lake in each of said groups, except from July 1 to Oct. 31.

23. To bring to shore crabs or lobsters in such condition that size can not be taken; or to ship or carry crabs out of Dists. 1½, 2½, 5, 6, 7, 8 or 9. To sell any crabs taken in Eel River or tributaries or to possess more than 10 crabs taken there or to take any between ½ hour after sunset and ½ hour before sunrise.

24. To take or possess in Dist. 3 salt water eels of less than 12 in. or more than 15 per day.

25. To take or possess crickles less than 1½ in. in diameter, or to take or possess more then 15 (Dists. 2 and 10) Washington clams or more than 10 horse clams or more than 30 razor or jackknife clams per day, or in Dists. 18, 19, 21 more than 15 lbs. of mussels per day. To take or posses any Pismo clams in Dist. 18 between ½ hour after sunset and ½ hour before sunrise, or to possess any clam digging implement in that district. To possess any clam digging implement in any clam preserve.

26. To take red abalones less than 7 in., in greatest diameter; green, 6½; pink, 6; black, 5; in dry abalones; to dive for abalones in Dists. 7, 15, 16, 17, 19, 20 and 20a; to take more than 10 per day or 20 per week in Dists. 7, 15, 16, 17, 19, 20 and 20a. To take more than 10 per day from shore in Dists. 7, 10 and 18; to take more than 10 black abalones per day in Dists. 15, 16, 17, 18, 19, 20, 20a, 21. To possess more than 10 per day in Dist. 2.

27. To fish for game fish without having an angling license.

28. To take game fish between 1 hour after sunset and 1 hour before sunrise in Dists. 1, 1½, 1¾, 2, 2½, 2¾, 3, 4, 4½, 4¾, 23, 25. To take striped bass by hook and line between sunset and sunrise.

29. To fish with nets except in commercial districts or to injure any legal net.

30. To fish through ice for any fish or to take fish in Dist. 14.

31. To place, cause to be placed, or discharge into any waters substances deleterious to fish or plant life.

32. To fish within 250 ft. of fishway or 150 ft. of upper side of fish screen, or lower side of dam, or to take fish except salmon within ½ mile of either side of spawning station, or any lake within ½ mile of spawning station when station is in operation.

33. To kill, injure or capture Cal sea lions in Dists. 19, 20, 20a.

34. To take invertebrates or marine plants in Hopkins Marine Refuge (Monterey Co.) or in that area between the west line of the property of the Scripps Institute and a line 1,000 feet west of low tide line (San Diego Co.).

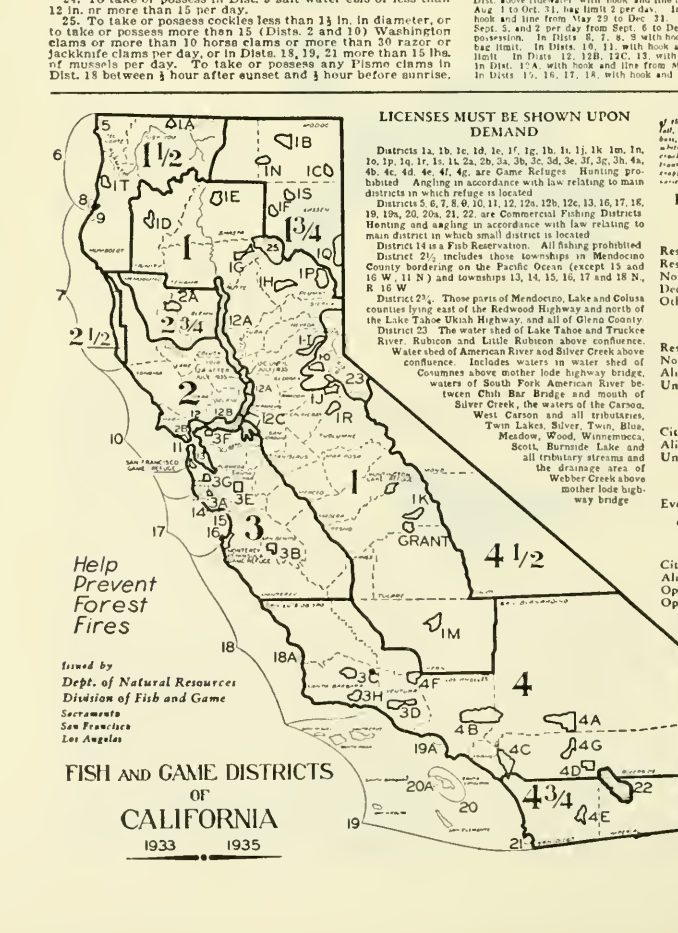
35. To take more than 5 white sea bass from May 1 to June 30, or to take at any one time more than 5 under 28 in.

36. To take more than 30 lbs. of halibut under 4 lbs. each, or to take more than 5 barracuda less than 4 lbs. each.

37. To take frogs less than 4 in. in length measured from tip of nose to posterior end of body between hind legs, or to take or possess more than 24 frogs per day or 48 frogs per week.

NOTE A.—SALMON. Salmon can not be taken on spawning beds, or within 10 miles of spawn-taking station, or 3 miles north and south of mouth of Klamath River. All salmon boats must have landing net, and no salmon less than 27 in. silver less than 24 in. can be taken in ocean and Humboldt Bay Dists. Undersized salmon can not be gaffed or clubbed, or brought ashore in such condition that size can not be determined. Salmon may be taken with hook and line in any district when trout season for said district is open.

In Dist. 1, salmon may be taken with hook and line or spear between May 29 and Oct. 31, except (a) in Feather River from its mouth to mouth of the Yuba; (b) in American River from its mouth to Fair Oaks bridge. In Dist. 2, (c) in Russian, Napa and Navarro rivers; (d) in Eel River and (e) in tidewater in Dists. 2, 2½ and 15, with hook and line from May 1 to last day of Feb., bag limit 2 per day. In Feather River between mouth of Yuba and Thermalito bridge, with hook and line between May 1 and Dec. 31, bag limit 2 per day. In San Joaquin River, from mouth to Mendota weir, with hook and line from April 1 to Dec. 31. In Dist. 1¾, with hook and line from May 29 to Dec. 31; with spear from Aug. 1 to Oct. 31, bag limit 2 per day. In Dists. 2, 2¾, with hook and line from May 1 to Feb. last; with spear from Nov. 1 to Feb. last, bag limit 2 per day. In Dist. 3, with hook and line from May 29 to Oct. 31. Bag limit 5 per day from May 29 to Sept. 5, and 2 per day from Sept. 6 to Dec. 31, not more than 1 daily bag limit in possession. In Dists 6, 7, 8, 9 with hook and line from April 1 to Sept. 15, no bag limit. In Dists. 9, 11, with hook and line from May 1 to Aug. 20, no bag limit. In Dists. 12, 12B, 12C, 13, with hook and line at any time, no bag limit. In Dist. 12A, with hook and line from May 1 to Feb. last, bag limit 2 per day. In Dists 15, 16, 17, 18, with hook and line from Mar. 1 to July 15.




## LICENSES MUST BE SHOWN UPON DEMAND

Districts 1a, 1b, 1c, 1d, 1e, 1f, 1g, 1h, 1i, 1j, 1k, 1m, 1n, 1o, 1p, 1q, 1r, 1s, 1t, 2a, 2b, 2c, 3a, 3b, 3c, 3d, 3e, 3f, 3g, 3h, 4a, 4b, 4c, 4d, 4e, 4f, 4g, are Game Refuges. Hunting prohibited. Angling in accordance with law relating to main districts in which refuge is located.

Districts 5, 6, 7, 8, 9, 10, 11, 12, 12a, 12b, 12c, 13, 16, 17, 18, 19, 19a, 20, 20a, 21, 22, are Commercial Fishing Districts. Henting and angling in accordance with law relating to main district in which small district is located.

District 14 is a Fish Restocking District. Fishing prohibited.

District 2½ includes those townships in Mendocino County bordering on the Pacific Ocean (except 15 and 16 W., 11 N.) and townships 13, 14, 15, 16, 17 and 18 N., R 16 W.

District 2¾. Those parts of Mendocino, Lake and Colusa counties lying east of the Redwood Highway and north of the Lake Tahoe Ukiah Highway, and all of Glenn County.

District 23. The water shed of Lake Tahoe and Truckee River, Rubicon and Little Rubicon above confluence. Water shed of American River and Silver Creek above confluence. Includes waters in water shed of Cosumnes above mother lode highway bridge, waters of South Fork American River between Chili Bar Bridge and mouth of Silver Creek, the waters of the Carson, West Carson and all tributaries, Twin Lakes, Silver, Twin, Blue, Meadow, Wood, Winnemucca, Scott, Burnside Lake and all tributary streams and the drainage area of Webber Creek above mother lode highway bridge.

*Sporting fishing licenses are required for the taking of the following fish and mollusk only, viz.: yellow fin, marlin, broad bill swordfish, pig fish or Pacific bonito, albacore, barracuda, bonita, rock bass, California whiting (called bass or croakers and corbina), yellow fin, croaker, spotfin croaker, salmon, steelhead and other trout, shad, whitefish, striped bass, black bass, perch, crappie, catfish bass, Pismo clams, abalones, and all varieties of sunfishes.*

## LICENSE PROVISIONS

### HUNTING

License year July 1 to June 30

| | |
|---|---|
| Residents under 18 | $1.00 |
| Resident citizens | 2.00 |
| Nonresident citizens | 10.00 |
| Declarant aliens | 10.00 |
| Other aliens | 25.00 |

### ANGLING

License year January 1 to December 31

| | |
|---|---|
| Resident citizens | $2.00 |
| Nonresident citizens | 3.00 |
| Aliens | 5.00 |
| Under 18 no license required | |

### TRAPPING

License year July 1 to June 30

| | |
|---|---|
| Citizens | $1.00 |
| Aliens | 2.00 |
| Under 18 no license required | |

### DEER TAG

License year January 1 to December 31

| | |
|---|---|
| Everyone (2 tags) | $1.00 |

### COMMERCIAL HUNTING CLUBS

License year July 1 to June 30

| | |
|---|---|
| Citizens | $25.00 |
| Aliens | 100.00 |
| Operators, citizens | 5.00 |
| Operators, aliens | 25.00 |

*For Laws in Full See Fish and Game Code*

*For Commercial Fish Laws See Commercial Abstract*

*For Information Regarding Fish or Game Write to the Division of Fish and Game*

# CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION."

VOLUME 20 SACRAMENTO, JULY, 1934 No. 3

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# A STUDY OF THE LIFE HISTORY AND FOOD HABITS OF MULE DEER IN CALIFORNIA*

*By* JOSEPH S. DIXON

With photographs by the author.

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## INTRODUCTION

The mule deer is the most important species of game mammal found in California. It affords sport, recreation and inspiration to more citizens of California than does any other native mammal.

The mule deer is not restricted to any particular section or portion of the State, but, through its various geographic races, is found the entire length of California from Oregon to the Mexican boundary. As a matter of fact, it is surprising to find that from 1927 to 1933, inclusive, there was only one county in California in which deer were not killed, namely, thickly-populated San Francisco County. Deer, either black-tailed or mule, were killed during that seven-year period in every other county in the State. Furthermore, the mule deer is found in all four national parks located in California; so that the species is enjoyed by *all the people,* bringing pleasure both to the sportsman and to the nonhunting public.

The successful quest of a large "lava" buck is to the average sportsman, the nimrod's crowning achievement. This is emphasized with each passing year. Ten years ago only a few local sportsmen sought Rocky Mountain mule deer bucks in Modoc County. Now, on the opening day of the deer season, hunters pour into that section by hundreds from every portion of the west, each intent on "getting" one of the big "lava" bucks. This increased pressure on the big mule deer in Modoc County is graphically shown by the data afforded by the recently installed system of deer tags, which has been introduced by our State Division of Fish and Game, whereby each hunter taking a buck in California reports to the Division the locality, time, and other details concerning the killing of the deer. We now have dependable information as to the numbers of deer killed in the various counties of the State. From the deer tags we learn that the reported kill of mule

deer bucks in Modoc County has been as follows: 1927, 510; 1928, 729; 1929, 835; 1930, 1129. Thus it will be seen that the toll levied on mule deer in this one county more than doubled in these four years.

The so-called "granite" bucks of the higher central portions of the Sierra Nevada, while not reaching the extreme development of the Rocky Mountain mule deer bucks of Modoc and Lassen counties, are famed among hunters for their large size and craftiness, two characteristics which place them near the top of the list in the eyes of the true sportsman.

The sportsman takes, on the average, a more active and more aggressive interest in game animals than does the stockman or the rancher or the average citizen, yet we find that there are men in other walks of life who have a very direct and concrete interest in deer. This is particularly true in the case of certain owners of small orchards and vineyards along the main western flank of the Sierra Nevada. In many instances these ranchers are located in the midst of forest lands or brush-covered areas where deer have bred up because of favorable conditions, such as abundant food supply and safe breeding places and relative freedom from their natural enemies. In planting alfalfa, grain crops, deciduous orchards and vineyards, the rancher who is located in the chaparral belt is often unintentionally providing an appetizing addition to the normal food of deer. In a similar manner, the ranchman or stockman often affords deer unintentional protection through his efforts to protect his own domestic animals from the inroads of predatory animals such as mountain lions and coyotes. Thus it has come to pass that in many instances deer have increased locally so that they have become a nuisance and, in certain instances, a source of serious loss to the vineyardist and the orchardist.

As a result of my studies regarding the food preferences of deer, I have found that under certain conditions there is serious competition for food between deer and domestic stock. This struggle for sustenance between the wild game (deer) and the flocks and herds of man occurs on both privately owned range land and upon the national forests, of which we have no less than eighteen in California, covering a total area of 19,180,000 acres, which is approximately one-fifth of the land surface area of the State. Through various studies that have been made of the food requirements of both deer and domestic animals, and through actual experience in the field, the writer has found that competition for food is most intense between deer and domestic sheep, the competition being slightly less between deer and range cattle, and least of all between deer and horses.

The continued requests that have come to the writer from time to time for facts and definite data regarding the food habits and life history of deer in California constitute one outstanding reason for the publication of this report. From time to time, notably during the epidemic of hoof-and-mouth disease in California, I have made, at the request of the Fish and Game Commission, special investigations to determine all possible facts regarding the extent, distribution and condition of deer that had contracted the disease. At other times during epidemics among the deer, such as occurred in Modoc County in 1924 and a few years later in Trinity County, I have made special investigations, at the request of our Division of Fish and Game, which is more

directly concerned with the welfare of deer in California than any other State agency. A second State institution which has been directly concerned in ascertaining definite facts concerning the deer of California is the Museum of Vertebrate Zoology of the University of California. Not only have the facts thus obtained been a real contribution to science, but practical and direct use of them has been made by the writer and others. The United States Forest Service and the State Chamber of Commerce have recently shown outstanding interest in deer as a recreational asset of California.

In addition to sportsmen, stockmen and ranchers, there are other people directly interested in the welfare of deer, particularly in our national parks. These are the average citizens who, perhaps, prefer their deer alive rather than as venison. The recreational and inspirational value of deer in our national parks is becoming more and more recognized by an increasingly large number of people. The presence of living deer under natural conditions in the national parks and in the national forests may satisfy certain human wants just as truly when the deer are alive as when they are killed and eaten by the hunter.

Many ranchers who have suffered damage from deer have been forced to take an active interest in the solution of the problems and, in like manner, stockmen whose flocks and herds compete directly with deer for food are also taking an increased interest in these animals.

The author has hunted and studied deer in most of the mountain and foothill counties of California. Furthermore, the observations here presented cover a period of thirty years. During the ten-year period, 1920–1930, as Economic Mammalogist in the Museum of Vertebrate Zoology, I made a special study of the deer of California. More recently, opportunity has also been utilized to study mule deer in Arizona, Colorado, Utah, and Wyoming. As a result, it was found that in these other regions habits of mule deer differed considerably from those of these animals in California. It was therefore deemed important that the data here given as applying to California be restricted to facts found and observations *actually made in and known to apply to mule deer in California.*

Because of limited space, necessitating a fifty per cent reduction, many extensive notes and detailed descriptions covering seasonal color, skull and teeth characters, nomenclature, bibliography, and discussion of other scientific details, have been eliminated from this paper, which deals with the living animal in its native habitat. On the other hand, special reference has been given here to the ecology, life history, and food preferences of mule deer in California. It is my firm belief that any adequate game management is directly dependent upon a thorough knowledge of these fundamental factors. Our game management will be no better than our real knowledge of these vital requirements of the deer.

It is becoming obvious that the time is rapidly approaching when an equitable division of forage between wild game and domestic stock will be a serious question in certain of our national forests. On the one hand, we have the hunters and sportsmen of the State who are insisting that every protection possible be afforded the deer, and on the other hand we have the orchardists, the vineyardists, and stockmen who

suffer real and concrete damage because of the presence of deer. Any just solution of this very real problem must be made upon the basis of known facts, and it is the writer's hope and belief that the data and facts which this study has brought out will be of basic assistance in working out an equitable solution of this problem.

ACKNOWLEDGMENTS

The author of this study wishes to acknowledge the help of, and to express his gratitude to, two friends, Annie M. Alexander and George M. Wright, whose encouragement, interest and support have made this field investigation and this report possible.

Gus Nordquist, Oakland, California, has given much valuable aid by generously allowing the writer to examine in the flesh hundreds of deer heads that have been shipped in by deer hunters from all parts of California to his taxidermy studio to be mounted. Nordquist has also aided in the securing of many critical deer skulls which the writer has used in this study and which are now deposited in the Museum of Vertebrate Zoology of the University of California.

Dr. A. W. Sampson of the Division of Forestry of the University of California has kindly worked and conferred with the writer on numerous occasions regarding the food and forage habits of deer, and has also permitted use of some of his field observations.

The writer is also indebted to J. Bruce, State Lion Hunter of California, for the opportunity to accompany him on numerous lion hunting trips at different seasons of the year. In this way much valuable information was gained at first hand in the field regarding the toll taken by cougars and other natural enemies of deer.

The writer is under obligation to various officials of the Division of Fish and Game for assistance rendered. He is also obliged to the Director of the Museum of Vertebrate Zoology for the use of material in that institution. The writer is likewise indebted to the Director of the National Park Service and to the superintendents and the park naturalists in Lassen, Yosemite, and Sequoia national parks. These gentlemen have furnished information and assistance while the writer has been engaged in working upon the deer problem in the various national parks. To the many forest rangers, fish and game deputies, and other persons who have assisted in numerous ways, I wish to express my gratitude.

## IDENTIFICATION

### CHARACTERS OF THE GENUS ODOCOILEUS

The mule deer belongs to the order ARTIODACTYLA or Even-toed Ungulates, and to the Cervidae or "deer" family. The genus *Odocoileus* as described by Rafinesque (Atlantic Journal, Vol. 1, 1832, p. 109) is placed by Gerrit S. Miller (Bull. 128, U. S. Nat. Mus., 1924, p. 484) between the genus *Cervus* (elk) and the genus *Mazama* (brockets). Two noteworthy characters which separate the deer family from other living ungulates of North America are the possession of antlers and certain dermal glands. The antlers of deer are often incorrectly referred to by sportsmen and others as "horns." However, true horns are derived from cuticle, as claws and nails are. Horns are *hollow* and are usually present in both sexes. With the exception of the pronghorned antelope, horns are *permanent unbranched structures*. On the other hand, antlers are true bone, not hollow, and are normally grown and shed once each year. Antlers are usually branched and, with the exception of caribou and reindeer, are normally borne only by the males of the species.

### NOMENCLATURE

Following are references to the original descriptions of the various subspecies or geographic races of mule deer recorded as occurring in California.

Rocky Mountain Mule Deer—*Cervus hemionus* Rafinesque, Am. Monthly Mag. 1, October, 1817: 436.
*Cariacus macrotis* Say, Narrative Long's Expd. to Rocky Mts., 2, 1823: 88.

California Mule Deer—*Cervus macrotis* var. *californicus* Caton, Am. Naturalist, 10, August, 1876: 464.

Burro Deer—*Dorcelaphus hemionus eremicus* Mearns, Proc. U. S. Nat. Mus., 20, February 11, 1897: 470–471.

Inyo Mule Deer—*Odocoileus hemionus inyoensis* Cowan, Proc. Biol. Soc. Wash., 46, April 27, 1933: 69–70.

Southern Mule Deer—*Odocoileus hemionus fuliginatus* Cowan, Journal of Mammalogy, 14, November, 1933: 326–327.

There has been much difference of opinion regarding the correct scientific name of the Rocky Mountain mule deer. Vernon Bailey and H. H. Sheldon have insisted that *macrotis* is the name that should be used, while Gerrit S. Miller and Dr. Joseph Grinnell have insisted on using *hemionus* in their check lists of mammals. My detailed examination of skulls and teeth of topotype material indicates that several pages would be needed to give a fair presentation of the facts. Because of limited space this will have to be left for a later publication. In this paper common names are used (see distribution map).

## DISTRIBUTION OF MULE DEER IN CALIFORNIA

Of the five forms of mule deer now recognized in California (see distribution map, Fig. 47) three forms, the Rocky Mountain, Inyo, and burro deer occur chiefly or entirely east of the crest of the Sierra Nevada. The other two forms, the California and southern mule deer inhabit the Pacific drainage of the Sierra Nevada. The Rocky Mountain mule deer is found in northeastern California, chiefly in Modoc and

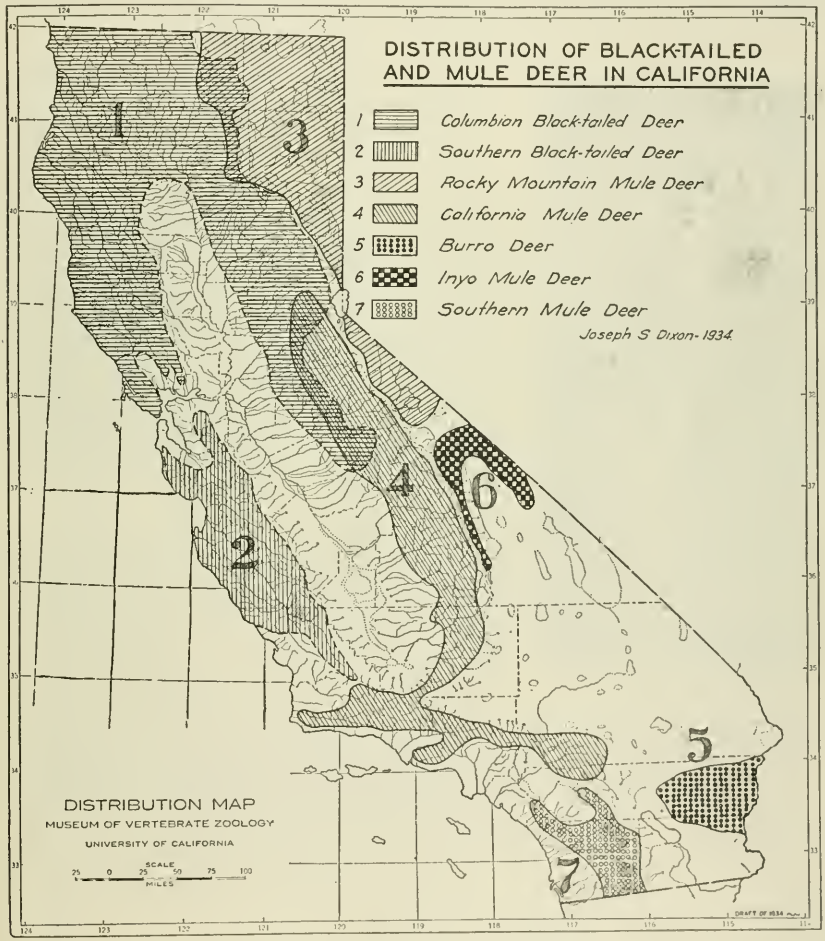


FIG. 47. Map showing author's concept of distribution of mule deer and coast black-tailed deer in California.

Lassen counties and then south along the eastern flank of the Sierra Nevada to Mono Lake. The Inyo deer occurs along the eastern declivity of the southern Sierra Nevada, extending from Owens Lake north to the head of Owens Valley, thence swinging east to include the White Mountains of extreme eastern California. The burro deer formerly ranged over western Imperial County but was driven out of that region by settlement of the Imperial Valley and is now (1933)

restricted to the dry desert washes and Chocolate Mountains of northeastern Imperial County and to the eastern portion of Riverside County (see distribution map).

The California mule deer, in my experience, ranges from the American River south along the western slope of the Sierra Nevada to Tehachapi Pass and thence westward past Mount Pinos, to and including the Santa Inez, San Gabriel, and San Bernardino Mountains. The southern mule deer occurs in California in the San Jacinto, Trabuco, Palomar, and Cuyumaca Mountains in San Diego, western Riverside, and southeastern Orange counties (see distribution map).

FIG. 48. Black-tailed doe in Yosemite Valley, July 1, 1927. Note color and shape of tail of living animal. Mus. Vert. Zool. No. 5402.

There has been much recent discussion regarding hybrids of both Rocky Mountain mule deer and California mule deer with Columbian black-tailed deer. Limited space prevents full discussion of this interrelation, but I have personally examined a number of such hybrid specimens from the Shasta, Lassen, and Yosemite areas. As early as 1927, I discovered, and demonstrated by photographs (see Fig. 48), the presence of coast black-tailed deer and hybrids in Yosemite Valley, where only mule deer were reported to exist. A few years later I was able, through Nordquist, to retrieve and to preserve such a specimen from near Wawona, Mariposa County.

On February 12, 1932, three miles east of Jackson, Amador County, I examined the hide and other remains of a Columbian black-tailed buck that had been killed at that locality late the previous fall. Both the tail, which was entirely intact, having been left unskinned, and the metatarsal gland of the hind leg were clearly characteristic of a Columbian black-tailed deer. From this and from dead deer which I examined on the Stanislaus National Forest during the foot-and-mouth epizootic, I am convinced that the range of the Columbian black-tailed deer extends down along the lower foothills of the Sierra Nevada at least to Wawona, Mariposa County (see distribution map).

## CHARACTERS

### GENERAL CHARACTERS

Rocky Mountain and California mule deer are larger than either the white-tailed deer of the eastern United States or the true black-tailed deer of the Pacific Coast. Body robust; ears long and large (see Fig. 49); antlers massive, and, in adult males, the main beams normally double-forked to form four nearly equal branches or tines (see Fig. 50). The winter coat of the mule deer is dark gray (see Fig. 51), whereas the summer pelage is rusty or rusty tan. A conspicuous creamy white rump patch is characteristic of the Rocky Mountain mule deer. The tail is cylindrical and averages about six inches in

FIG. 49. A mature California mule deer buck. Note robust body, large ears and massive antlers. Yosemite, December 6, 1927. Mus. Vert. Zool. No. 5607.

length. The tail at its base is white on dorsal, ventral, and lateral surfaces. In the true Rocky Mountain form of mule deer, *the black terminal tail tip never extends more than half-way up the tail.* The skull is long and narrow with deep lachrymal pits below the eyes. The molar teeth are heavy in this race. In all forms of the mule deer the metatarsal gland on outside of lower hind leg (see Fig. 52) is a distinctive feature, being much larger than in either the white-tailed deer or the coast black-tailed deer. The relative average length of the metatarsal gland proper in adult males in the three types of deer is: mule deer, 5 inches; coast black-tailed deer, 3¼ inches; white-tailed deer, 1 inch.

FIG. 50. California mule deer, adult male with characteristic double-forked antlers. Yosemite, November 2, 1929. Wild Life Division No. 80.

FIG. 51. The winter coat of the California mule deer is dark gray. Yosemite, December 10, 1927. Mus. Vert. Zool. No. 5606.

MEASUREMENTS

The following measurements here given in inches are those of typical Rocky Mountain mule deer which the writer measured in the flesh on September 24, 1924, eight miles north of Happy Camp, Modoc County, California.

Adult four-point buck:

Length, 70
Tail, 8
Hind foot, 20
Ear from crown, 9
Height at shoulder, 44
Metatarsal gland, 5½
Spread of antlers, 28
Circumference of antler at base, 6
Length of antler around longest tine, 18
Hoof of hind foot, 3 x 2½

FIG. 52. California mule deer in "blue" winter coat. Note metatarsal gland on outside of lower right hind leg. Yosemite, September 18, 1927. Mus. Vert. Zool. No. 5486.

Adult doe:

Length, 61
Tail, 7
Hind foot, 19
Ear from crown, 8½
Height at shoulder, 32
Metatarsal gland, 4½
Hoof of front foot, 2⅞ x 1⅝

Male fawn (just acquiring first fall coat):

Length, 39
Tail, 5
Hind foot, 14
Ear from crown, 6½
Height at shoulder, 25
Metatarsal gland, 3
Hoof of front foot, 1½ x 1⅛

Measurements of a pair of California mule deer killed September 4, 1924, at Niagara Creek, Tuolumne County, California, in foot-and-mouth disease, are as follows:

Forked-horn buck:

Length, 59
Tail, 8
Hind foot, 18
Ear from crown, 8
Metatarsal gland, 4

Adult doe:

Length, 53
Tail, 7
Hind foot, 17
Ear from crown, 7½
Metatarsal gland, 3½

WEIGHTS

The heaviest reliable weights of mule deer that I have been able to find are vouched for by J. S. Hunter of our State Division of Fish and Game, who reports two bucks that dressed 380 and 350 pounds, respectively, (California Fish and Game, Jan., 1924, p. 19). Each of these deer would have weighed over 400 pounds when alive. The largest deer killed recently that I have been able to verify, was shot by Arthur Oliver, 2317 Mission Street, San Francisco. On September 30, 1930, near White Horse Valley in Shasta County, Oliver killed a large mule deer buck that weighed 308 pounds on standard scales when gutted but with head, skin, and feet still attached. This animal was fat and when alive would have tipped the scales at nearly 400 pounds. All of the largest mule deer from California that I have record of have come from the northeastern corner of the State in the Lassen and Modoc sections.

The heaviest authenticated weight that I have been able to obtain of a California mule deer, was of a four-point buck, killed during the last week of September, 1923, at Sequoia Lake, Fresno County, by Arthur and William Bullard. This buck, one-half hour after killing, and not gutted, but with head and feet on, was placed on standard platform scales and found to weigh exactly 200 pounds. Fat on the rump of this deer was 1½ inches thick.

ANTLERS AND HORNED DOES

There has been a great deal of discussion regarding the primary purpose of antlers in the deer family. Since antlers are deciduous and are grown anew each year, there is a tremendous amount of vitality and nutriment necessarily expended in their production. Some writers

have raised the point that it would be much more economical for the animals involved if the antlers were permanent like horns and not renewed each year. It has been argued that the primary purpose of antlers is to afford protection not only to the animal wearing them but also to other members, such as the female and young of the species. Caton and others have pointed out that caribou and reindeer are the only two members of the deer family in North America in which females normally bear antlers. It is also obvious that if the antlers were to serve in securing the maximum protection for the species, they should be borne by the female of the species rather than by the male, since in such polygamous species as deer the male takes little or, in most cases, no responsibility in caring for the dependent young of the species, and the entire burden of caring for the young therefore falls

FIG. 53. Evenly forked, wide spreading, massive antlers are typical in all races of mule deer. Yosemite, November 2, 1929. Wild Life Division No. 104.

upon the shoulders of the mother, and she is the one that should be most entitled to bear the weapons of defense. However, with the two exceptions above noted, we find that this is not the case, and we must therefore conclude that the primary aim of antlers is to serve some other purpose than the protection of the weaker members of the species.

It has been suggested that antlers serve importantly as a means of carrying out physical competition between contesting males, much in the same manner as boxing gloves serve as a means of carrying on competition between rival pugilists.

It has been suggested that the most efficient form of antler would be a single long, slender, unbranched spike that would enable its possessor to give effective sword-like thrusts. It has been pointed out that

in case of a battle between two strong, vigorous males, the possession of such weapons would prove deadly to one or probably both of the contestants, and that the primary object of the contest would thus be made abortive. The present branched form of antler (see Fig. 49) that is found in our present species of deer serves as a foil which permits strenuous contests for supremacy between contesting males, thereby eliminating the weaker individuals, thus carrying out nature's method of providing for the survival of the fittest in that the stronger males are the ones that are left to reproduce and carry on the species, without being critically injured or permanently disabled in the elimination contests.

Many hunters and not a few writers have claimed that the antlers of the mule deer buck can always be told by their tendency to develop a double fork on either antler instead of as in the case of the white-tailed deer where numerous tines arise from one large central beam. The antlers of the Columbian black-tailed deer are of the same general double-branched type as those of the mule deer. As a matter of fact, Caton, after years of study, came to the conclusion that there was no single character which would serve positively to distinguish the antlers of mule deer from those of black-tailed deer. While I believe this conclusion is correct, there is a general difference in massiveness, spread and size of mule deer antlers which places the species at the top of the list from the trophy standpoint. In mule deer the normal type of antlers (see Fig. 53) have massive beams and evenly spreading antlers which result in their reaching an unusual dimension both as regards the circumference of the antler at the base and the height and spread. Now and then a mule deer buck with high or upstanding antlers (see Fig. 54) will be encountered, but this tall type of antler is more characteristic of the black-tailed deer than it is of the mule deer.

FIG. 54. Now and then a California mule deer buck has high, narrow, pinched-in antlers. Sequoia, December 21, 1929. Wild Life Division No. 335.

In certain areas where the two species come together, we find antlers of both types on both the mule and the black-tailed deer, and in such cases it is practically impossible to tell from the antler alone which species it represents. The antlers of the adult mule deer buck are frequently very symmetrical in their division, the tines being of relatively the same form, diameter, and curvature. This tendency is especially noticeable while the antlers are still in the formative stage and in the velvet, and is well illustrated by Fig. 55, which is that of a large mule deer buck that I photographed on the floor of Yosemite Valley.

Mule deer bucks have been reported from time to time as possessing antlers with a spread of upwards of 40 inches. In one notable case in California, a mule deer buck was killed in the Modoc region and the head was subsequently mounted. When it was measured, it was found to have a spread of 40½ inches. The antlers were a magnificent set, having nine points on each side. However, the authenticity of the head was questioned, and when it was subsequently examined it was found that the skull was not the original skull that had borne the antlers and that the antlers had been artificially attached in a manner so that a very great spread had resulted. Naturally such a "made up" trophy could not be accepted as a record head. Two large sets of antlers of mule deer of which I have obtained authentic record both

Fig. 55. Antlers evenly forked and nearly grown but still in the velvet. Yosemite, July 16, 1928. Mus. Vert. Zool. No. 5708.

had a spread of 36 inches. I have measured a number of sets of antlers that have had spreads of between 30 and 32 inches. The normal head of good size will have a spread of about 28 inches.

The largest set of antlers of Rocky Mountain mule deer from California which I have personally examined, photographed, and measured (see Fig. 56) was killed by William Junkans on October 8, 1930, 13 miles northwest of Susanville, Lassen County, California. The official measurements in inches of this record head, which is the largest mule deer head listed for California, are given (*Records of North American Big Game,* Prentiss N. Gray, Editor, published under auspices of National Collection of Heads and Horns, Derrydale Press,

New York, 1932, p. 32) as follows: Length of outside curve, 27; circumference of main beam, 6; greatest spread, 42½; number of points, 12-9.

This deer was found by William Junkans to weigh 320 pounds when gutted, but with hide, head, and feet attached.

In our mule deer in California, we find that antlers are normally borne only by males of the species. However, during the past ten years I have been able to obtain three bona fide and verified examples where antlers have been borne by females of the Rocky Mountain mule deer. From time to time woodsmen and hunters have reported the occurrence of antlered female deer, but since only the mounted heads were preserved, there has been no proof of sex of the animal kept. The first of the three antlered does which has come to my personal attention

FIG. 56. Record Rocky Mountain mule deer head for California. Length, 27 inches; spread, 42⅛ inches. Killed by Wm. Junkans, October 8, 1930, thirteen miles northwest of Susanville, California. Wild Life Division No. 2539.

is now number 35,326 in the Museum of Vertebrate Zoology. This deer was killed on September 11, 1925, at a point approximately four miles east of Sierraville and twenty-six miles northwest of Truckee, California. District Ranger H. I. Snider of Truckee states in letters of September 12 and 30, 1925: "I saw the cleanings of this deer and know that it was a doe with horns. The general appearance of the animal was that of an extra large doe with horns. The hoofs I thought were rather large for a doe; however, this deer weighed 160 pounds dressed. The shape of the head and neck were very much like that of a normal doe. The bladder and urinary organs appeared normal. Hunters who killed does in olden times and who saw this female, state that they

believe she had never had a fawn. Her nipples were about the same size as those of a buck." I personally examined the entire fresh skin of this doe and was able to verify beyond any question of doubt that the animal was a female. The antlers of the doe were gnarled and malformed. They were still in the velvet on September 11 when the animal was shot. There was no indication that the velvet would have been shed at all, and the antlers were similar to those of certain castrated bucks in which the antlers remain in the velvet. The tail and metatarsal gland of this doe were typical of the Rocky Mountain mule deer.

The second antlered doe (now number 36,543 in the Museum of Vertebrate Zoology) was shot by Oscar T. Schumacher on September 29, 1926, at a point seven miles south of Truckee, California, about a mile and one-half from the Truckee River. The head of this doe is similar to that of an average forked-horn buck of the species. The antlers are of fair size and have very well developed brow tines low down near the base. When killed on September 29, the antlers of this deer were completely out of the velvet, being brown and hard like those of an ordinary buck. According to Schumacher's testimony, "this doe was in first class condition, fat and well built, weighing 150 pounds dressed."

The third doe with antlers (number 36,544 in the Museum of Vertebrate Zoology) was brought to my attention through the assistance of Dr. L. A. Herrick and Dr. Robert T. Legge of Berkeley. This was a forked-horn doe in good flesh. It was killed on October 8, 1926, near the Sequoia Silver Fox Farm at Lake Tahoe, California. As in the previous cases, examination of the partly skinned specimen showed that the animal was unquestionably a female. A comparison of the antlers of these two forked-horn does showed that they could be matched exactly by antlers of forked-horn bucks from the same region.

Measurements of the three antlered does are as follows:

| *Mus. Vert. Zool. No.* | *Sprcad, inches* | *Height above crown, inches* | *Circumference at base, inches* |
|---|---|---|---|
| 35,326 | 9¾ | 12* | -- |
| 36,543 | 10⅝ | 9¾ | 2½ |
| 36,544 | 12½ | 11½ | 3 |

* Antlers malformed; the right antler with five points has a height of 12 inches, while the left antler has four points and a height of 7¼ inches.

Considerable discussion has arisen regarding the possible causes of antlers appearing on heads of the female deer. It would seem to the writer that antlers in deer are a secondary sexual character and, just as we occasionally find women who possess beards, it is not surprising to find in deer an occasional doe with antlers. H. T. Morgan, in *The Genetic and Operative Evidence Relating to Secondary Sexual Characters,* published by the Carnegie Institution of Washington (1919, p. 70), states: "There are, however, a few records of horns developing in this sex [female] in old age, or presumably after disease of the ovaries." I would like to point out that in the case of the first antlered doe, the doe in question was old and the antlers were malformed and in the velvet, so that it is entirely possible that her reproductive organs

FIG. 57. Mule deer have the largest ears of all North American deer. This character which gives this deer its name, is especially prominent in females. Yosemite, July 1, 1927. Mus. Vert. Zool. No. 5413.

FIG. 58. The large flexible ears are instantly adjusted to catch the slightest sound coming from any direction. Yosemite, June 20, 1927. Mus. Vert. Zool. No. 5414.

may have been diseased. However, in the two younger does with antlers I have been unable to find any evidence that the reproductive organs were aberrant. Furthermore, both of these younger does had hard, normal, symmetrical antlers free of velvet.

### EARS

The mule deer possesses the largest ear in proportion to body size of any of our North American deer. This is most conspicuous in the adult doe (see Fig. 57). This character has been utilized in the scientific names *hemionus,* which may be freely translated as "half mule," and *macrotis,* which means "large ears." Not only is this member of large size but it is so controlled by a muscular arrangement as to be instantly adjusted to catch the slightest sound coming from any direction (see Fig. 58).

The inside of the ear of the Rocky Mountain mule deer is well covered with long silky hair, light gray in general color. The outside covering is a shorter, stiffer covering of darker hairs. There is a general tendency toward rich dark brown color around the outer rim of the ear and particularly on the back of the ear (see Figs. 57 and 58). The black edging of the ear is much less conspicuous in the newly born fawn than it is in the adult, but comparison between the sexes shows that even in day-old fawns the males usually show more tendency toward the dark coloration than the females, which are lighter in color.

In none of our North American deer is the flexibility in movement of ears as great as it is in the mule deer. It would seem probable that there is a close interrelation between type of habitat and the development in the size of the ear. The burro deer and certain Rocky Mountain mule deer living in extreme open desert country have been found to possess the maximum ear development, whereas the California and southern mule deer, which live in dense brush habitats, have ears of smaller size that are scantily covered with a growth of stiff hairs.

### TAIL

All forms of mule deer which occur in California have a characteristic type of tail, the tail being cylindrical in general form and the terminal half consisting of long black hairs. In typical Rocky Mountain mule deer, this tuft of black hairs occupies only the terminal half of the tail, the upper portion of the tail being creamy white on the dorsal surface and sides and normally naked part way down the under side. In many instances as the hairs become abraded there is a decided narrowing of the tail at its middle (see Fig. 59).

The tail of a mule deer doe (Mus. Vert. Zool. No. 35,326) killed by W. D. Johnson on September 11, 1925, at a point four miles east of Sierraville and twenty-six miles northwest of Truckee, measured seven inches in length exclusive of hair, and was typical of a Rocky Mountain mule deer. In extreme examples of the Rocky Mountain mule deer, the terminal black tip does not occupy more than one-third of the tail. On the other hand, in many specimens of California mule deer, the black terminal tip is continued as a distinct black stripe that extends clear to the base of the tail. As a matter of fact, this character was given by the original describer, Caton, as one of the outstanding characteristics of this form. It has been my experience that, in general,

mule deer with tails having a black stripe extending up the dorsal surface are most frequently found in areas where the ranges of mule deer and black-tailed deer come together or overlap. Therefore, it is my opinion that this character is a result of hybridization rather than a dependable subspecific character. This point is well illustrated by Fig. 60 which shows tails of three deer which I personally photographed in the flesh on October 16, 1928, and to the same scale. The first tail (see Fig. 60a) is that of a typical mule deer killed at Crank Spring, Modoc County. The tail of the deer on the right (see Fig. 60c) is that of a Columbian black-tailed deer from Mineral, Tehama County. The central tail (see Fig. 60b) is that of a hybrid between a mule deer and a black-tailed deer killed on the south fork of the Merced River in Mariposa County. In all three instances I was able personally to examine the entire skins of the animals with skulls, antlers, legs, and tails attached. Metatarsal glands, skulls, and antlers of the three specimens showed conclusively that the first (Fig. 60a) was unquestionably a mule deer and that the last (Fig. 60c) was an unquestioned Columbian black-tailed deer. The central specimen (Fig 60b) was chiefly black-tail in all three characters (skull, metatarsal gland, and tail), and in my opinion was one of many hybrids between mule deer and Columbian black-tailed deer.

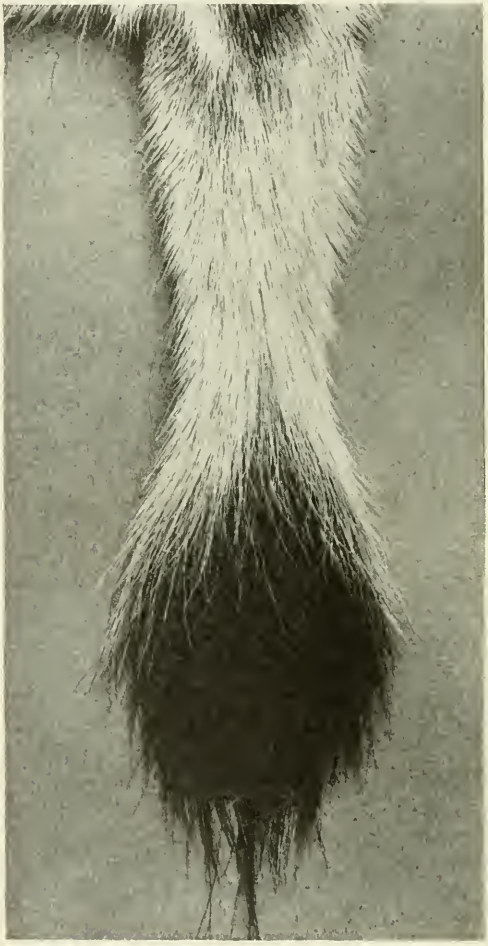

Fig. 59. In the Rocky Mountain mule deer, the tail is often constricted in the middle portion as here shown, but with only the terminal tip black. Specimen from four miles east of Sierraville, California, September 15, 1925. Mus. Vert. Zool. No. 4684.

For many years all the deer in the Yosemite region in the west central portion of the Sierra Nevada were regarded as typical mule deer. However, my investigations there have shown that there are many individuals which, on the basis of tail, metatarsal gland, and other characters are clearly and unequivocally black-tailed deer. In numerous instances I was able to photograph at close range tails of liv-

ing deer. On July 1, 1927, I was able to approach within a few feet of a doe that had a tail on which a broad black stripe extended up the entire dorsal surface clear to and above the base of the tail (see Fig. 48). By no stretch of the imagination could such a tail be considered as belonging to a mule deer. I investigated further and found that the metatarsal gland of this particular doe was very short, being not more than 3¼ inches in length. Taking another instance, on December 6, 1927, on the floor of Yosemite Valley, I examined at close range and photographed another adult doe which had a broad black tail (see Fig. 61) characteristic of the Columbian black-tailed deer. This doe likewise had the short metatarsal gland of the black-tailed deer.

One other point should be emphasized, and that is that all the deer that I have been able to examine on the east side of the Sierra

a b c

FIG. 60. Photograph of deer tails in the flesh (dorsal view). (a) Rocky Mountain mule deer from Crank Spring, Modoc County. (b) Hybrid chiefly black tail, South Fork Merced River, Mariposa County. (c) Columbian black-tailed deer from Mineral, Tehama County. Mus. Vert. Zool. No. 5840.

Nevada had characteristic and typical mule deer tails. On the western slopes near the summit of the range, we find that the tails of deer are practically all of the straight mule deer type, but as I extended my examinations down the western slope of the Sierra I found an increased number of deer which showed a tendency toward the black-tailed type of deer. This has been particularly noticeable in the Yosemite region and also in the Stanislaus National Forest on the Tuolumne River where several thousand deer were killed during the foot-and-mouth epidemic. A very large proportion of the poisoned deer showed strong tendencies toward the black-tailed type.

The black-tailed tendency is not restricted to adult animals but was also noted in a pair of spotted fawns (see Fig. 62) on the floor of

Yosemite Valley on September 17, 1927. Not only was color character illustrated, but also the characteristic habit of the black-tailed deer to elevate the tail to a vertical position when surprised or frightened is clearly shown by the fawn at the left (see Fig. 62). In the case of typical mule deer fawns, I have never found any instance where the tail was raised to a vertical position when the animal was suddenly surprised or frightened.

I have examined a large number of skins of southern mule deer taken by hunters from the central portion of San Diego County and found that the majority of these deer do not show the black stripe down the tail. On the desert side of the mountains in eastern San Diego County, specimens examined showed that almost without exception tails were those of typical mule deer, whereas along the extreme western slope of the mountains near the coast the black stripe down the tail was most in evidence.

FIG. 61. A Columbian black-tailed doe photographed in Yosemite Valley, December 6, 1927. Note width and extent of black on tail. Mus. Vert. Zool. No. 5666.

In the cases of Inyo and burro deer, I have been unable to find any trace of a black stripe down the tail, all tails being of extreme Rocky Mountain mule deer type.

In regard to size of the tail, it has been stated that the average length of the tail in the adult mule deer is from five to six inches. My own experience has been that the length of the tail bone (this does not include the long terminal tuft of hairs) in adult Rocky Mountain mule deer in California averages eight inches, with seven and ten inches as extremes. In the case of California mule deer, tails have been found to be somewhat shorter (about one inch) than in true Rocky Mountain mule deer.

There has been considerable discussion among sportsmen, writers, and even scientists regarding the position in which the tails of mule deer and coast black-tailed deer are held when the animals are frightened or alarmed. In one instance, a well-known Western writer, in an article on mule deer published in a nationally known magazine, illustrated a frightened mule deer with the tail not raised. The writer was severely criticized by many sportsmen, particularly those in the East, who believed that when frightened or when running away from danger, all deer raised their "flags" to a vertical position. I have taken special pains to ascertain the facts regarding this point on many occasions and have found that in the coast black-tailed deer, both in Columbian and southern, the characteristic reaction when alarmed

is for the deer to raise its tail above the horizontal position, usually to a nearly erect position, so that the white under portion is brought plainly in view as the animal runs away. However, in the case of all forms of mule deer the tendency under similar circumstances is to keep the tail down. At times the tail of the frightened mule deer may be twitched back and forth, as the animal runs away, but in the majority of instances the tail is not elevated above the horizontal and there is often no decided movement of this member. After working in a mule deer country, it is always a matter of interest and surprise upon returning to the habitat of the black-tailed deer to note this characteristic difference in behavior. As a matter of fact, in my estimation, it is one of the most conspicuous differences to be noted between living individuals of the two species. Certainly it is one of the best field characters that we have for identifying the two types of deer.

FIG. 62. Columbian black-tailed, spotted fawns in Yosemite Valley. Note tendency of nearest fawn to raise tail when frightened, a character of black-tailed and not of mule deer. September 17, 1927. Mus. Vert. Zool. No. 5523.

## METATARSAL GLANDS

The most reliable and distinctive external character that I have been able to find in the genus *Odocoileus* is the metatarsal gland, which is a dermal structure located on the outer side of the hind leg slightly more than halfway above the center of the long bone that extends from the "knee" or hock, to the hoof. The location of the gland is discernible by the coarse, curly character of the hair that laps over it.

The size (length, in particular) of this gland has been found to be decidedly constant in each of the three forms of common deer found in the United States. In the white-tailed deer, the common species of the eastern United States, and in the western geographic races of this species, the metatarsal gland is very short, approximately one inch in length, and has a broad elliptical form or outline. In the Columbian

and in the southern black-tailed deer of the Pacific Coast, the metatarsal gland is of medium length, being, in average adults, about three inches in length in females, and three and one-quarter inches in length in males. In the black-tailed deer, although the length of the metatarsal gland is three times that of the same organ in the white-tailed deer, the width of the metatarsal gland is actually less, rarely being as much as one-half inch. In the mule deer, the metatarsal gland reaches its highest development, attaining a length of as much as five and one-half inches. A large four-point buck I measured at Hackamore Reservoir, eight miles north of Happy Camp, Modoc County, California, on September 24, 1924, had a metatarsal gland of five and one-half inches in length. In an adult Rocky Mountain mule deer doe of average size measured at the same time and place, the metatarsal gland had a length of four and one-half inches. A male fawn of the Rocky Mountain mule deer, approximately four months old, measured at the same locality and on the same date, had a metatarsal gland three inches long. It will thus be seen that a four-months-old mule deer fawn may have a metatarsal gland as long and as wide as that of an adult black-tailed deer.

Form and size of antlers of the mule deer and the black-tailed deer may vary greatly. The form, size, and color of the tail in the two species is fairly constant, but I have found the length of the metatarsal gland to be subject to the least variation, and therefore I regard it as the most conservative and the most reliable single external character that can be used to differentiate between the two species. Where hybrids of the Columbian black-tailed deer and the mule deer occur, I have found that the size of the metatarsal gland is intermediate between that of the two species. However, in adults of either species I have found that there is no overlapping except where actual interbreeding and hybridization has taken place.

## EYE SHINE

In former times, before the practice became unlawful, many deer were killed by "jack hunting" at night. The method used was for the hunter to carry a small, powerful acetylene searchlight attached to his hat or cap. When such a light is carried in this manner, close to the eyes of the hunter, the light from the lamp is reflected back from the eye of the deer to the eye of the hunter. This "eye shine" is particularly observable in nocturnal animals such as owls, poorwills, deer and other night prowlers.

Light reflected from the eyes of nocturnal animals under such circumstances has been found to vary in color, and certain types or kinds of animals have been found to have a characteristically colored "eye shine." In order to determine the facts in the case and to settle various arguments, I made especial effort to examine and to record the color and other details of the "eye shine" in mule deer. On December 14, 1929, on the floor of Yosemite Valley, at 8.30 o'clock, I watched two bucks with considerable interest as they "horned" a certain slender, smooth willow sapling. They were so intent on this operation that I was able to watch them at a distance of twenty feet for several minutes by the aid of a powerful electric flashlight. I found that under such conditions their eyes shone like two bright-colored flames of white fire. At certain times when the bucks turned their heads and were not

looking directly at the flashlight, their eyes had a curious reddish glow, but only the clear white light was to be seen when they looked directly at me. I was able to detect the "eye shine" in deer, and by means of that to pick them out of a tangled mass of willows where it would have been impossible otherwise to have detected the animals in their natural surroundings.

VOICE

I have heard deer call many times, but I have been unable thus far to detect any specific difference in voice between the various geographic races of mule deer in California. Although not frequently heard, the mule deer in the wild has a distinct voice which is used both by bucks in the heat of battle and by the doe in calling her young. When in mortal pain or terror a buck, a doe, or a fawn will often utter

FIG. 63. California mule deer doe and her young in hiding place in tall grass. Yosemite, July 10, 1928. Mus. Vert. Zool. No. 5748.

an agonized bleat which reminds one of the death cry of a stricken rabbit.

In Yosemite Valley on January 30, 1929, I witnessed, at a distance of fifty feet, a prolonged fight between two large four-point bucks. This battle waged back and forth over the meadow until the weaker buck was driven back into a ditch and forced down upon his knees. When thus pinned down and helpless, he uttered a hoarse bawl which was almost a moan. Apparently this was his way of saying "I've had enough," for the other buck immediately let him up, and the fight stopped at once.

During the mating season a buck will sometimes use his voice to frighten a competing buck away from a coveted doe. On December 6,

1927, in Yosemite, I watched two large bucks in hot pursuit of a certain doe. Both bucks were decidedly pugnacious. However, when the larger and dominant buck approached to within thirty feet of the other buck, he stopped and lowered his head until his nose almost touched the ground. He then gave a series of hoarse hisses and grunts. Upon hearing this, the other buck did not stay to fight but departed in haste. Again in Yosemite on December 10, 1927, I watched a forked-horn buck feeding with other deer. Whenever a certain spike buck came near him the larger buck uttered a warning wheezy grunt, and the hairs on his back and rump stood up stiffly like bristles.

At 5.30 o'clock on the morning of July 10, 1928, in a meadow in Yosemite, I watched an old doe which, from her anxious actions, I felt sure had a fawn hidden nearby. I retired to the shelter of a thicket and remained in hiding. In just ten minutes, by the watch, this doe hid in the tall grass. She waited a few moments, after lying down, and then gave a low bleat or call. Upon hearing this call, her fawn at once rose up out of the dense grass where he had been hiding (see Fig. 63), and trotted over to his mother, and began to nurse. On four different dates I have heard and watched nursing does call their fawns from their places of hiding, and in each instance the mother's call note was low and intimate, being just loud enough to carry the few yards to the hidden fawn.

The use of voice, which enables a doe and her fawn to communicate and to keep in touch with each other, continues at intervals as long as they remain together, and I have observed does call their fawns long after the latter had been weaned. On February 27, 1928, in Yosemite, George M. Wright watched a doe call her fawn of the previous year, and in his field notes states: "The doe used a quiet little bleat for calling her fawn. This call was repeated several times, and was definitely audible for a distance of 125 feet."

### TRACKS

Tracks made by deer are of outstanding interest both to the field naturalist and to the hunter, since they frequently tell a great deal that men wish to know. The freshness of the track affords some idea of how recently the deer had been at that particular spot. The size and shape of the tracks, together with other "sign," will in many instances, but not always, indicate the sex of the deer. The depth of the track, allowing for the condition of the soil, can be taken as a fair indication of the weight, and hence of the general physical condition of the animal. Under the same soil conditions, a fat heavy deer will make deeper hoof prints that will a thin animal with hoofs of the same size.

In general, large deer usually make large tracks. However, deer with bodies of medium size sometimes have large hoofs and hence make large tracks. Size of tracks alone can not be relied upon to indicate the true size of a buck's antlers. As illustrating these two points, I offer the following field experience. On October 7, 1924, five miles north of Fredonyer Peak in Lassen County, I found and followed the freshly made trail of a large Rocky Mountain mule deer. As the deer walked leisurely along, his tracks were 25 inches apart. The right front foot track (see Fig 64) measured 4 inches in length and $2\frac{3}{4}$ inches in width, when this buck was walking at normal gait on soft damp ground. This

is the largest mule deer track that I have been able personally to measure and to photograph. I followed the tracks of this buck to a heavy thicket of mountain mahogany, where he was found bedded down in cool seclusion. When "jumped" at close quarters, this buck was found to be of only fair size, and his antlers were of but medium size with only three points on one antler and four points on the other.

In the Yosemite region at 4500 feet elevation on the old Coulterville road on November 24, 1915, I measured the tracks of a large California mule deer buck made as I watched while the animal was standing still on level ground, and found that they measured $2\frac{3}{4}$ inches in length and $2\frac{1}{8}$ inches in width. This has, in my experience, been the size of track made by the average "good" buck of this species.


FIG. 64. Largest track of Rocky Mountain mule deer known to the author. It measured 4 inches in length and $2\frac{3}{4}$ inches in width. Near Fredonyer Peak, Lassen County, October 7, 1924. Mus. Vert. Zool. No. 4560.

At Eagle Lake, Lassen County, on May 15, 1925, I watched a buck of medium size with growing antlers between three and four inches in length, feeding at mid-day within 150 yards of Eagle Lake. A large doe was feeding near this buck so that I had an excellent opportunity to measure and to compare their tracks. I found that the buck's track measured $2\frac{3}{4}$ inches in length and 2 inches in width. I found that the tracks of the large doe were of similar size and could not be distinguished from tracks of this medium-sized buck. Watching both animals as they made tracks was the only way that the tracks of the two could be separated. These were Rocky Mountain mule deer.

At Chuckwalla Well in eastern Riverside County, California, on December 29, 1930, I measured the front foot tracks of a female burro deer and found that they measured 2½ inches in length and nearly 2 inches in width. This is about the size of tracks of average large female Rocky Mountain mule deer. Tracks of California mule deer are about one-third smaller than those of either the Rocky Mountain mule deer or burro deer of comparable sex and age.

Considerable difference of opinion exists as to whether tracks of a buck can always be distinguished from those of a doe. My own experience, including a careful checking of tracks of both sexes, has led to the following conclusions:

1. In general, tracks made by bucks average larger than those made by does.

2. Tracks made by old bucks are broader, proportionately, than those made by young bucks and does.

FIG. 65. Track made by a Rocky Mountain mule deer running. Note spread hoofs and imprints of "dew claws." Eagle Lake, Lassen County, May 17, 1925. Mus. Vert. Zool. No. 4688.

3. Tracks of equal size can not always, by themselves, be positively identified as having been made by a buck or doe.

4. Antlered does may make decidedly buck-like tracks. Thus, an old doe with antlers was mistaken for a buck and shot by W. D. Johnson, on September 11, 1925, at a locality four miles east of Sierraville, California. I examined, in the flesh, the head and feet of this doe. The hoofs of the front feet were two inches in width and were similar in shape to those of a buck of similar size.

5. In the field it is often possible, by following tracks made by a deer, to arrive at definite conclusions as to the sex of the animal that made them. For instance a doe does not stop and "horn" brush or saplings as bucks frequently do. A positive identification of the sex of the animal may often be had by following tracks and noting the relative position of urine deposits. In nearly every instance mule deer stand still while urinating. If the deposit of urine is located well *forward* of the hind foot tracks the animal may safely be listed as a buck, whereas if the urine deposit is located *behind* the hind foot tracks, the deer is a doe.

Tracks of a very young mule deer fawn are rarely seen, for the reason that the mother usually keeps her fawns carefully hidden in thickets of grass or brush during the first ten days of their lives. By the time the fawns are old enough to follow their mothers about and to run by their sides, their tracks usually measure 1 inch in length and ¾ of an inch in width. In early summer, smaller tracks, made by very young fawns, may sometimes be found.

In measuring tracks made by deer, it has been my experience that tracks made in snow are often unreliable as to size, since actual measurements have shown that such tracks, during a thaw, may increase as much as a quarter of an inch in size, through melting of the snow, in twenty-four hours.

Tracks made by running deer show hoofs spread (see Fig. 65) and such tracks are appreciably larger than would be the case if the same animal were standing or walking quietly along on firm ground.

### BEDS

There is considerable variation in the location of beds among mule deer. The site chosen varies not only with the season but also with the age and sex of the animal. Bucks usually choose a different type of bedding ground than do does and fawns.

Mule deer of both sexes normally do most of their feeding in the early morning before sunrise or in late afternoon and evening after sundown. They spend the middle of the day bedded down in cool secluded nooks, chewing their cuds and digesting the food hurriedly gathered during the early morning hours.

In summer the bucks retire as soon as the sunshine strikes where they are feeding (see Fig. 66). On July 15, 1929, I watched a number of California mule deer feeding on an open meadow. The bucks seemed to be more sensitive to sunlight than were the does and fawns. Fifteen minutes after the sun's rays first struck the meadow, the three bucks (see Fig. 66), as if by some mutual understanding, lined up and left the meadow, going over to the dense shade of a grove of young yellow pines, where they bedded down for their daily rest. On July 13, 1928, I likewise found a large buck bedded down in the dense shade of a wild plum thicket near a meadow. In general, I have found that mature bucks prefer rocky ridges for bedding grounds. In such a retreat, the big buck (see Fig. 67) has a double advantage, being able to hear the approach of most human hunters, while the rising currents of air which sweep up both slopes of the ridge often carry to him the telltale scent of any silent-footed cougar or coyote that may attempt to capture him through stealth and hidden approach.

During the hunting season the wise old bucks often elude the sportsman by bedding down in dense secluded thickets where they remain throughout the day. On September 16, 1923, near the head of Hat Creek on the eastern flank of Lassen Peak, I found such a buck bedded down in a thick clump of mountain hemlocks. The experienced deer hunter learns to look for big mule deer bucks on the higher ridges. A certain large buck was found in Yosemite to bed down in the same thicket day after day, but he usually occupied a different bed each day.

In times of necessity, as in midwinter, mule deer will bed down in snow. This was demonstrated in Yosemite on April 6, 1929, when with

FIG. 66. As soon as the sun struck this meadow, the big bucks left it to bed down in thickets for the day. Yosemite, July 15, 1929. Wild Life Division, No. 132.

FIG. 67. Wise old bucks bed down for safety on rocky ridges as here shown. Yosemite, January 29, 1929. J. S. Dixon No. 32.

a foot of snow on the ground and with the trees blanketed with a fresh fall of snow, I watched a band of twenty deer, including bucks, does and fawns, on their bedding ground. The beds were usually made singly, but in certain instances were found in groups, three, and even four beds to one square rod. These beds were oval in outline and of sufficient size just to accommodate the body of the deer. They were normally located either at the foot of some small tree or at the base of a buckthorn or manzanita bush. In one instance, the bed, which was unusually large, was actually arched over by bushes, but the other beds were all so situated that the deer in them had an open and unobstructed view of their immediate surroundings.

The beds were observed to be made by a preliminary pawing away of the snow followed by the snow melting through coming in contact with the warm body of the reclining deer. I watched one deer prepare its bed by first pawing away the snow and then bedding down after turning around several times just as a dog often does before it lies down to sleep. I saw the same bed occupied by two deer, one after the other, and in one instance a particular bed was used by three different deer in one week. This habit of interchanging beds is characteristic of the younger deer and has been found to have a direct bearing on the transfer of deer ticks from one deer to another. An examination of fresh deer beds revealed the presence there of one or more deer ticks hidden in the refuse.

When given a free choice, even the old bucks prefer a warm bed of dry leaves, in the shelter of some dense pine or cedar, to a chilly bed in the snow. Such a preference was repeatedly shown by a large buck in December, 1927, in Yosemite. Instead of bedding down in the snow, this buck regularly chose a warm bed of dry leaves under a dense incense cedar tree. Here he had an unobstructed view and kept warm and dry, chewing his cud in comfort (see Fig. 68).

Investigation has shown that in late fall and winter when the weather turns cold, mule deer seek out sunny nooks in which to take sun baths. On October 31, 1929, in Yosemite, I followed a three-point buck until he found a quiet sunny spot, well screened on either side by dense incense cedar trees. Here he bedded down in the bright warm sunlight (see Fig. 69). As soon as the shifting shadows reached the spot where he lay, he arose and moved over to another sunny spot. I have noted this habit of taking sun baths many times in does and fawns also. In summer days does and fawns are more inclined than bucks to bed down in open meadows. In the Yosemite region, both inside and outside the park, I found that during dark nights mule deer bedded down out in the open meadows, away from trees and bushes. I found that this was the regular custom of mule deer under natural conditions where they were not hunted by man. On July 1, 1927, I found that all of the does and fawns, after they had satisfied their hunger, went out into the open meadow and bedded down in relatively short grass (see Fig. 57). When I got down on my hands and knees and tried to stalk such deer I discovered the probable reason for their choice. The first movement of my body, which was visible above the short grass, was immediately detected by the deer and they sprang to their feet and were away instantly. By further experiments, I found that such open bedding grounds were regularly selected, apparently because of the

FIG. 68. In winter sheltered beds of warm dry leaves are preferred. Yosemite, December 10, 1927. Mus. Vert. Zool. No. 5599.

FIG. 69. On cold fall and winter mornings bucks often take sun baths, under sheltering incense cedars, as here shown. Yosemite, October 31, 1929. Wild Life Division No. 99.

unobstructed view that the deer thus had. By such advantage they were able to see, or otherwise to detect, the approach of prowling predators such as cougar, coyote, or bear, that might try to capture them through stealth.

Investigation at various hours of the night during July showed that does and their fawns regularly spent dark nights out in the open meadows, while seemingly less cautious bucks sometimes spent the night under some large, lone yellow pine near the edge of the meadow.

Some hunters claim that when the moon shines brightly mule deer feed under cover of trees at night and bed down in the denser thickets during the day. These men also claim that during the dark of the moon the deer feed less at night and are more inclined to bed down at night out in the open. The other group of hunters claims that the intensity of the moonlight has little or nothing to do with the deers' feeding habits or with their choice of beds. I have made numerous personal observations on this very point and while no hard and fast rule can be laid down, definite tendencies may be recognized. At 9.30 o'clock on the evening of December 6, 1927, in the Yosemite region, the moon was nearly full and shone so brilliantly from a cloudless sky that I was able to see almost as well as I could at twilight. By aid of a powerful electric flashlight, two of us moved cautiously through the woods finding eleven deer, all except one bedded down in dense shadows under thickly foliaged trees, chiefly incense cedars. One fawn was grazing just outside the heavy shadow of a tree. We then searched the moonlit meadows without finding a single deer in them. During the dark of the moon I searched these same meadows and found them well populated with grazing deer. At intervals during the summer and fall I made frequent investigations and on dark, moonless nights found deer numerous and bedded down out in this open meadow, but they bedded down in the shadows under trees on bright moonlight nights; so that my numerous observations indicate that mule deer tend to bed down in summer under trees when either the sunlight or moonlight is intense, but when the light is dim, as during overcast days or during dark nights, they tend to bed down in open meadows. Further experiments carried on at various hours of the night revealed the fact that on bright moonlight nights deer in deep shadows were relatively difficult to see. While thus concealed, they had an excellent chance to detect the approach of any intruder through the moonlit zone surrounding them. On dark nights visibility was generally poor and the deer then utilized the open meadows where visibility of surrounding terrain was best.

Many years' experience with the California mule deer has convinced me that this race is much more of a brush inhabitant than either the Rocky Mountain mule deer or the burro deer. Preference for an open habitat is most marked in the burro deer which is a true denizen of the desert. On December 29, 1930, at an unnamed spring, one mile west of Chuckwalla Well in Riverside County I found and followed the fresh track of a female burro deer. This deer had bedded down in soft dry sand in an open wash under an ironwood tree. The bed measured thirty inches in length and was twenty-four inches wide. Other beds of other burro deer were found near the first, being entirely out in the open sandy wash. The Rocky Mountain mule deer frequently beds down behind a thin screen of mountain mahogany bushes.

Young spotted fawns are usually hidden by their mothers in dense clumps of grass (see Fig. 63) or in thickets of brush. When surprised or pursued, such fawns often seek to escape detection by crouching motionless in their grassy beds with necks outstretched (see Fig. 70). When undisturbed in their beds, spotted fawns are nearly always found curled up, this being their normal posture in repose.

In Giant Forest of Sequoia National Park on July 1, 1933, I found a pair of spotted fawns, known to be six days old, hiding near our camp. One of the fawns when first found was bedded down in the narrow

Fig. 70. When pursued, the spotted fawns often seek to escape detection by hiding with neck outstretched in the open grassy meadows. Yosemite, July 10, 1928. Mus. Vert. Zool. No. 5758.

crack of a granite boulder. This crack was ten inches wide and three feet deep, being closed at both ends, and had a smooth floor covered with pine needles. I marveled that so young a fawn could get into and out of the narrow crack by itself, but such was the case. I watched it, and after the mother returned from her breakfast in the meadow, she called them, facing first one and then the other fawn, to her to nurse, the fawns being hidden separately some sixty feet apart. After

nursing for ten minutes, each fawn of his or her own volition, and not being assisted by the mother, went off by itself and selected a safe hiding place. The first fawn chose to hide in a clump of green grass that grew between two flat boulders out in the open sunlight. The other fawn chose an open shelf at the mouth of a wide crack at the base of a large granite rock (see Fig. 71). This male fawn left and returned to this bed three times during the morning. Another variation with locality was apparent, for in Giant Forest the does appear to prefer having and keeping their fawns on the dry ridges at the protecting base of some giant Sequoia rather than out in the grassy meadow as in Yosemite.

FIG. 71. One fawn chose his own resting place and bedded at the base of a large granite boulder. Giant Forest, Sequoia, July 1, 1933. Wild Life Division No. 3101.

## MANNERISMS

### *Gait.*

The general appearance and movements of the mule deer are relatively clumsy compared with those of the black-tailed deer, and particularly so when compared with those of the white-tailed deer. The large body, robust limbs, and particularly the enormous ears of the Rocky Mountain mule deer give it a clumsy appearance which is noticeable when the animal is walking and even when it is running or bounding. The *bounding* gait of the mule deer has received special attention from numerous writers. As a matter of fact, it is one of the most characteristic attributes of the species and, though seemingly ungainly, such a bounding gait accomplishes two very desirable and important functions. In the first place, it enables the animal to travel rapidly over

the rough, broken lava and rocky terrain which they frequently inhabit. Secondly, the bounding gait gives the deer a vantage point from which it is able to secure temporarily a better view of its pursuer. In short, the bounding gait, although seemingly clumsy, is very effective.

When walking at a normal gait, unalarmed and unafraid, the average distance between tracks of an adult Rocky Mountain mule deer has been found to vary from fifteen to thirty inches. On October 7, 1924, five miles north of Fredonyer Peak, Lassen County, I found the fresh tracks of a large mule deer buck. As he leisurely walked along, his tracks were almost in a straight line and were twenty-five inches apart. When this buck was later surprised and "jumped," I found, by actual measurement, that he covered fifteen and sixteen feet at a single bound. At Eagle Lake, Lassen County, on May 17, 1925, I measured and photographed the tracks of a female mule deer that had run at normal gait across a strip of wet sand along the lake shore, and found that the average distance covered by a single bound was nine feet.

The greatest distances covered by mule deer at a single bound that I have been able to discover were made by two adult does that were thoroughly frightened near Niagara Creek, Tuolumne County, on September 1, 1924. In running on level ground these two does leaped across a little ditch. One cleared eighteen feet at a single bound and the other cleared twenty feet, slightly uphill (both of these distances by actual measurement). It is to be reasonably expected that a deer can cover a greater distance leaping downhill than it can on the level ground or uphill. However, out of all the instances where I have actually observed deer running and have subsequently measured the distance covered by a single bound, the two cases just reported represent the extreme observed and measured to date.

With regard to the height to which a mule deer can jump, it must be confessed that appearances are usually deceiving and that the animal does not jump nearly so high as it appears. At Niagara Creek, Tuolumne County, on September 1, 1924, I "jumped" a large California mule deer doe that went bounding off, hopping over the tops of bushes, one of which, at a distance of fifty yards, I took to be at least six feet high, but when I came to measure the bush with my steel tape, I found its height to be forty-eight inches. The extreme high jump made by a mule deer of which I have been able to obtain reliable data was reported to me October 16, 1924, by William Horn, in eastern Lassen County. For a number of years Horn kept a female Rocky Mountain mule deer that had the run of the ranch but which came back to the vicinity of the ranch house each year at fawning time, where she remained until the beginning of the next breeding season. One day the doe was pursued by a large buck, and, in her effort to escape him, she ran into the cattle corral near the ranch house. This corral consisted of split posts ten feet in length, buried two feet in the ground and placed on end. When the deer ran into the corral, Horn slipped up and closed the corral gate. As soon as the wild buck from the hills saw that he was captured, he made a valiant effort to escape by jumping over the top of the eight foot fence. His first attempt was unsuccessful, but the second time he ran clear across the corral and succeeded in making it over the top. I personally measured the height of the posts

and found them to be a full eight feet. This is the greatest height I have actually measured that I have known a mule deer to jump.

This ability of mule deer to jump has a direct bearing on deer management. In many instances it has been found desirable to construct deer-proof fences around apple orchards, vineyards, and gardens in order to prevent serious destruction of valuable property. Numerous types and heights of fences have been tried out, but of many fences examined, the one described herewith has proven best as regards cost, ease of construction, upkeep, and efficiency. This fence effectively protected an apple orchard located 4½ miles northeast of Dunlap, Fresno County, where in January, 1924, I found mule deer numerous and hungry.

Split cedar posts, 7 feet long, sunk 18 inches into the ground and spaced 10 feet apart, supported the fence. The main portion of this fence consisted of medium weight, 8-strand woven wire hog fencing, 42 inches high. The distance between strands from top to bottom was 9, 7½, 6, 5½, 5, 3, 3, and 2 inches, respectively. A single tight strand of barbed wire was stretched on the ground 2 inches below the woven wire fence. Four strands of light barbed wire were placed at intervals of 5, 7, 12, and 12 inches above the hog fence, being stapled to and supported by 2 x 4-inch scantlings 4½ feet long, which had been spiked to the upper portions of the cedar posts. This method placed the highest barbed wire 6½ feet above the ground, and this proved high enough to keep the hungry deer out of the apple orchard, thereby protecting the trees and fruit.

*Posture.*

When alarmed, the mule deer carries its head elevated with the nose forward so that it is above the line of the back. When the animal is walking slowly along, unalarmed and unafraid, the head is often carried below the level of the back, particularly when the animal is following, by scent, the trail left by another deer. When grazing leisurely, the front legs are spread slightly, and the head and neck are carried close to the ground.

As an example of the different postures in which the head may be carried, I cite an instance in which I was standing at the edge of an open meadow but partially concealed by screening branches of a bush. While I stood watching a doe that was busily feeding on green grass in the open meadow about sixty feet distant from me, she suddenly, through a slight movement on my part, became aware of my presence. At the time, she was headed directly toward me and had her front legs spread well apart, so that her lower lips touched the ground. The moment she caught sight of the slight movement that I had made, she gazed intently and fixedly in my direction, but as I remained motionless she was apparently unable to make out what had caused the movement. In order to secure a better view of the strange object, she quickly lifted her head as high as possible and viewed me for a moment in that position. Not being satisfied with what she saw, she then stretched her neck as far as possible to one side and then to the other, gazing intently at me in all of the positions. She did this without moving any portion of her body other than her head, neck, and ears. I presume that

through thus obtaining a view of the strange object from these different angles, she was able to make out the image of a man for, although I remained motionless, she immediately turned and trotted off.

As has been previously stated, the ears of the mule deer are exceedingly flexible and may be readily turned in any direction—backward, sidewise, and forward—so as best to detect the slightest sound. This ability is particularly marked in the doe, which, through the responsibility of care of young, frequently utilizes the sense of hearing to a finer degree than do the bucks which have only themselves to look out for.

In Yosemite Valley on July 20, 1928, I watched an old mule deer doe (see Fig. 72) which, upon detecting the approach of a large black

Fig. 72. Adult California mule deer doe and twin spotted fawns trying to locate an intruder. Note use of ears, eyes and nostrils. Yosemite, July 20, 1928. Mus. Vert. Zool. No. 5510.

bear, had called her two spotted fawns from a thicket of velvet grass. As the bear turned and wandered off in another direction through the woods, the doe's ears were flexed constantly, first forward and then backward, in an intense effort to detect the slightest sound made by the bear, which was screened in a thicket nearby. In this instance, the senses of sight, scent, and sound were all used by the doe to secure for her offspring the greatest possible protection. However, she seemed to depend more upon her hearing than upon the other senses to locate the hidden danger.

The position of the tail of the mule deer has been subject to much discussion. Under normal conditions its short, cylindrical tail hangs directly downward, or it may be twitched violently back and forth

when the deer is bothered by flies. This twitching of the tail is perhaps a nervous reflex manifestation, since I have frequently noted the tails of mule deer being twitched violently when the only flies around the deer were buzzing around the animals' forelegs. This twitching of the tail, under such circumstances, is frequently accompanied by a violent stamping of the forefeet and perhaps is merely a method of expressing irritation.

As bearing on the position in which the tail is carried in the frightened mule deer, I wish to cite the following incident which I have found to be the typical reaction of mule deer in California. December 8, 1927, in Yosemite Valley, I observed two adult mule deer that were badly frightened. They ran with tails *held straight down*, and in this instance the tails were not twitched back and forth across the white rump patches as is sometimes the case.

## SENSES

### *Sight.*

The sense of sight is highly developed in the mule deer, being somewhat better, in my estimation, than that of the black-tailed deer. This may be due in part to the more open character of the mule deers' habitat.

Not only are mule deer able to see well during daylight hours but their eyes are especially effective during the dim lighting of early morning and late evening. Because of the limitations of the human eye, I have been unable to ascertain just how effective the sight of deer may be at night, but I have repeatedly found under such circumstances that the eyesight of deer was very much keener than my own. If I may be allowed a photographic comparison, I would say that the eye of the mule deer at night may be compared to an f 4.5 lens, while the human eye would not rate higher than an f 6.8 lens.

As with most other large game mammals, the sight of deer is not particularly keen or analytical as regards *stationary* objects. This has been proven many times by different individuals who, when clad in neutral colored (khaki) clothes, have remained stationary against a neutral background and have had deer walk up to within fifteen or twenty feet of them without detecting their presence so long as the human observers remained motionless and so long as there was no telltale breeze blowing from the observers toward the deer. However, the least movement, such as the mere twitching of a finger or slight movement of the hand, has been found sometimes in such instances to be immediately detected by the deer, which, without the slightest hesitation, would immediately dash away.

There is considerable question in my mind, owing to various field experiences, that the mule deer is able to identify definitely a strange object at a distance. The extreme wariness of certain old mule deer bucks that resort to instant flight the moment they detect the moving figure of the hunter on the skyline, at a distance of two or three hundred yards, I believe in many cases to be merely an instinctive reaction to flee from the presence of any suspicious moving object. In short, I do not believe that in such cases the deer always recognizes the identity of the moving form.

*Smell.*

I feel certain, from numerous and close observations, that the average doe does not depend upon the sense of sight to identify her own offspring, because on numerous occasions I have observed a doe being followed temporarily by a fawn which was not her own. Several times I have observed such fawns come up to a doe and start to nurse, it apparently being a matter of indifference to the fawn whether the doe in question was its own mother or not. In one instance, a strange fawn was observed to nurse for several minutes undetected, both the doe and the fawn remaining quiet until the doe reached around and smelled of the fawn, whereupon she immediately realized that the fawn was not her own, and accordingly drove it away with rapid, straight-armed thrusts of her front legs and feet.

In Yosemite Valley on September 16, 1927, I watched three does that were feeding together with their fawns, which were so nearly of a size that I was unable at first to distinguish between them. The fawns wandered about, running first with one doe and then with another indiscriminately. Whenever one of the does wished to be sure of the identity of the fawn following her, she always resorted to smelling it (see Fig. 73). This procedure was so uniformly carried out that I

FIG. 73. Numerous observations show that does can not always recognize their own fawns by sight. In case of doubt they rely on the sense of smell as here shown. Yosemite, September 16, 1927. Mus. Vert. Zool. No. 5514.

considered it the "acid test" whereby the mother was able with certainty to identify her offspring. Repeated observations under such circumstances proved conclusively that the does were unable to recognize with certainty their own fawns through sight alone.

Two other experiences that I have had with mule deer should be cited as evidence of the degree in which the sense of smell is utilized.

On December 9, 1927, I watched a mule deer fawn, not over six months old, that had been recently bereft of his mother and had been thrown entirely upon his own resources. This fawn was rooting about in the six inches of freshly fallen, loose, dry, fluffy snow (see Fig. 74) in search of fallen leaves and acorns of the black oak. There is a possibility that this fawn was assisted in a slight degree by the sense of touch in locating the acorns, but from repeated observations made at a distance of not more than ten feet, I am satisfied that he depended entirely upon the sense of smell to locate the desired oak leaves from amid a large number of dried leaves of other species, among which the oak leaves were thoroughly mixed.

FIG. 74. In winter, mule deer depend considerably on the sense of smell in locating snow covered food, such as acorns and leaves which they secure by rooting about in loose snow. Yosemite, December 9, 1927. Mus. Vert. Zool. No. 5655.

I followed another weaned fawn about for a number of hours on this same date. The day previous the ground had been warmed and clothed, particularly under the trees, with a carpet of green, sprouting, annual wild oats and other grasses. This was the first real blanket of snow that this fawn had ever seen in his life, and he was apparently at a loss to account for the sudden disappearance of the green grass upon which he had been accustomed to feed. As I followed this fawn about, I found that he depended primarily upon the sense of smell in his effort to locate food. Any twigs or other likely looking object that might possibly furnish a meal were immediately approached and subjected to a test through the sense of smell.

On numerous occasions in the fall when the acorns were dropping, I have watched mule deer standing under oak trees waiting for acorns to fall. As soon as the waiting deer heard an acorn hit the bed of dry

leaves, several would immediately start in the general direction of the sound. Then there would be a scramble to locate the exact spot where the acorn lay. In a number of observed cases there was considerable competition between the deer and "digger" squirrels to see which would secure the acorn. California woodpeckers were also important contenders for the acorn crop, but in nearly every case observed they were outwitted by either the deer or the squirrels.

I have noted many times that during the fall and particularly during the winter, mule deer are able to distinguish between good and defective (blank or worm-eaten) acorns. In order to check definitely on this ability, I purposely selected a number of worm-eaten and blank acorns and carefully mixed them with an equal number of good acorns. I scattered them about under an oak tree in the spot where mule deer were accustomed to hunt for acorns, and concealed myself nearby in some bushes. In some cases I was able to watch deer feeding at a distance of not more than ten feet. I have thus become thoroughly convinced through such experiments that a mule deer can and does detect a defective acorn without ever touching it. The blank acorns are, to all appearances, at least as far as the human eye can detect, exactly similar to the good acorns. However, there is one difference, and that is that the blank acorns are very light in weight. This difference can easily be detected by a person taking them into his hand. However, I have been unable to find any character whereby they can be distinguished by the human eye at a distance of even one foot. The worm-eaten acorns usually show very small holes, which might possibly give the deer some clue. However, my observations have shown conclusively that the deer were able to distinguish such wormy acorns when they were hidden beneath leaves and thus completely out of sight. Since the acorns in question were not even touched by the deer, the sense of feeling could not have played any part in the selection. Therefore, I concluded that the sense of smell was the medium through which such acorns were detected and left untouched by the deer. In one instance I tested this power of discrimination of a large mule deer buck, and found that he was able to select the good acorns unerringly and that the worm-eaten and particularly the blank acorns were left untouched.

FIG. 75. This buck fed for five minutes on the pungent leaves of the California laurel tree and returned to browse on the same sapling three times in fifteen minutes. Yosemite, June 26, 1927. Mus. Vert. Zool. No. 5392.

*Taste.*

The sense of taste is fairly well developed in the mule deer. Certain plants apparently are more acceptable to them than are other closely related species. This is well illustrated by the Spanish clover (*Lotus americana*) which, in Yosemite Valley, is eaten by deer during the summer to a larger extent than is any other plant. Apparently a spicy, pungent leaf, such as that of the California bay or laurel, is not displeasing to a deer's sense of taste, because on numerous occasions I have found mule deer feeding rather extensively on the leaves of this tree. On June 26, 1927, in Yosemite, I watched a forked-horn buck that fed continuously for a period of over five minutes on the pungent leaves of a California bay sapling (see Fig. 75). Furthermore, this buck returned three different times within an hour to browse on this particular tree, and this selection was made when green growing grass and other fresh, succulent vegetation was available in an abundance within a few feet of the bay tree.

As evidence that deer do exercise a selective choice through the sense of taste, I wish to present an incident that took place in Yosemite Valley on July 31, 1929. Two large bucks, with antlers well grown but still in the velvet, came up to a camp table upon which breakfast dishes had just been placed. These bucks were first directed to the table by seeing it. As they came closer they began to smell of the various objects and food on the table and finally, through the sense of taste, they selected the food that was most to their liking.

## GENERAL HABITS

### EXTENT AND CAUSES OF SEASONAL MIGRATIONS

From the time white men first began to settle along the Pacific slope of the Sierra Nevada in California it has been known that throughout this region mule deer occupy separate and distinct summer and winter ranges.

The normal summer range lies well back in the mountain meadows and along the higher ridges at elevations varying from 4000 to 12,000 feet. This summer range lies in the Transition, Canadian, and Hudsonian life zones. Contrasting with this relatively high summer habitat, the winter range of the same deer lies in the lower foothills from 3500 feet elevation near the lower limit of the yellow pine forest, down to 1500 feet in the rolling oak-covered foothills of the Upper Sonoran life zone along the eastern margins of the great interior valley of California.

While the altitudinal variation between the summer and winter range is considerable, the lineal distance between the two ranges is often fifty miles. Since two migrations are made each year, an upward one in the spring and a compensating downward migration in late fall, we find that many of these mule deer each year complete a total migration of one hundred miles. It is reasonable to suppose that some outstanding advantage must be gained to justify this annual expenditure of energy. Various explanations have been given for these extensive seasonal movements of mule deer. Dr. Carl P. Russell in his illuminating paper on "Seasonal Migration of Mule Deer," published in *Ecological Monographs* (vol. 2, 1932, pp. 1-46), has pointed out details of mule deer migrations in the Yosemite and Yellowstone regions, and has sought to correlate these movements with temperature, food supply, breeding cycle, and other phases of the life history of the mule deer.

For a general review of this matter, the reader is directed to Dr. Russell's excellent paper on the subject. It is not the present writer's intention to enter into a detailed discussion of the migration of mule deer in the Yosemite, since his findings and general conclusions, although made independently, coincide closely with those set forth in Dr. Russell's worthy paper. However, considerable added data on this subject have resulted from my study of mule deer in the Sequoia and Lassen sections, as well as some additional data concerning the winter range of mule deer in the Yosemite region. Presentation of such unpublished data is believed to be desirable at this time.

Russell has pointed out (p. 39) that: "if suitable food is available in a given area throughout the year, some or all of the deer in that area may not migrate." He also points out (p. 37) that: "low temperatures, while bringing about great physical changes in forage plants, do not render them unfit for food" and that "deer could safely reside in winter at high levels in the mountains so far as concerns the food

value of high mountain plants." Russell also points out that it is not low temperature alone that causes the mule deer to migrate to lower regions each fall, but rather it is the deep snow which, while it does not destroy the food value of plants, does render these food plants inaccessible to deer and hence is the chief causative factor in the fall migration of mule deer. Not only does a heavy snowfall cover up many food plants but it also makes effective travel for deer difficult or impossible. Unlike the white-tailed deer of the eastern United States our mule deer do not "yard" in winter but choose open hillsides where the snow is not too deep to prevent their moving freely about. Not only is free movement necessary in order that the mule deer may be able to obtain a livelihood on winter range where forage is relatively sparse but, most important of all, free movement is essential if the

FIG. 76. Mule deer trails all made in twenty-four hours, after a snowstorm on typical winter range. Pilot Ridge, Mariposa County, January 9, 1922. Mus. Vert. Zool. No. 3427.

mule deer are to evade capture by their natural enemies such as the coyote and the cougar.

In 1922, I spent two weeks in midwinter, January 4-17, on snowshoes studying food habits and the relation of coyotes to deer on the upper winter range. Pilot Ridge and Crane Flat, which lie between Hetch Hetchy and Yosemite valleys, were chosen for this study. The deer which range over the central portion of Yosemite National Park in summer, winter almost entirely within this area. At Hazel Green, 5665 feet altitude, the five feet of recently fallen snow had settled down to forty inches. At this date, January 9, 1922, tracks of mule deer made since the last snowstorm, on January 6, were abundant on the warm south side of the ridge (see Fig. 76) where in numerous

places the snow was not much over eighteen inches in depth. I spent several days on snowshoes on this winter range following both coyotes and deer about so as to obtain first-hand information and facts relative to winter food habits and interrelation of the two species. At Crane Flat in mid-January, I found the snow was slightly crusted and somewhat over five feet deep on the level. The mule deer seemed to realize that they were at a decided disadvantage in deep, crusted snow and although food, in the form of wind-broken branches, was plentiful on the snow, they stayed out of such dangerous areas. Why?

In the morning when the deer began to work up along the south slopes where the snow was shallow, I found by tracking, and watching with binoculars, that a pair of coyotes would slip around the hill, one keeping from 50 to 70 yards above its mate. The coyotes usually kept within sight of each other, and if hidden from view, each would stop at 400-yard intervals and wait until the other coyote appeared.

The lower coyote always kept about fifty yards ahead of its mate. As soon as a deer was located, the lower coyote would attempt to drive it up the hill and over the crest. If the deer tried to break back, the second coyote would rush in so that the deer was pocketed between the two animals. By thus keeping the deer between them, they were able to drive young or inexperienced deer over the crest of the ridge into deep-crusted snow, where the deer would break through at every jump while the coyotes were able to run on top of the crust and soon to capture and kill the deer that floundered helplessly about. This and other similar experiences have convinced me that the presence of natural enemies combined with unfavorable crusted snow may keep deer out of areas which would otherwise be excellent winter range for them.

Russell (p. 35) points out that in Yosemite deer on the upper summer range often begin to seek lower range in advance of the fall snowstorms. It has been my experience that deer are very well aware that at high altitudes their danger from natural enemies is greatly increased in the fall by the possibility of snow falling to depths sufficient to render them helpless before the attacks of predators, and under such circumstances a downward migration before storms may be merely a precautionary movement to prevent possible disaster. It has been my experience that some wise old doe, and not a buck, takes the lead in such matters. Snowstorms of slight intensity usually cause a downward migration, while heavy snowstorms, even if they come early in the fall, cause mule deer to abandon their summer range. I had an excellent demonstration of this fact at Lassen Peak in September, 1923. While camped at 6600 feet elevation on Warner Creek, I encountered the heaviest September fall of snow that I have experienced anywhere in western North America. It began to snow on September 23. At the end of the three days' storm 26 inches of snow lay on the level meadows.

When the snow first began to fall, I found sixteen Rocky Mountain mule deer within a distance of two miles of camp. The next morning, with about a foot of snow on the ground, I traveled six miles back and forth over the identical area and was unable to find any deer at all. Not even a fresh track could be found. Investigation showed that the deer began to abandon their summer habitat and started at once toward their winter range, which lay across a high ridge, 50

miles east of this point. Subsequent investigation showed that they did not return to this summer habitat until the following spring.

The same general route is followed by mule deer in going to and in coming from their summer range. My own investigations extending over a period of 20 years indicate that rarely do mule deer in migration pass from one drainage basin to another. When they do, their absence is only temporary. Thus, mule deer that winter on the eastern or great basin side of the Sierra Nevada sometimes cross over the main Sierran crest in late summer, but as far as we have been able to learn, they nearly always return and winter on the eastern side of these mountains. This has been noted in Yosemite near Tioga Pass.

In the Lassen section I found that the Rocky Mountain mule deer ranges regularly as far west as the head of Hat Creek at the eastern base of Lassen Peak. We have one definite instance in the Lassen section, where mule deer wintered on the western side of the divide. On February 22, 1920, on the north rim of Battle Creek, at an elevation of 4000 feet, about ten miles above Paynes Creek Post Office in Tehama County, Gus Nordquist saw three unquestioned mule deer, which he watched for some time at a distance of 50 feet. There was about two feet of snow on the level at this date, through which the deer were pawing to get at food, a gray growth known locally as "squaw carpet." Nordquist states that the evidence of pawed snow indicated that these mule deer had spent the winter in that locality and had not gone down out of the snow as do the coast black-tailed deer that are native to that locality.

In contrast to this it has been my experience that during winters with light snowfall, California mule deer often remain at relatively high altitudes, from 6000 to 7000 feet, until January first or even later. This is especially the case in many places along the southern part of the Sierra Nevada, as at Giant Forest in Sequoia National Park, where the deer can drop directly from the 7000-foot ridges down into the protected canyons at elevations of 2000 feet or less, and thereby get out of the snow in a very short distance. In most such instances the deer can get below the snow line by merely dropping a mile or two down the ridge.

Thus in Sequoia Park on January 24, 1924, at 5000 feet deer were abundant. Here I counted a band of 14 deer and found that they consisted of six does, six fawns and two large bucks. I was able to approach within 30 feet of many of these deer and found they were all California mule deer.

On December 18, 1929, I found that much of the ground in Giant Forest was still bare of snow and that deer were hunting over it for bits of staghorn lichen that had been blown off the trees by a recent gale. On the same day at 7000 feet elevation on a warm south- and west-facing slope, I found a band of mule deer, two does, three fawns and two big bucks, feeding together in a dense thicket of bitter cherry and snow brush. The brush, four feet in height, effectively concealed the does and fawns. However, the heads and antlers of the bucks projected above it. Well traveled deer trails led back and forth through this thicket, and deer tracks and droppings showed that this was the favorite feeding ground of all the deer in the region at that time. Some of the larger bucks were found to be unusually wild, and they were

believed to be deer that had only recently come down from the higher mountains. At this time the meadows in Giant Forest were still free from snow. Ninety-eight inches of snow was officially reported on the ground on January 31, 1932, when all deer had migrated to lower elevations in the oak belt.

During seasons of normal snowfall some mule deer remain throughout the year in Yosemite Valley and do not migrate at all. At this elevation, 4000 feet, the snow usually does not reach a depth sufficient to force deer to leave the Valley. However, during winters of heavy snowfall, nearly all of the deer drift down the Merced River Canyon to lower levels. According to the park superintendent's report of February 3, 1932, "between January 30, and February 3, a total of 51 inches of snow fell on the floor of Yosemite Valley." This heavy, wet snow packed on top of 32 inches of snow already on the ground gave a depth of 83 inches, which is the "greatest depth of snow recorded for Yosemite since park weather records began in 1906."

At my request, Assistant Postmaster Charles W. Michael and Park Naturalist C. A. Harwell made special investigations covering available food supply, migration, and relation of predators to deer during this critical period. Their findings are so important that they are given herewith in detail. In his letter of February 18, 1932, Michael states: "During the big storm, at the end of January, or shortly after, most of the deer went down the canyon. After the storm there was one deer where there had been ten before. * * *" Continuing, he says: "My morning walk takes me through the winter haunts of the deer, about the mouth of Indian Canyon. Twice in the last week Mrs. Michael and I have had an all-day trip. One trip to Mirror Lake and one trip down the Valley as far as the bear pits. On the day we went down the Valley, the only deer seen were three we found opposite the post office on our return. On the day we went to Mirror Lake, three deer were seen in Camp 15, feeding on fallen cedar boughs, and two were seen on the edge of Tenaya Creek. Following is our daily count of deer seen from February 9 to 17: 1—5—0—2—0—3—8—13."

The 13 seen on February 17 were believed to represent all the deer between the post office and the Ahwahnee grounds. Of these, probably 10 were deer that had come back up the canyon after the storm.

Concerning the shortage of food supply as the cause of deer leaving the Valley, Michael states: "Lack of food had nothing to do with the deer exodus from the Valley. Never since I have been in the Valley has there been so much available food. The storm brought down such a litter of branches that the Valley is strewn from end to end with forage that has been acceptable to deer in other seasons. * * * Heavy snows bring within reach much browse that is unreachable in fair weather. With conditions as they are, there is no reason for deer to go hungry.

"In my opinion deer leave the Valley not from food shortage, but because in heavy snows they are at the mercy of their natural enemies—coyotes, bobcats and mountain lions. Bobcats are more numerous in the Valley this winter than they have been for years."

Park Naturalist C. A. Harwell in his report accompanying letter of February 16, 1932, gives evidence similar to the above report as follows: "During the extremely heavy storms of the past few weeks

there has been a noticeable migration of deer from the floor of the Valley to lower, more open hillsides." Regarding available food, Harwell states: "Hundreds of our black oaks, too heavily laden with snow, were badly broken. Many of the limbs and branches broken down were covered with mistletoe. This furnished deer with a new and much relished food supply. Also boughs of all trees heavily laden with snow were pushed down within easy reach of these browsing animals."

Regarding actual attacks of predators, Harwell states: "On February 2, electricians Sam Cookson and Joe Gann, while driving up the highway, one mile east of Arch Rock Ranger Station, at 3 o'clock in the afternoon, saw a full grown doe jump from a 20-foot bank to the soft snow at the side of the highway with a wildcat at her throat. They brought their car to a stop within 20 feet of the two animals * * * grabbed shovels from their car and hurried to the rescue. * * * The doe was striking the cat sharply with her fore feet. The men observed that the cat had his teeth deeply imbedded in the throat of the deer. Blood was streaming from the wound. When Cookson and Gann got within a few feet, the cat loosened his hold and made an attempt to escape by scaling the bank. The deer trotted on down the road out of sight. The soft snow coupled with the steepness of the bank proved too much for the cat. When he saw he was cornered he turned on the men. A blow on the side of the head from a shovel quickly dispatched him. The wildcat was a male weighing 12 pounds, and is now a scientific specimen at the Yosemite Museum."

The fall migration of mule deer in California precedes the actual mating season, and in like manner the spring migration back to the summer range in the mountains is well in advance of the period when the fawns are born. The fall migration is often hurried, and when fall snow storms break suddenly, the migration of the mule deer may become almost a stampede to lower levels that are free of snow. Contrasting with this, the spring migration from the foothills to the higher summer range in the mountains is taken more leisurely. At the lower levels, deer begin their upward or spring migration as soon as the ground is free from snow, but at the higher levels, from 6500 feet up to 10,500 feet, progress is much slower, and deer do not seek these higher sections as soon as the snow is gone, but wait until the green spring vegetation has gained a good start.

On June 17, 1933, in ascending Alta Peak in Sequoia National Park, I found that a few bucks had reached 9000 feet altitude. On June 30, fresh deer tracks were found up to 10,000 feet on Silliman Crest near Twin Peaks. On July 4, I found deer had reached an altitude of 10,500 feet on the southwest slopes of Twin Peaks even in places where snow banks still lay several feet thick.

I believe that the spring migration parallels new spring plant growth. It is obvious that both plant development and deer migration vary from season to season; however, the following figures may be taken as average dates of spring arrival of mule deer on the west slope of the central Sierra Nevada:

| | |
|---|---|
| 4,000 feet, March 10. | 7,500 feet, June 5. |
| 5,000 feet, April 10. | 9,000 feet, July 5. |
| 6,000 feet, May 5. | 10,000 feet, August 5. |

Observations indicate that in the Sequoia region migration dates average 10 days earlier than the dates given above, while in the Lassen section in the northern part of the State migration dates were found to be slightly later than those in the Yosemite region.

There has been considerable discussion regarding the highest occurrence of mule deer in California. On August 23, 1933, I found fresh tracks of a large buck, probably the Inyo mule deer, crossing a pass well above timberline at 12,150 feet near Lake South America at the extreme head of Kern River. However, the highest altitudinal record for mule deer in California of which I have knowledge is recorded by George M. Wright, who on July 18, 1923, found a mature buck at 12,750 feet on the southwest face of Mount Kaweah, Sequoia National Park.

### FLUCTUATIONS IN MULE DEER POPULATIONS

John McCauley, a long-time resident of Stage Station, Mariposa County, told me that in 1900 mule deer had been so hunted in the region about Hazel Green that the appearance of a deer during the winter caused an immediate stampede of hunters to that point. Does were shot as quickly as bucks, and hunters were not concerned about obeying game laws.

Upon my first visit to Yosemite Valley in 1915, I found deer were so rare there that whenever one camper discovered a deer he would call all the other campers to come and see the unusual sight. Through protection from predatory natural enemies and human hunters, the deer in Yosemite increased so rapidly that they were numerous there by 1925. On April 30, 1929, I personally in two hours counted 69 deer on the floor of Yosemite Valley, and then only covered about three-fourths of the Valley floor. At this same time a friend on horseback counted 100 head of deer in one evening on the Valley floor. On March 27, 1930, I counted 96 deer in one hour in Yosemite Valley. In order to preserve the native flora of Yosemite and to restock an adjoining area that had been denuded of deer during the foot-and-mouth epizootic, in two years (1930 and 1931) a total of 137 deer, chiefly yearlings, were trapped in enclosures and transported by truck from Yosemite Valley to Hetch Hetchy in the northern portion of Yosemite National Park. This gave temporary relief.

Great fluctuations in numbers of mule deer have also taken place outside our national parks. Dan Mann, an old resident of Tuolumne County, informed the writer that in 1862, deer were very scarce along the Sonora Pass Road. This continued for about ten years, but by 1876 deer began to be plentiful and continued so until 1890, when heavy hunting plus a severe winter greatly reduced their number. However, they gradually increased until at the time of the foot-and-mouth epizootic in July, 1924, deer were more numerous, according to old-timers, on the Stanislaus National Forest than they had been at any time since the days of '49, when the first influx of white men began. The non-sale of deer meat, the protection of does, and the killing off of mountain lions are believed to be the three main reasons for this increase.

During the foot-and-mouth epizootic and the resulting eradication campaign which in the deer extended from July 12, 1924, until June 10, 1926, when all quarantine restrictions were removed, a total of

22,214 deer were slaughtered (Charles Keane, *"The Epizootic of Foot and Mouth Disease in California,"* State of California Department of Agriculture, Special Publication, No. 65, 1926, p. 51).

Since these 22,214 deer were killed on 1000 square miles of range, it has been argued that the deer population was "22 deer per square mile," which hardly represents the facts in the case, because it must be remembered that at least three armies of deer crossed this area on spring and fall migrations from the foothills to the uplands during the foot-and-mouth disaster, so that the 22,000 deer killed represented the deer population on more than 1000 square miles. In the early days of California, it was customary for meat hunters to lie in wait and to shoot many deer at certain passes through which the deer traveled in migration, but the number of deer so killed in such areas should not be cited as representing the normal deer population of these limited areas.

It is interesting to note that ten years after the deer had been wiped out in the campaign to control the foot-and-mouth disease, through a voluntary cessation of hunting, infiltration, and breeding up of the deer, good hunting was again to be had in the Stanislaus National Forest.

It is the writer's experience that five mule deer per square mile is a fairly good deer population on average range in California.

### WINTER RANGE

On the south-facing slope of Pilot Ridge, Mariposa County, which at 4,000 feet elevation is covered with bluebrush and scattered clumps of golden oak trees, on January 21, 1921, we found mule deer numerous, fourteen being in sight at one time and over fifty being encountered in a distance of one mile. The average depth of snow at this time was eighteen inches, although it reached a measured depth of two feet in several places. The deer were found to stay under the golden oak trees where they were sheltered and where we found that they pawed out beds in the snow, which there was only about eight inches deep, so that they could lie down on the thick carpet of dead leaves beneath. This tendency of deer to seek beds of dead leaves rather than snow to rest on, is graphically shown by a photograph (see Fig. 68), and has been noted by the writer many times.

This area on the south side of Pilot Ridge is one of the most important wintering grounds of deer in the State, since many of the deer which spend the summer in the central portion, winter just outside the Park in this area.

On January 8, 1922, at the writer's request, John McCauley took a census of deer observed by him on a day's horseback trip through this important winter range. The route covered included Deer Flat, Bull Creek, and Anderson Valley. The distance traveled was 18 miles, which was covered in six hours. During this time, 37 deer, consisting of 22 does, 13 bucks (nearly all 2-point or larger) and 2 fawns were seen, singly and in bunches, as follows: 10 a.m., 1 doe; 10.30 a.m., 2 bucks, 1 doe; 11.35 a.m., 1 doe, 2 fawns; 12.30 p.m., 5 bucks, 6 does; 2.40 p.m., 1 doe; 3.45 p.m., 1 large buck; 4.15 p.m., 3 bucks, 4 does; 4.20 p.m., 2 does; 4.30 p.m., 2 does; 4.35 p.m., 2 does, 2 bucks; 4.40 p.m., 2 does.

LOCAL HABITAT

The local habitat of the mule deer in California varies greatly with locality. In the Modoc region mule deer are commonly found in the open stands of Jeffrey and western yellow pine, or at times the big bucks may be found foraging out in the broken lava beds adjacent to the yellow pine forest (see Fig. 77). It would seem impossible for animals as large and as heavy as the mule deer to run as fast as they do

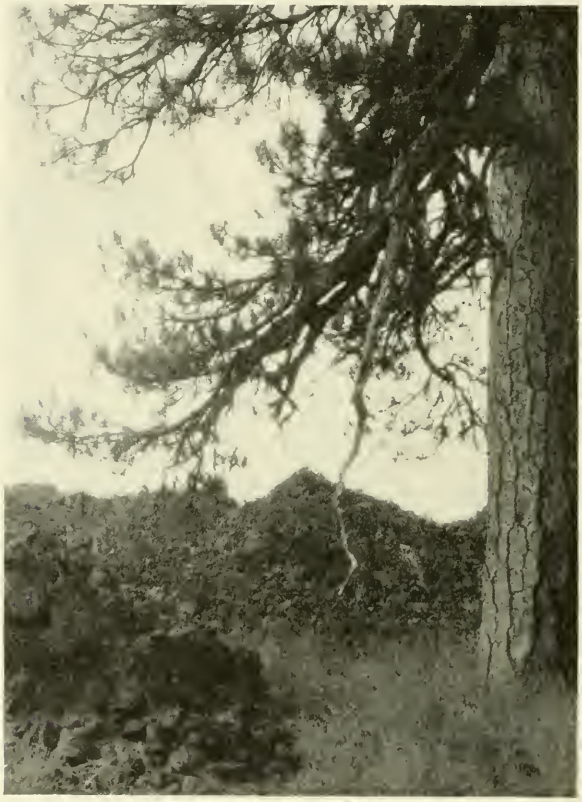

FIG. 77. In the Modoc region Rocky Mountain mule deer often forage out in the broken lava beds at the margins of the western yellow pine forests. Medicine Lake, Siskiyou County, September 25, 1924. Mus. Vert. Zool. No. 4451.

over the broken lava beds where a man would certainly fall if he attempted to run across them at full speed.

In the central Sierran region the mule deer is a characteristic inhabitant of the yellow pine and white fir forest. In such localities the deer often may be found bedded down during the heat of the day in the shade of some large yellow pine. However, the older bucks, during the hours of sunlight, show a decided preference for the seclusion of

the shady incense cedar thickets. Here in the early morning they may be found taking a sun bath, screened from intruders by the drooping branches of the cedar trees, in the brilliant sunshine which shoots through an opening like a spotlight. The more experienced bucks, particularly those that come in contact with hunters, show a tendency to bed down on or near the crest of rocky ridges where it would be difficult for a man to approach without giving some warning through the breaking of dead limbs or the dislodging of loose rocks. Such a buck is illustrated by Fig. 67. I finally succeeded in "snapping" this wise old buck in his noonday bed, but at that only one photograph was secured, for the second the sound of the releasing shutter startled him he bounded away without stopping to take a second look. Does and fawns show less care in choice of bedding places. However, when a mountain lion is in the vicinity, I have found that all of the deer show much greater care in selection of bedding places and tend to bed down under such circumstances on or near the crest of the ridges, keeping in the shade but out in the open rather than in thickets of brush, so that the air currents which sweep up either side of such ridges during the daytime can carry to them the scent or sound of any approaching enemy.

During the summer, mule deer tend to leave the forest and to graze out in the open meadows during early morning and late evening. There is also a considerable tendency, especially in areas where the deer are not hunted, for the animals to bed down out in the open meadow where they can have a wide vista and can detect the approach of any potential enemy.

There has been much conflicting evidence given regarding the daily range of the mule deer. In certain instances I have found that a given individual could be found day after day in a relatively small area, not over one mile square in extent. This has been particularly true with certain bucks that have been found to repair day after day to a certain ridge or clump of brush where they have remained in hiding. During midsummer or midwinter, the daily movement of a given deer has been found to be much less than it is during the spring or fall when migratory movements from the winter to the summer range are in order. On the summer range, and also on the winter range, I have found that certain individual deer, when they have not been alarmed by predatory animals or hunted by man, have a monthly range of not over one township in extent, and in many cases the entire day is spent in an area less than 1000 acres in extent.

The seasonal range of mule deer is in some instances very slight, perhaps not more than five miles in extent. However, in the majority of cases in California mule deer there is a seasonal shifting of four or five thousand feet in elevation and from 20 to 70 miles in distance. At Eagle Lake, in Lassen County, on May 15, 1925, Rocky Mountain mule deer were working westward around the southern end of the Lake en route to their summer range. The difference in distance between the summer and winter ranges in that particular locality varies from twenty to thirty miles. In the central portion of the Sierra Nevada there is a greater distance between the summer and winter ranges of the mule deer, owing to the fact that the western slope of the Sierra Nevada in that region has a very low gradient.

In connection with the suppression of the foot-and-mouth disease among deer in the Stanislaus National Forest, in 1924, it was found that the summer range of mule deer was, in certain instances, as much as 50 miles distant from the winter range.

On July 28, 1929, west of Saddlebag Lake along the crest of the Sierra Nevada, I found freshly made tracks of deer. The nearest known wintering ground of mule deer to the west was 50 miles distant.

During the rutting season, mule deer bucks have been known to travel as much as ten miles overnight. One of the best illustrations of the range of mule deer that we have been able to secure was reported by H. C. Bryant (*Journal of Mammalogy*, Aug., 1924, p. 201): "In 1921, Ranger Henry Skelton and his brother, stationed at Caseada, about eight miles down the canyon from Yosemite, took an interest in a tame doe with two fawns. Incidentally, one of the fawns became so injured that it was mercifully killed. The doe became so tame that it could be petted. In sending to a mail-order house for materials, a small bell was noted in the catalogue and was ordered, that it might be placed around the neck of the tame doe. Having been thus marked with a leather collar and a bell, the doe was continuously identified in the vicinity during the rest of the summer. In the following summer (1922), this same doe with the bell was reported along the south rim of Yosemite Valley on the Pohono trail. During the past summer (1923), the same animal was reported many times from Little Yosemite Valley, a minimum distance of seventeen miles from the place where it was first belled, and in the summer of 1924 along the Half Dome trail about four miles north of its 1923 habitat. She has wintered regularly at Caseada." Observations that have been made in years following 1924 showed that this individual doe had about the same annual range over a period of years, and that her daily range, both on the winter and summer ranges, covered a relatively small area, not more than one square mile in extent.

The Rocky Mountain mule deer and the burro deer are more partial to open woods and broken rock country than are either the black-tailed or California mule deer, which latter are regular brush inhabitants. However, on the west slope of the Sierra Nevada at the lower altitudes which form the winter range of the California mule deer, I have found that at this season they are very partial to the protection afforded by scattered clumps of brush, especially to scrub oak, or buck brush.

The California mule deer is a characteristic inhabitant of the chaparral belt, and in this area, while many of the deer do make a regular spring migration to the summer range in the higher mountains, there are a certain number of deer to be found in the brush belt throughout the year.

In the vicinity of Giant Forest, Fresno County, I found that mule deer make a decided and often extensive seasonal migration. In hunting mountain lions with State Lion Hunter J. Bruce in that region in midwinter, we found that the majority of the deer at that season of the year were to be found in the brush belt just below the lower edge of the yellow pine belt. The extreme elevations of the winter range varied from 1500 to 4800 feet. However, the bulk of the deer were to be found between the 3000-3500-foot contour lines. In this region on August

30, 1930, I found that the larger bucks were high up near timberline, two large bucks being seen on the very summit above Silliman Pass (11,400 feet). A few days later, on September 1, 1930, I crossed Elizabeth Pass (11,650 feet). As I climbed up out of Deadman Canyon, the highest elevation at which deer tracks or droppings could be found was 10,000 feet. However, the bare granite basins on both sides of Elizabeth Pass, together with the broken slides, appear to be effective barriers which discourage deer from crossing the pass. Investigation of the high granite ridges in that vicinity showed that in late summer deer, especially the big bucks, regularly reach an elevation of 11,000 feet.

Grinnell and Taylor (MS) report deer tracks being found as high as 11,500 feet, in the vicinity of Mount Whitney. In the Yosemite region, at 10,400 feet, near Saddlebag Lake, I found numerous fresh deer tracks on July 28, 1929. In this locality the altitudinal summer range of deer was found to reach 11,000 feet. On July 23, I found fresh tracks of six deer, all apparently does and fawns with no large bucks in the entire group, at an elevation of just under 10,000 feet near the upper belt of dense lodgepole pine trees at the west base of Mount Dana. The freshly cropped vegetation showed that these deer had browsed along the edge of a green alpine meadow and had eaten both fresh green grass and shrubby vegetation.

## BREEDING HABITS

### AGE AT WHICH BUCKS DEVELOP ANTLERS

Under normal conditions in the central Sierra Nevada region, the first antlers of male California mule deer are single spikes from three to ten inches in length. Such antlers start to develop when the animal is about one year old. However, in early fawns the growth of the antler is sometimes sufficient to perforate the skin the first season (Caton, *Antelope and Deer of America*, 1877, p. 192). I have several times verified this fact. In Yosemite on January 30, 1929, I observed

FIG. 78. After reaching full physical development a mule deer buck begins to decline. Although his antlers retain their full spread a reduction in points takes place as here shown. Yosemite, December 6, 1927. Mus. Vert. Zool. No. 5618.

two male mule deer fawns in which antlers had just broken through the skin on the tops of their heads. One had little sharp antlers not over an inch long protruding through and above the surface of the skin. Another male fawn had small antlers over one and one-fourth inches in length. In both instances the diminutive antlers were hard and free of velvet. At this date the majority of buck fawns gave no indication of their antlers coming through the skin at any time in the near future. In both instances just cited the fawns stayed close to and were dependent on their mothers. These fawns could not have been more than eight months old at the date of observation.

In the Modoc and Lassen regions in northeastern California it has been my own observation, as well as that of residents of the region, that a male Rocky Mountain mule deer in normal strength and vigor will have his first antlers "forked-horn." In one well-attested instance in the Lassen region, a mule deer buck known to have been only a yearling had three points on one antler and two on the other (Grinnell, Dixon and Linsdale, *Vertebrate Natural History of Lassen Peak Region,* 1930, p. 572).

It has been pointed out that deer in captivity tend to produce smaller antlers than those of the same species and age in the wild. It has been thought that this difference in size of antlers may be due to the presence or absence of certain foods of high mineral content. This difference in available food might well account for the variation that we find in the size of antlers in the same species of deer in localities only a few miles apart.

During the second year of his life a mule deer buck is usually a "forked-horn." The brow tine, which is commonly known to hunters as the "eyeguard" is not acquired until the third year, at which time a third point is usually added to each antler. Basal snags, or protuberances at the base of the antler below the eye-guard, are only present on *old* bucks. Many of these old bucks are only "forked-horns" and frequently lack brow tines (see Fig. 78).

Some hunters have claimed that the age of a buck can always be determined by the number of points on his antlers. While there is a general relationship between age and the number of points, no hard and fast rule can be laid down, because, as will presently be shown, there is much variation in antlers with age even in the same individual.

My own experience has been that the development of antlers in a normal male mule deer is as follows: yearling, forked-horn or spike, varying with sub-species; two-year-old, forked-horn, rarely a three-pointer; three-year-old, three-pointer, rarely a forked-horn; four-year-old to eight-year-old, four pointer. Four points, exclusive of the brow tine, on each antler is the regular number of points for a fully adult mule deer buck. Aside from freak sets of antlers, the largest number of points of which I have dependable record in mule deer in California is seven *full points* on one antler and eight on the companion antler.

Antlers in deer are secondary sexual characters and are closely linked up with the reproductive system. Where it has been possible personally to check on the animal in the flesh, it has invariably been my experience that all bucks bearing freak antlers or antlers that never shed their velvet have been sexually aberrant.

After reaching full normal size of four points, some bucks subsequently add extra prongs and snags or even an extra tine or two to their antlers (see Fig 56). However, the majority of mule deer bucks rarely develop more than four main tines to each antler. After a buck has reached the zenith of his physical perfection, and although his antlers may retain their full spread, a reduction in the number of tines frequently takes place from year to year, so that we commonly find large old bucks (see Fig 78) having antlers that are reduced to only three, two, or in extreme cases only a single tine or "spike." In several instances I have been able to examine the skeleton, skull, and particularly the worn teeth, of such bucks that have fallen to the hunter's

rifle, and have been able to prove beyond question that they were old, decadent individuals. The more observant hunters recognize these large, old forked-horn bucks and frequently refer to them as "Pacific" bucks (see Fig. 79). Other less observant hunters marvel at their size but maintain that they are just "forked-horns" and that they therefore must be young deer.

### BREEDING AGE OF DOES

Caton states that none of the Rocky Mountain mule deer which he raised "showed the least inclination to breed the summer they were a year old." However, Ranger Oscar L. Barnum gives, in letter of February 15, 1931, the known breeding data of two Rocky Mountain mule deer does in California, thus:

| *Born* | *First bred* | *Fawn born* |
|---|---|---|
| July 17, 1928 | November 27, 1929 | (single) June 23, 1930 |
| July 17, 1928 | December 7, 1929 | (twins) July 5, 1930 |

FIG. 79. A so-called "Pacific" buck is merely a large old decadent buck in which the antlers have been reduced to the "forked horn" stage as here pictured. Yosemite, December 6, 1927. Mus. Vert. Zool. No. 5625.

My observations show that many yearling mule deer does in California fail to breed and that over half of them do not breed successfully until they are over two years old. The normal breeding range of the average mule deer doe has, in known instances, been from 2 to 12 years of age.

The average deer hunter finds a doe that has "lost her fawn" through a coyote, bear, eagle, or disease, and jumps to the conclusion that every doe seen in late summer or fall without a fawn is a barren doe. My year-round investigations show that this is not the case and that the percentage of barren does has been exaggerated and is actually not more than 5 or 6 per cent.

GROWTH OF ANTLERS

The interval between the dropping of the old antlers and the time when the new antlers start to grow again in mule deer of California has been found, by accurate check, to vary from two to four weeks. As soon as the old antler is dropped, the top of the pedicel, where the antler joined the skull, becomes granulated around its entire margin and in a short time is completely overgrown. This process has been noted by me many times. On February 8, 1930, in Yosemite, I observed and photographed a buck that was known to have shed his antlers one week previously. In this instance, a distinct granular ring had already formed around the outer rim of the pedicel or process of the skull upon which the antler grows (see Fig. 80). Within ten days the

FIG. 80. As soon as the antler is shed the scar becomes granulated and in a short time heals over, as in this California mule deer buck with antlers shed one week. Yosemite, February 8, 1930. Wild Life Division No. 781.

pedicel was completely covered with black naked skin, which then remained free of any covering of velvet or hair until after the new antler had begun to develop.

My own observation has been that the most vigorous mature bucks which are the first to drop their antlers are also the first to start to grow new antlers in the early spring. The earliest date upon which I have actually observed antlers "sprouting" was March 4, but in the case of the unicorn buck of Yosemite, George Wright (MS) reports the new antlers had begun to develop on March 2, 1928. Immature bucks, together with sickly or poorly nourished males, are the last individuals to shed their antlers and are correspondingly late in growing a new set. In Yosemite Valley on April 8, 1929, George Wright noted bucks with new antlers "nearly an inch long."

On April 29, 1929, I found a group of five mature bucks that were feeding harmoniously together in a willow patch on the floor of Yosemite Valley. These bucks were in much better flesh than they had been when seen the last of the previous January. At this season the bucks were actually wilder than the does and fawns. Antler growth had begun in all five bucks, and in each case the length of the new antler was recorded in inches, as follows: $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{2}$ and $2\frac{1}{2}$. In any given buck the two antlers were of equal length and diameter. The antlers had attained their full diameter, from $1\frac{1}{8}$ to $1\frac{3}{8}$ inches, from the start, so the growth was all longitudinal (see Fig. 81). At this early stage of growth, the antlers were dark bluish-black in color, turgid in texture, and covered with a very short and fine growth of downy hair. The new

Fig. 81. By the last of April, California mule deer bucks have new growing antlers as much as $2\frac{1}{2}$ inches long, as here shown. Yosemite, April 29, 1929. J. S. Dixon No. 11.

growing antlers were apparently decidedly sensitive to the touch. Although the bucks were quite playful at this season, care was taken not to strike their antlers against those of another buck or against any other hard object such as the limbs or trunk of a tree. Instead of selecting a smooth willow sapling to rub his tender antlers on, one buck massaged his antler by reaching around and gently rubbing its tender tip against the skin of his belly or on the inside of his hind leg. This operation was repeated three times within a period of five minutes and proved to be the regular "manicure" method employed.

Oscar L. Barnum (in a letter of March 3, 1931) states that the first sets of new antlers observed by him in Rocky Mountain mule deer in the Modoc region have been as follows: On April 17 and April 23, 1927, two bucks were noted, each with new antlers about three inches

in length; on April 15, 1929, a buck was observed with new antlers three inches long; and on April 14, 1930, two bucks were seen with new antlers each about $2\frac{1}{2}$ inches long. Barnum reports that in his section by the first of May practically all of the bucks have new antlers large enough to be seen without difficulty. He states that in the Modoc region branching of the antlers is in evidence by May 20 and that the antler is fully grown by the middle of July, although the velvet is not normally shed until about the tenth day of September.

My own extensive observations, together with those of George M. Wright, made in Yosemite, indicate that on the average California mule deer bucks are a trifle later in developing full antlers than are Rocky Mountain mule deer in the Modoc region. The reason why the earliest dates for new antlers come from Yosemite was possibly the fact that they were especially watched for and were detected at an early stage

FIG. 82. In Yosemite, many of the bucks had new antlers grown out to the first forking by July 1. Yosemite, June 29, 1927. Mus. Vert. Zool. No. 5386.

of development when less than an inch in length, while in the Modoc region the new antlers were not noted until they had made considerable growth. In the Modoc region branching of antlers was in evidence by May 20. In Yosemite on May 24, 1928, Wright found that many of the bucks had antlers grown out to about the first forking, while some antlers had barely begun to fork on July 1 (see Fig. 82). On July 15, 1929, in Yosemite, I watched two large bucks that were feeding in a meadow (see Fig 83) and found that their antlers were not over three-fourths grown. A large four-point buck photographed at the same place on August 1, 1929 (see Fig. 84), had antlers not yet fully grown.

On July 18, 1928, I watched a band of nine buck deer feeding harmoniously on an area not more than an acre in extent in Yosemite.

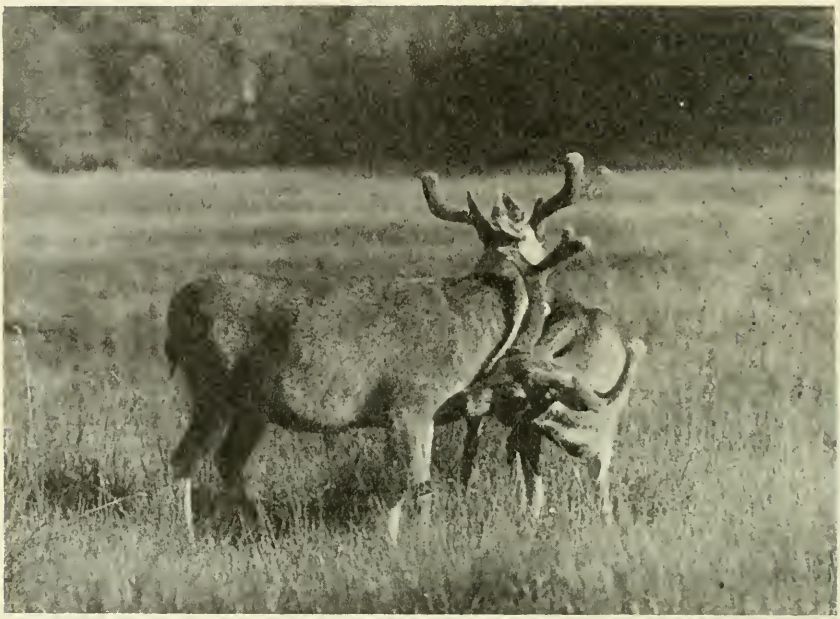

FIG. 83. Two large bucks biting ticks on each other. Note that the antlers are not over three-fourths grown by the middle of July. Yosemite, July 15, 1929. Wild Life Division No. 144.

FIG. 84. A large 4-point buck in full "red" summer coat but with antlers still in velvet and not fully formed. Yosemite, August 1, 1929. Wild Life Division No. 165.

There were four-point, 2; three-point, 3; three-two-point, 1; two-point, 2; spike, 1. All their antlers were in the velvet and appeared to be three-fourths grown. On August 1, 1929, in Yosemite, I found a spike buck that had antlers between 5 and 6 inches long but still in the velvet. In the Yosemite region, the earliest date upon which I have found bucks with antlers practically grown but still in the velvet was July 20.

By the tenth of September some of the bucks begin to "fight brush" in order to free their antlers of velvet. One of the most notable instances in which I was able to witness removal of the velvet from a buck's antlers took place in Yosemite Valley in 1927, where, on September 14, I found a very tame buck with large antlers still in the velvet (see Fig 85). At this date he was all shed out into the short

FIG. 85. California mule deer buck with antlers fully grown but still in the velvet. Yosemite, September 14, 1927, 5 p.m. Mus. Vert. Zool. No. 5478.

"blue" (really gray) winter coat. He was fat and in excellent condition, with large well-balanced antlers that carried three tines on each side. I watched him for some time at a distance of ten feet as he fed on goldenrod stalks which were just ready to bud. As far as I could see, even with binoculars, the velvet was as solidly attached as ever to the antlers, and there was no break or tear in it at any point. I left him at 6.20 p.m., still chewing peacefully on the goldenrod. Twelve hours later, at 6 o'clock on the morning of September 15, I met this same buck coming out of a thicket of western chokecherry where I later found evidence that he had been "horning" the brush to free his antlers of velvet. The velvet which the day before had covered his antlers now hung in long limp ribbons from the base of his antlers, to which support the shreds remained firmly attached. The shreds of velvet caused the buck considerable worry in that every time he lowered his head to

graze on the grass they dangled in front of his eyes and obscured his vision. The buck kept shaking his head vigorously and twice I saw him take the offending strands in his mouth and chew them off as high up as he could grasp them. The velvet thus obtained was not dropped or thrown away but was *chewed up and swallowed with evident relish.* By 7 o'clock all of the velvet had been "bobbed" by being chewed off to the level of the buck's mouth. The buck then went out and after bedding down in the center of the meadow began chewing his cud (see Fig. 86). Half an hour later this buck was down near our camp horning some smooth willow saplings in an effort to get rid of the remaining velvet. He no longer rubbed the tips of his antlers, which were then hard and polished and a beautiful brown in color, but spent most of his energy in trying to remove the velvet where it was still tightly attached at the base of his antlers. By 9 o'clock the wet, stringy strips of velvet had begun to dry and to shrivel up into narrow "shoestrings" which, two days later, resembled strips of dried up, twisted rawhide (see Fig. 87) that remained tightly attached to the antlers. However, the bony burr at the base of the antler stuck out and protected the velvet so

Fig. 86. The same buck (see Fig. 85), thirteen hours later with velvet hanging in shreds but with the ends bitten off, chewed up, and swallowed by the buck. Yosemite, September 15, 1927, 6 a.m. Mus. Vert. Zool. No. 5481.

that even repeated rubbings of the antlers against willow saplings failed to remove it. I was much interested in finding out just how the strips of dried-up velvet would finally be gotten rid of, so I continued to keep close watch on this particular buck and, on the morning of September 18, I watched him lower his head, then reach forward with his right hind leg and using the sharp points of the hoof as a chisel, he neatly pried off and dislodged the remaining shreds of dry, stiff velvet.

It has been my experience that shedding of velvet on the antlers of vigorous bucks in good physical condition is rapid and complete.

Inspection at close range of tame bucks observed in the act of removing the velvet shows that there is normally a wet, vascular, bloody film between the velvet and the hard bony surface of the antler which serves much in the same way that the freshly flowing spring sap of a willow permits the ready separation of the bruised bark from the wood. However, in cases where the buck is sickly or poorly nourished, the velvet dries down and adheres tightly to the antlers, so that it is very difficult for the buck to scrape it off.

In selecting a "rubbing post" upon which to remove velvet and to polish their antlers, bucks show a decided preference for straight, upright saplings of smooth-barked willow, wild plum, or wild cherry. Small saplings between two and three inches in diameter are most frequently chosen (see Fig. 88). On January 30, 1929, in Yosemite, I found many wild plum saplings that had been "horned" by bucks so that the bark had been removed and bare white patches two inches wide and 18 inches long resulted. These "barked" areas were nearly always within three feet of the ground. Many of these "barked" areas showed grooves cut into the wood. Such grooves have been mistaken for toothmarks by some people, but close inspection showed that the indentations had been made by the sharp round-pointed eyeguards and tines of the deer rather than by his relatively wide, flat, chisel-like lower incisor teeth. Furthermore, in nearly every instance, the shreds of wood and pieces of bark that had been raked off or gouged out by the antlers were found lying dried up *on the ground* at the base of the barked saplings, thus completing the evidence.

FIG. 87. Buck shown (see Fig. 86), but two days later with velvet dried up. Yosemite, September 17, 1927. Mus. Vert. Zool. No. 5485.

Bucks continue to polish their antlers long after the last bits of velvet have been removed. In fact, they "horn" certain saplings as long as they retain their antlers. On December 10, 1927, in Yosemite, I photographed a buck in the act of vigorously "horning" a bush (see Fig. 88). On the evening of December 13, I watched a three-point buck "horn" a willow sapling, stripping all of the bark off one side of the sapling for a distance of 26 inches. After the smaller buck had been working on the willow for a period of four minutes, a large four-point buck came along and chased him away and began to "horn" the same willow.

The larger buck stopped three different times and *smelled the spot* where the other buck had been rubbing the base of his antlers on the

willow. This incident suggests that saplings that are regularly "horned" by a number of different bucks, as I have found frequently to be the case, may serve as "intelligence posts," just as certain "bear trees" are selected and bitten, rubbed and scratched by bears.

### ADULT BUCKS WITH SPIKE ANTLERS

Hunters have reported the killing at rare intervals of old bucks that have carried spike antlers. That the antlers of such old bucks do revert to single spikes has been questioned by certain authors. Caton, in his excellent book on the antelope and deer of America, states (p. 232): "We have no well authenticated, reliable observations to justify the conclusions that these [large] spike antlers are ever grown upon

FIG. 88. A California mule deer buck horning a willow. Mule deer continue to polish their antlers long after the velvet is off. Yosemite, December 10, 1927. Mus. Vert. Zool. No. 5624.

adult animals. All we have on the subject is a sort of general conjecture, founded no doubt upon exceptional cases."

The best concrete evidence that I have been able to secure on this point is as follows: On January 31, 1929, I found an old buck in Yosemite Valley that carried a tall, four-point antler on the right side of his head, while his left antler was a straight spike one inch in diameter and ten inches in length (see Fig. 89). A good cheek was obtained on the length of the spike, which was fully two inches longer than his ear. This buck had received an injury to his left hip, so that he walked with an unusual weaving motion. The injury appeared to have been done by the antlers of some large buck. This may have been the reason

why this buck was very shy and kept out of the way of all of the larger bucks.

Gus Nordquist has mounted between 300 and 400 deer heads each year for the past ten years. He has thus had an excellent opportunity to observe unusual sets of antlers since deer heads from all over California are shipped to him to be mounted. Nordquist has taken the trouble to examine the teeth and skulls of two large spike bucks and stated that the worn teeth and the characters of the skull in each case showed that the bucks that carried these large antlers were unquestionably old individuals. Nordquist states that in one instance the spike antlers were over fifteen inches in length and more than an inch and a quarter in diameter at the base. Examination of the teeth and skull proved that the animal that wore the antlers was well past middle age.

FIG. 89. This old buck's left antler was a straight spike ten inches long and one inch in diameter. The other antler was tall and carried four points. Yosemite, January 31, 1929. J. S. Dixon No. 30.

I have personally examined two sets of spike antlers that measured over fourteen inches in length and well over an inch and one-eighth in diameter. In both instances there was conclusive evidence that the bucks were old.

Nordquist and I have both found that in nearly every instance where an old buck has been found bearing spike antlers, there have also been several extra snags, from one to six inches in length, clustered about the base of the main antler. The presence of such snags or prongs at the base of the antler has been shown by both Caton and Nordquist to be characteristic of age, and restricted to antlers of *old* bucks.

In 1930 I found that in Yosemite Valley all of the older bucks had dropped their antlers by February 8, the earliest date a buck was seen

without antlers having been reported by Charles Michael as January 27. In 1931, because of the mild winter, we thought that the bucks might drop their antlers earlier than they did in 1930. However, this was not the case, since only two old bucks had dropped their antlers by February 8, 1931. As a general rule, the mature and more vigorous bucks are the first to shed their antlers, some being without them by January 15. In 1929, the last buck with old antlers was noted in Yosemite on March 30, and by April 9, some of the mature bucks which had dropped their antlers early had new ones nearly an inch in length.

### UNICORN BUCK

Among the many cases of malformed antlers in mule deer which I have personally observed and studied, in all but two instances the dis-

FIG. 90. The "unicorn" buck. Note oddly shaped antlers and location of the *third* antler. Yosemite, December 6, 1927. Mus. Vert. Zool. No. 5612.

tortion was restricted to the two antlers themselves and did not involve any other bony process. However, in the case of the unicorn buck of Yosemite, we have a deer that developed a *third* bony process or antler growing out of the center of his face about halfway between his eyes and nostrils (see Fig. 90). This third antler first made its appearance as a single spike, but in 1927 it developed two prongs or tines. On September 14, 1927, the third antler was still in the velvet and had a height of $2\frac{1}{4}$ inches with a basal diameter of one inch. His regular antlers were in the velvet also, and at this date had a spread of 30 inches and were apparently nearly grown. On November 18, 1927, two residents of Yosemite saw the unicorn, and on that date the shreds of dry velvet were just peeling off his antlers. On December 6, 1927,

I again encountered this buck and found that his antlers were full-grown and carried several extra tines or points (see Fig. 91). By this time the buck was in full winter pelage and his antlers, including the one on his nose, were free from velvet, being hard and polished. According to local residents, the unicorn buck came back in the spring with a hole or depression in his forehead where the supernumerary antler had been. A knob began to appear there simultaneously with the budding antlers.

"Old Horny" was one of the tamest bucks in the park, yet, unlike the other older bucks, he never was mean, even during the rutting season, or vicious toward men, women, or children. It was thought from his malformed antlers and his exceedingly gentle behavior that he was sexually deficient. However, examination of his reproductive organs and subsequent observations proved that this was not the case. His testicles, though small, were intact, and the fact that this buck was seen to drive off other large bucks and to mate successfully with several does proved that he was sexually potent. For some unknown reason, other larger and more powerful bucks repeatedly gave way and relinquished their rights, even to the coveted does, to the unicorn. When another buck came near him, "Old Horny" faced the intruder, then, lowering his head, gave a hoarse hiss or grunt. Upon receiving such a challenge, the other buck always departed in haste.

FIG. 91. A close up of the "unicorn" buck to show location and forking of *third* antler on face in front of eyes. Yosemite, December 6, 1927. Mus. Vert. Zool. No. 5611.

It became obvious during the winter of 1928 that "Old Horny" was fast entering upon a decline. His body became thin and emaciated and his spirit was broken. Watch was kept, but he grew more feeble, and on February 24, 1928, after the two main antlers were shed, he was placed in one of the government barns where he could be fed and taken care of. Finally, in the first week of March, in spite of all that could be done for him, "Old Horny" died. A post mortem by George M. Wright revealed that he was heavily infested with ticks. A large bump was present on the right side of the lower jaw. When the head was skinned, it was discovered that the lower jaw on the right side and an area extending all the way back to the base of the cranium was infected and full of pus. When the skull was cleaned it was found that the skull was not bilaterally perfect and that the two antler sockets were not in the same relative position.

During the life of the unicorn there had been much discussion and debate regarding the exact location of the third antler with regard to

the bones of the skull. Certain leading scientists claimed that in the deer family only the frontal bones produced antler sockets and that therefore the third antler must also be located on the frontal bone. The skull of this interesting buck was cleaned and preserved by George M. Wright and then placed in the Yosemite Museum where it may be examined by those interested. Examination of the cleaned cranium revealed the fact that the third antler *was not an outgrowth of the frontal bones*, but was located more than halfway down on the *nasal bones* (see Fig. 92).

This is such an important specimen that full details should be placed on record. I found that the cleaned skull measured, in millimeters, as follows:

Length, 295; zygomatic width, 132; interorbital width, 89; length of nasals, 88; greatest width of nasals, 39; height of third antler, 54;

FIG. 92. Skull of "unicorn" buck showing third antler growing out of *nasal* and not frontal bones of skull. Specimen in Yosemite Museum photographed April 5, 1928. J. S. Dixon No. 5.

greatest width of third antler, 30; distance to anterior end of nasals from front base of third antler, 28; distance from posterior end of nasals to posterior base of third antler, 37; width of foramen magnum, 14; length of foramen magnum, 19. The teeth in both the upper and lower jaws were much worn. Several of the upper molariform teeth were worn down until they were only a little over one millimeter thick. I do not recall having examined any deer skull in which the teeth were so nearly worn clear down to the gums. The sinus bones were unusually thick and heavy, and the whole skull showed signs of heavy bone deposits.

At the time of his death "Old Horny" had shed his two main antlers; however, the third antler (see Fig. 92) remained firmly attached. I was much interested in seeing just how the third antler is attached. It springs from a socket which, except for size, is in every way similar to the ones from which the two main antlers spring. The cleavage line is quite distinct, but it had been noted in previous years

that the third antler was not dropped until some weeks after the two main antlers were shed.

On December 14, 1929, I discovered a forked-horn buck on the floor of Yosemite Valley that had a rudimentary third antler in the center of his forehead almost directly between his eyes (see Fig. 93). This rudimentary antler was at this date out of the velvet and was hard and white like the polished tip of an ordinary antler. It was somewhat smaller than the third antler that "Old Horny" carried, being about $\frac{3}{4}$ of an inch in diameter and about $1\frac{1}{4}$ inches high. There was

FIG. 93. Unicorn Jr., showing extra antler between eyes. Yosemite, December 14, 1929. Wild Life Division No. 114.

no sign of its branching, and the terminal tip was not over $\frac{1}{4}$ inch in diameter. Because this buck had certain mannerisms and physical characteristics that were strikingly like those of "Old Horny" we christened him "Unicorn Junior." Although it is impossible for me to produce scientific proof of the fact, it is my belief that "Unicorn Junior" was one of the progeny of "Old Horny," and this belief has been strengthened by subsequent observations.

### RELATIVE NUMBERS OF BUCKS, DOES, AND FAWNS

On September 13, 1927, I counted a typical band of 19 California mule deer in a meadow in Yosemite Valley and found them to be as follows:

1 large 4-point buck, with antlers still in the velvet.
1 3-point buck, with antlers still in the velvet.
1 forked-horn buck, with antlers still in the velvet.
1 spike buck.
9 does (1 doe had twin fawns); 4 does, 1 fawn each; 4 young does, no fawns).

This represents an average gathering of mule deer.

It has been my experience that mule deer are more gregarious than coast black-tailed deer. With mule deer it is a regular experience in late winter to encounter bands of from six to twenty individuals (see Fig. 94).

From 6.30 to 7 o'clock during the evening of June 29, 1927, in Yosemite, I watched a band of 16 deer feeding in an open meadow, and found they were as follows:

1 large buck, antlers in velvet, twelve inches long, and forked.
1 small buck, antlers in velvet and unbranched.
7 adult does.
7 yearling fawns.

FIG. 94. In late winter California mule deer often go in bands. Note use of ears to detect approach of enemy, also uniformity of tail pattern. Yosemite, April 29, 1929. J. S. Dixon No. 31.

From 6 to 6.40 p.m. on December 6, 1927, in Yosemite Valley, of 22 deer grazing in the meadow there were:

1 large 4-point buck.
1 forked-horn buck.
1 spike buck.
5 adult does.
2 young does.
12 fawns (two pair of twins and eight singles).

At Round Meadow, in Sequoia National Park, on June 9, 1933, I counted the California mule deer in the meadow at 6 o'clock in the evening and found the herd consisted of:

3 large 4-point bucks.
1 forked-horn buck.
1 spike buck.
8 pregnant does.
6 young does.
8 yearling fawns.

On September 16, 1933, I counted the deer in this same meadow and found:

5 adult bucks (three 3-point and two 4-point).
8 adult does.
4 young does.
3 spotted fawns.

On December 18, 1929, I counted the deer in this meadow and found:

2 adult bucks.
4 adult does.
4 fawns.

At first sight the relative number of mature bucks to does and fawns may seem comparatively unimportant. However, a detailed study of mule deer in various parts of California indicates:

1. The hunting season of mule deer comes before the mating season.

2. Vigorous, mature bucks bear the biggest and best antlers.

3. Such bucks carry the "heads" that make the best trophies, and thus the individuals that nature has selected to breed and to perpetuate the race are the very ones especially sought for and killed by the licensed hunters of the State.

4. Where the number of such vigorous breeding bucks is unduly decreased, mating is deferred, or accomplished by inferior bucks, resulting in many late or weakling fawns being born.

5. Such late or weakling fawns are often not properly weaned, owing to lack of suitable green, succulent forage in late summer. As a result, these fawns continue to be a serious drain on their mothers, so that both mother and fawn enter the winter in a backward, weakened condition, falling easy prey to predators, disease, cold, and starvation.

## YOUNG VERSUS MATURE BUCKS AS BREEDERS

At mating time, in a polygamous species such as the mule deer, victories go principally to males of full physical strength and vigor. The tendency is for the weaker bucks to be driven off by the stronger ones, and a system of selective breeding which tends to exclude both immature and old decadent males from breeding results. It is believed that this is nature's way of insuring the survival of the fittest, thereby keeping up the vitality and vigor of the race.

It would appear, from my investigations, that this critical breeding period in a mule deer normally extends over a relatively short span, perhaps for not more than three or four years of his life when he is in his prime and physically at his best.

It has been pointed out that physical strength and sexual potency may not decline uniformly in an aging animal. It has been found that in elk and in other members of the deer family, a well-established bull or buck may sometimes hold his harem against all rivals after there has been a decided lowering in his fertility. However, the leadership of the "herd" buck is challenged constantly and he is forced to fight

numerous battles each breeding season if he is to maintain his leadership. Just as soon as the leading buck becomes decadent and is unable to defend his harem, younger bucks slip in and secure the coveted does.

Oscar L. Barnum, forest ranger, stationed at Cedarville, California, cites such an instance (CALIFORNIA FISH AND GAME, vol. 16, no. 2, p. 184). His report, somewhat condensed, is as follows: On November 6, 1926, in the Warner Mountains of Modoc County, California, a band of 17 deer (14 does and 3 bucks) were observed mating. "One buck was a large seven-pointer, the second, a three-pointer, and the third buck a forked-horn. The large buck was continually trying to drive the smaller bucks away from the does. I watched them for about an hour and a half. The large buck would chase the three-pointer about 100 yards from the does, then look back and see the forked-horn with the does. He would then chase off the forked-horn while the three-pointer would follow back to the does. During the time that I watched them the small bucks made nine covers and the large buck not one. The large buck's exertions were telling on him and he was nearly run down."

The instance just cited is, I believe, a clear case of a "decadent" buck being dethroned. The shooting by hunters of such "aged" bucks accomplishes three things. It removes the decadent buck, permits regular breeding to continue, and at the same time provides the hunter with a valued trophy.

However, a study of the breeding habits of mule deer has convinced me that each season approximately ninety per cent of the effective mating is accomplished by a relatively small number of dominant bucks. It should be stated here that the number of "covers" that a buck makes is not a true index of "effective" breeding. Repeated observations have shown that young bucks, particularly spike bucks and, to a lesser extent, forked-horns, tend to run with the does the year round, and this has given rise to the assumption that they are more of a factor in reproduction than they really are. Another point which should be noted here is that a young buck tends to chase a doe for days when she is "in heat" and will "cover" her as many as a dozen times during that time. Contrasted to this, a mature buck usually "serves" a doe once or twice at the critical time, and then leaves her and hunts up a new female. Thus, while a spike buck may make as many "covers" as a mature buck, the number of females with which he effectively mates is decidedly less than it is with a mature buck.

Another reason why spike bucks and forked-horns appear to have a large part in the reproductive activities is the fact that these young bucks are the ones that are abroad most frequently in the daytime, and hence are the ones usually observed in actual pursuit of does. During the hunting season the larger bucks tend to hide out in dense brush during the day and thus they escape the hunter's watchful eye, which is fortunate for the deer of the future. This habit of the big bucks to remain under cover carries over into the mating season, which follows the hunting season. On December 7, 1927, even in Yosemite Valley where protected, I found that during the late morning and early afternoon the older bucks did not come out into the open meadows but remained hidden in the dense azalea and cedar thickets. As soon as the afternoon shadows began to fall, the larger bucks started to come out into the meadows to feed, keeping, for the most part, well within

the shadows. After sundown, these larger bucks came out and fed in the open meadows along with the other deer. Thus, it was found by repeated observations that these old bucks were the first deer to leave the meadows in the morning, as well as the last individuals to come out into the open meadows in the evenings.

From "sign" and tracks left in the snow, it is evident that most of the mating takes place at night. The mating that occurs in the daytime is more likely to take place during the morning and evening hours than during the middle of the day.

During the rutting season I have followed mule deer about for days at a time in freshly-fallen snow, and have found that the normal mating practice is as follows: The most virile bucks are those that are just reaching maturity. Such bucks may, in some cases, be three-pointers, although the majority have acquired the fourth tine or point to each antler. My field studies of deer in Yosemite and in the Sequoia region, which have extended over a number of breeding seasons, have shown that in each season 90 per cent of the effective mating was accomplished by such dominant bucks. The usual procedure is as follows: As soon as their antlers become hardened and are freed of velvet, the bucks stage a series of combats which demonstrate which bucks are dominant and which are the weaker individuals. Through such elimination contests, a practical understanding is reached among all the bucks as to which is superior, and each buck learns his proper place. In most instances, the weaker bucks give way to their superiors whenever they appear on the scene.

The oestrum period in female deer varies, so that all the does are not ready to mate at the same time. When the pre-oestrum period is reached by a doe, she is singled out and closely followed by one of the dominant bucks until she is ready to mate. This "running" of does by bucks may extend from two to five days and is often confused with actual mating, which takes place subsequently as the final chapter in the mating episode. Mating having been accomplished, the "herd" buck hunts up a new doe and runs at her side until she is ready to mate. The actual breeding period thus covers at least two months, November 15 to January 15, but in the majority of cases mating takes place early in December.

## BATTLES BETWEEN BUCKS

In Yosemite Valley in the afternoon of January 30, 1929, I witnessed a sharp fight between two large bucks which, by my watch, lasted 12 minutes, when there was a brief pause of two minutes, after which the fight was continued for another five minutes. The battle began at 3.50 and ended nineteen minutes later, at 4.09 o'clock. At the start, one buck was grazing out in the edge of a meadow with three does. The other larger buck came out of the timber where he had been sleeping during the middle of the day, crossed over and began sniffing around the does. This was the immediate cause for combat. The heads of both bucks went down at the same instant, and they came together with a sharp clash that could be distinctly heard 60 yards distant. There was a vigorous tussle from the start. Both bucks were old four-pointers and had evidently been in many previous bouts, so that each knew all tricks of the game. After the first brisk clash of antlers, the

bucks settled down to a steady fencing match. In case of an ordinary fight between bucks, the terminal forks of the antlers catch (see Fig. 95) and keep the combatants a certain distance apart. The initial part of the battle consisted in each buck making a vigorous attempt to push his adversary backward so as to force him to bend his neck. This at once gave the advantage to the aggressor, because the sharp terminal points of his antlers would then project far enough beyond the enemy's guard so that they would gouge into his adversary's eye, ear, or neck. As long as both bucks remained in a straight line facing each other neither could gain much advantage, but as soon as either one gave ground or was forced back so that his body was at right angles to his opponent he was caught at a disadvantage, for then the points of the other buck's antlers would begin to reach past his own antlers and would gouge him in the eye, ear, or neck. By watching with binoculars bucks that were fighting, I have repeatedly seen the points of the antlers driven into the bases of the bucks' ears.

FIG. 95. In an ordinary fight between bucks, the terminal forks of the antlers catch and each buck attempts to force his adversary to bend his neck, thus permitting the tip of the enemy's antler to reach through and gouge his opponent's eye, ear, or neck. Yosemite, November 2, 1929. Wild Life Division No. 150.

When fighting hardest, one of the bucks would frequently bend his forelegs and drop to his knees. This move was the equivalent of a "clinch" and merely slowed up the fight until the buck could regain his breath and strength, when he would again rise on all four feet and the struggle would be continued. Neither buck appeared to have any advantage in size or strength, and the battle was waged back and forth over an area 50 feet square in the meadow. Once, when one of the bucks was forced backward into a ditch and was "pinned" down, he gave a hoarse grunting sound which was almost a moan. Then by a supreme effort he forced his adversary back and, having regained his feet, the battle raged again.

At this point there was a brief two-minute rest between rounds, during which the two bucks backed off, with stiff necks and heads held high. Then, holding their tails erect, they lowered their heads, locked

antlers, and the contest was renewed and continued for another five minutes.

Finally one of the bucks backed off and started to nibble at a tuft of grass. The other buck rushed at him but this time he did not accept the challenge but turned tail and trotted off to a brush pile where he began to browse on dead oak leaves. The victorious buck made no effort to follow up or to punish his vanquished foe, seemingly being content to let his adversary go unharmed the moment the opponent was willing to acknowledge defeat.

In such battles between bucks, casualties are relatively rare. In my study of mule deer in California, I have found that now and then two large bucks will fight with such force and vigor that the tines of their antlers will be forced past each other and become locked, so that

FIG. 96. Two friendly California mule deer bucks, with antlers recently shed, biting ticks on each other's head and neck. Yosemite, February 8, 1930. Wild Life Division No. 775.

both bucks become exhausted and eventually die a lingering death through their being unable to pull their antlers apart so that each might go his separate way. The chief purpose of the fighting that takes place between bucks appears to be to afford a series of competitive tryouts to see which buck shall be driven out and which one left to breed.

### FRIENDLINESS OF BUCKS

As soon as the rutting season is over there is a marked change in the behavior of the larger bucks. Their antagonistic attitude toward each other is replaced by a general tolerance and even fellowship. For example, as early as January 14, 1921, near Sawmill Mountain on the

South Fork of the Tuolumne River, I found four large bucks, all four-pointers, that were feeding together in a close band. Numerous fresh scars on the smooth-barked limbs of manzanita bushes in the vicinity indicated that these bucks had been sharpening and polishing their antlers there only a few days previously. I followed these old leaders of the deer herd about through the snow for some time and was surprised to find that they were entirely friendly and not at all antagonistic toward each other.

A similar incident was noted by the writer in the Giant Forest in Sequoia National Park January 24, 1924, when two large bucks, a three-pointer and a four-pointer, were watched feeding amicably together. In this instance there was conclusive evidence that in this region some fighting among bucks had taken place as late as the middle

Fig. 97. When biting ticks on each others' heads these big California mule deer bucks were especially careful to avoid striking their tender growing antlers. Yosemite, July 19, 1929. Wild Life Division No. 163.

of January. However, fighting appears to cease even before the bucks' antlers are dropped. After the antlers are shed there are frequently decided demonstrations of friendliness among bucks. On February 8, 1930, in Yosemite Valley, I watched a pair of old bucks that recently had shed their antlers, as they stood busily engaged in biting wood-ticks on each other's necks (see Fig. 96). This friendliness continues among the larger bucks during late spring and summer after their antlers are well developed and nearly grown. On July 15, 1929, I found four of the larger bucks in Yosemite Valley banded together. Two of these bucks spent a great deal of time in biting ticks on each other's necks. By this date their antlers were well grown, having

spreads of 24 and 26 inches. These dimensions were checked by measuring the distance between two trees where the bucks passed. I noted that these bucks were very careful to prevent their antlers from striking when they were standing close together (see Fig. 97). At this season these bucks, which four months later would be fighting viciously for supremacy, were the acme of gentleness. Soon after the sunshine reached the meadow where they were feeding, the comrades, by mutual consent, lined up in single file and left the meadow for the seclusion and heavy shade of a nearby dense grove of young yellow pines where they bedded down, almost touching each other.

This sociability was marked among the bucks of Yosemite on the evening of July 18, 1928, when I watched nine bucks (two 4-pointers, three 3-pointers, one 3-2 pointer, two 2-pointers, and one spike) feeding harmoniously together in an area not exceeding one acre. At times five of the bucks fed contentedly together in the meadow on a plot of ground 50 feet square. When thus closely banded together, the larger bucks took special care not to touch or to strike their antlers (then nearly grown) against those of their comrades. This restraint was probably primarily due to the tenderness of their own growing antlers rather than to any particular consideration for the "other fellow."

In order to test the sensitiveness of a buck's growing antlers while they were in the velvet, I have twice very gently touched the tips of a tame buck's antler. I found the velvet soft and the antler warm to the touch. However, the buck was very sensitive when the slightest pressure was applied to his antler and immediately shook his head and trotted away.

In marked contrast to this friendliness between the adult bucks during the summer, I found that the young bucks were exceedingly jealous of each other, especially when does were about. On July 13, 1929, in Yosemite Valley I watched a forked-horn buck with antlers still soft and in the velvet chase a smaller buck with undeveloped antlers away from an adult doe. The forked-horn made no effort to use his antlers but drove his adversary away by effective thrusts of his forelegs and sharp hoofs, thus using the same method of defense that the doe uses the year around.

I have watched in vain during many "rutting" seasons for some evidence of kindly consideration on the part of the bucks for the does. However, in Yosemite Valley on July 12, 1928, just after sunrise, I was watching a doe that was exceedingly heavy with fawn as she grazed about near the margin of an open meadow. Her sides were greatly distended, and her full udder indicated that she would give birth to her fawn within the next few days. I was much surprised to see an adult three-point buck follow this doe about and lick her back and sides. He even stood and nibbled woodticks on her back. The doe did not resent the attentions thus showered upon her. On the contrary, she stopped and stood still to receive them. The buck made no amorous advances and seemed only to be interested in the well-being of the doe. I have never seen such real gentleness shown does even by the most considerate bucks during the mating season, at which time the males might be expected to lavish the greatest care on the females.

BREEDING SEASON AND PERIOD OF GESTATION

According to my observations, which have extended over many seasons, the period of gestation in the mule deer is about *seven* months (205 to 212 days).

In 1927, the first actual copulation that I was able to discover in deer in Yosemite took place on December 10. I had been watching the deer daily from the sixth of December, so had actual mating taken place during the daytime I would have had a fair chance to notice it.

The following season, the first fawns that I was able to find were born at noon on the ninth day of July, 1928. In 1928, the earliest observed actual breeding among deer took place on December 2. The earliest fawns observed the following season were born on June 30.

FIG. 98. Does far advanced in pregnancy, as here shown, are more sedate and do not bound wildly about as at other seasons. Yosemite, July 10, 1928. Mus. Vert. Zool. No. 5749.

The most definite data that I have been able to secure on the period of gestation of the Rocky Mountain mule deer in California has been obtained through the kindly interest of U. S. Forest Ranger Oscar L. Barnum. In a letter of February 15, 1931, Barnum states:

"Mr. J. W. Stiner of Cedarville, California, has had three pet female mule deer at his place, and he has kept an accurate record of the date when these deer mated and he also set down the dates when the fawns which resulted from these matings were born. 'Fleet,' the old doe, bred December 21, 1927, and gave birth to twin female fawns on July 17, 1928. In 1928 she took the buck on December 24, and gave birth on July 19, 1929, to twin fawns. In 1929, she bred December 23,

and gave birth July 16, 1930, to a male and a female fawn. She bred again on December 21, 1930.

"One female fawn that was born July 17, 1928, bred for the first time on November 27, 1929, and gave birth to a single fawn on June 23, 1930. The other female that was also born on July 17, 1928, bred for the first time on December 7, 1929, giving birth to two fawns on July 5, 1930. This doe bred the following season on December 18, 1930."

From the above data it will be seen that the actual gestation period of Rocky Mountain mule deer in four known instances was 205, 207, 208 and 209 days, or approximately seven months, in marked contrast to six months which is so often given for this species.

Observations have shown that practically all of the deer in the Yosemite region breed between December 10 and January 27, these two dates representing the earliest and latest dates upon which actual copulation has been observed. Checking up by actual observation the following summer, I found that the first fawns (twins) were born at noon on July 9, and that 90 per cent of the pregnant does had dropped their fawns by July 30.

When adult does are far advanced in pregnancy (see Fig. 98), they are much more sedate and do not bound wildly about as they do at other times of the year. This change in the demeanor of a pregnant doe was strikingly illustrated by an experience that I had on May 15, 1925, at Eagle Lake, Lassen County, California, when a large doe was noted loping along an open stretch of timber which led down toward the lake. She was very heavy with fawn and, although considerably alarmed, she slid along easily, not bouncing about stiff-legged as does customarily do under such circumstances when they are surprised in late summer or fall.

The fawning period of the mule deer is found to extend over several weeks. This is doubtless due to the fact, which I have observed many times, that all the does do not breed at the same time, and, since the breeding season extends over almost two months, the fawning period likewise varies considerably. Due to the fact that the mating season varies slightly from year to year, according to the general climatic variation of the season, we find that there is considerable variation both as regards the mating period and the subsequent fawning period. In all of the various seasons that I have spent in Yosemite, I have never seen other than an occasional spotted fawn before the first of July, and in many instances individual does which were known to be heavy with fawn have been watched critically for days at a time at this period of the year.

Thus on July 2, 1929, at 5.30 in the morning I was watching an old mule deer doe in the meadow by the Ahwahnee Hotel in Yosemite. She was a mature doe in good flesh and was in the full red summer coat. I could tell by her anxious actions and by the way that she kept watch-

ing, that she had a fawn hidden somewhere in the tall grass in the open meadow. I remained hidden in a clump of brush and, after a period of ten minutes spent in anxious waiting and watching, the doe went over and lay down in the tall grass. She then gave a low call, which at a distance sounded like the mewing of a cat. Upon hearing this call, her fawn rose up out of his hiding place in the grass, walked over to her and began to nurse (see Fig. 63). This fawn was able-bodied and was at least three days old. It was probably born the last day of June. Two other fawns were observed this same day, so that at least three fawns were known definitely to have been born in Yosemite by July 2 during the season of 1929.

On July 9, 1928, while watching deer in a meadow in Yosemite Valley, an old doe was observed lying partially hidden in the tall grass

FIG. 99. Female California mule deer fawn, twenty-four hours old and weighing 6¾ pounds, in normal resting posture with feet doubled up under her body. Female fawns are lighter colored than male fawns. Yosemite, July 10, 1928. Mus. Vert. Zool. No. 5772.

in the open meadow. When approached within a distance of six feet, she laid back her ears and struck at the intruder with her forefeet, as much as to say, "Keep your distance." The observer did not force her to get up, since she groaned and was in obvious labor pain. I passed near this same doe at 11 o'clock that morning and noted that she was still lying down practically in the same spot where she had been observed at 7 o'clock. At 12.30 o'clock, the doe was in acute distress, and a close inspection showed that one fawn had just been born and was lying beside the doe, which was feebly licking her offspring. The fawn was still wet and too weak to walk but dragged its hind legs feebly as it tried to crawl about. The second fawn of this litter was

born a few minutes later. This pair of fawns was left and not disturbed until they were 24 hours old (see Fig. 99). At subsequent intervals thereafter I weighed and measured them with the following results:

Female Fawn, Born July 9

| | *July 10* | *July 12* |
|---|---|---|
| Weight | 6¼ pounds | 6¾ pounds |
| Length | 23¼ inches | 26 inches |
| Tail | 3 inches | 3½ inches |
| Hind foot | 9 inches | 9¼ inches |
| Ear from crown | 3½ inches | 4⅛ inches |
| Height at shoulder (measured standing) | 14¼ inches | 16 inches |
| Metatarsal gland | 2 inches | 2 inches |

Male Fawn, Born July 9

| | *July 10* | *July 12* | *July 14* |
|---|---|---|---|
| Weight | 6⅝ pounds | 7½ pounds | 7⅝ pounds |
| Length | 23¾ inches | 26 inches | 27½ inches |
| Tail | 3¼ inches | 3¼ inches | 3-5/16 inches |
| Hind foot | 9¼ inches | 9½ inches | 9⅝ inches |
| Ear from crown | 3¾ inches | 4 inches | 4⅛ inches |
| Height at shoulder (measured standing) | 14¾ inches | 17 inches | 17 inches |
| Metatarsal gland | 2 inches | 2⅛ inches | 2¼ inches |

*Color:* The male fawn was much browner and notably darker on the dorsal surface than the female fawn. The female fawn was very pale, almost tan, above.

By July 20 only a few does (less than 10 per cent) remained that were obviously heavy with fawn, but these gave promise of giving birth to their young within the next few days. From time to time, extremely late fawns have been known to be born as late as the middle of August. However, it is believed that such fawns do not represent the normal breeding season, but it is probable that in such cases fertilization did not take place at the first mating.

On July 14, 1929, a pair of fawns was born during the night near our camp. An unsuccessful search for them was made soon after daylight, although we knew that they could not be far away. Our retiring from the scene gave the mother her much desired opportunity to return to her young. This she did so skillfully that we were unable to follow her as we had planned, but a subsequent search revealed her, together with her offspring, hidden in a clump of marsh grass. The fawns, when found, were still wet, and could not have been more than two or three hours old. They were able to stand up for a few minutes at a time, but the mother wisely made no effort to try to lead them away but kept them hidden in the dense grass where she nursed and protected them.

It was a matter of distinct surprise to me to find that when her hour of trial drew near, the doe, instead of seeking seclusion in some dense thicket or inaccessible boulder pile on the mountain side, went out into the open meadow to give birth to her fawns, keeping them well hidden for the first few days of their lives in the dense cover of sedge or other tall marsh grass.

In a number of instances I have been able to follow from birth the wanderings of certain fawns. Thus in the instance of a pair of fawns which were born on the ninth day of July, 1928, I carefully followed them for the first nine days of their lives. I found that instead of hiding her fawns close together or at the same place, this mother kept them

hidden in the tall grass some fifty yards distant from each other. On the morning of July 10, when the fawns were not quite one day old, I found the mother nursing them at 8 o'clock in the morning. She first went to the female fawn and nursed it, then started to coax it across the meadow as fast as its weak legs permitted for a distance of about one hundred yards to a point where the male fawn was hidden in a bunch of marsh grass. The mother nursed the male fawn for 10 minutes and the female for 15, then, thoroughly drained, she went off to feed by the river. We kept watch all day, but the mother did not nurse the female fawn again until 3.40 in the afternoon, while the male fawn was not nursed until 5.45 o'clock—an interval of almost ten hours elapsing between meals in this instance. While the mother was away feeding, the female fawn wandered nearly eighty yards from the spot where her mother had left her. However, the mother seemed to know about where to find her offspring and succeeded in locating this fawn without

FIG. 100. Female fawn nursing, standing sheltered by its mother's body. Yosemite, July 10, 1928. Mus. Vert. Zool. No. 5749.

difficulty. In another instance where the fawn had wandered away during the mother's absence, I watched and found that when she was unable to locate her fawn she gave a low bleat which was scarcely audible to my ears at a distance of 60 yards, but, upon hearing its mother call, the fawn jumped to its feet from its hiding place and then the mother rushed quickly over to it.

This particular doe usually remained standing while the fawn nursed, but normally during the first three or four days of their lives, fawns nurse while the mother is lying down hidden in tall grass. This latter arrangement makes for greater safety for the mother and her offspring. If the doe stood while the fawn nursed, the latter frequently walked in between its mother's forelegs and nursed with its tail to its mother's head (see Fig. 100). The female fawn was noted to nurse

steadily for a period of eight minutes by the watch, indulging in the frequent buttings of the mother which are so characteristic in the case of a domestic calf. After an interval of rest of 10 minutes, it again nursed for an additional period of two minutes. The fawns normally nursed hurriedly, 10 minutes' nursing forming a full meal. The male fawn was led by his mother, after he had nursed, back to the identical spot which had served as his hiding place during the entire morning. Contrasted to this, his sister had wandered over a five-acre tract of open meadow during her mother's absence. However, during the rest of the day both fawns remained in close hiding.

On various occasions I have taken the opportunity to test out the theory which has often been advanced that during the first few days of their lives the fawns carry no scent or body odor. When the fawns were from two to five days old I tried repeatedly, with my nose within an inch of the living animal, to detect any odor, but was unable to do so. I even buried my nostrils in the fawn's hairy coat without being able to detect any distinctive odor. I then tried smelling the metatarsal and hoof glands, but again I was unable to detect any odor. This test was repeated a number of times with various fawns that were less than a week old, but always with negative results. In another instance while I was hunting cougars with J. Bruce, State Lion Hunter of California, I have known his foxhounds and bloodhounds, which had the sense of smell highly developed, to pass by within six or eight feet of a young fawn hidden in the grass without detecting its presence. In a similar manner I have watched black bears hunting for fawns in the meadows during the early morning hours, and noted that they appear to hunt entirely by sight rather than through the sense of smell.

From these various experiences I have come to the conclusion that young fawns do not give off any appreciable odor during the first few days of their lives.

Unexpected hiding places are sometimes utilized by certain does. Thus on July 14, 1929, in Yosemite, a doe gave birth to twin fawns at 3 o'clock in the afternoon. The following morning she moved both fawns from their birthplace in an azalea thicket to new hiding places in another thicket nearby. One of the fawns of its own volition wandered over to the river's edge, a distance of 50 yards. Here it crawled into and hid under a pile of driftwood and debris. The extreme heat of the fawn's hiding place seemed to be unsatisfactory, and the doe promptly proceeded to take it back to the azalea thicket.

When first born, the fawns escape detection and pursuit by crouching in the grass and remaining motionless with necks outstretched (see Fig. 70). However, this is not their regular posture when in repose, for when undisturbed the same fawns are nearly always found curled up with heads turned back resting upon their bodies. This latter position is the true or normal resting posture.

On July 12, 1928, I watched a male fawn three days old as he sought to escape notice when frightened from his hiding place in a dense clump of saw-grass that was thirty inches high, but instead of hiding there, he sneaked out on the farther side and, crouching low to the ground, crawled off thirty feet to one side of the spot where he disappeared, and there lay down with his neck outstretched amid the thin grass in the open. However, owing to the brown, spotted pattern of his back, he was well concealed.

By July 18 I found that a pair of fawns born July 9 were able to run and to follow their mother about, instead of sneaking through the grass as had been their former custom. On this date I tried to approach the mother and her two fawns but they were off in a flash. The doe was very wild and ran out into a patch of tall velvet grass so that the fawns were completely out of sight, and only the ears of their mother showed above the grass. I found that when the fawns were nine days old they were so large and so active that I could no longer approach to within 20 feet of them.

In the Giant Forest of Sequoia National Park I found that California mule deer does often select some secluded nook at the buttressed base of a giant Sequoia for their nursery. In San Diego County I found that the fawns of the southern mule deer are usually born under or near some brushy thicket or even in a rock pile. There is considerable variation with locality as regards exact spots where fawns are born.

Fig. 101. The udder of a nursing California mule deer doe, as here shown, is about five inches in diameter and holds when full about two-thirds of a quart of milk. Note heavy infestation of wood ticks on the inside of the doe's thigh. Yosemite, July 6, 1929. Wild Life Division No. 171.

The number of fawns in a litter is also subject to considerable variation with locality, season, and food supply. In 30 years' experience with mule deer in all parts of California I have found that a young doe usually gives birth to a single fawn. Older does frequently give birth to twins. In Sequoia National Park in 1933 I found that twin fawns were born in about one case out of four, and I believe that this is about the average proportion of twin fawns.

The udder of an average nursing doe which we observed in Yosemite Valley, July 10, 1928, was found to be, when full (see Fig. 101), five inches in diameter and about four inches in depth. As nearly as could be judged through a comparison of the udder of a doe with that of a domestic milk goat, the capacity of this doe's udder was about two-thirds of a quart at each nursing. When a doe has two fawns it is the usual thing to find the udder of the doe soft and only partly full, due to repeated nursings. Even in one observed case where we knew that the fawns were not nursing for nearly eight hours, we took note of the fact that when the doe would return to her fawns in the evening her udder was not greatly distended with milk. It was only full enough to remove the wrinkles. The four teats on the doe's udder were about five-sixteenths of an inch in diameter and from one to one and a fourth inches in length. Older does were observed to have larger mammae than the younger does.

Regarding the amount of milk consumed by a fawn when first born, I have the following evidence to offer. A fawn only two or three days old that, through the death of its mother, was known not to have nursed for twelve hours and was obviously very hungry, consumed four ounces of fresh cow's milk when it was diluted one-half with water and fed in an ordinary nursing bottle with the regulation rubber nipple. It would therefore seem that four ounces of milk is a square meal for a young fawn having a weight of five and one-half pounds.

### AGE AT WHICH FAWNS ARE WEANED

Fawns of the mule deer are usually weaned when they reach an age of from 60 to 75 days. On September 18, 1927, in Yosemite Valley, I followed a doe and her two fawns about to see when they would

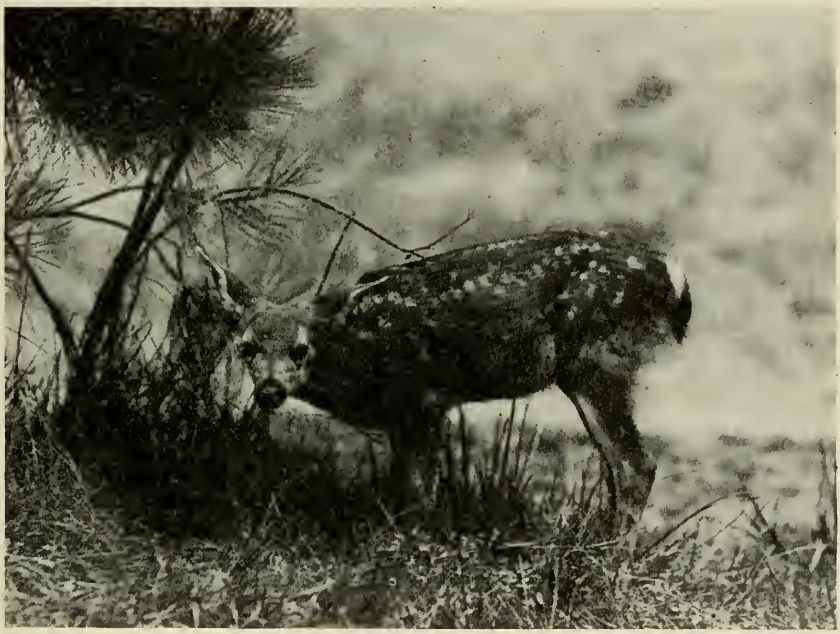

FIG. 102. A California mule deer fawn just weaned learning to eat green grass. Yosemite, September 18, 1927. Mus. Vert. Zool. No. 5517.

be weaned and what they would eat when first thrust out on their own resources. The two fawns under observation were still spotted, although the new fall coat had begun to creep in and the white spots were becoming dim (see Fig. 102). The mother of the fawns made considerable effort to discourage them from nursing. She would not stand still when the fawns tried to nurse. Finding, after several futile attempts, that their mother would no longer nurse them, the fawns began to cast about for green food. One of them began first to smell and then to nibble at the fresh tender tips of certain weeds and was particularly attracted by the new blades of velvet grass and blue grass, which it sought out and devoured with relish. While I watched the fawns feeding, their mother slipped away from them and hid in a clump of azalea

bushes, where she could watch them, yet leave them largely to their own resources. However, at the first alarming sound, the mother rejoined her offspring and they all stood alert in the open with ears cocked forward in an attempt to locate the hidden danger.

After the fawns have been weaned, the average doe shows a renewed interest in her offspring. This solicitude increases with the coming of winter storms, and constant watchfulness for danger is kept by the mother. On December 8, 1927, I watched a mother and her nearly grown fawn feeding on the tender young blades of sprouting annual grasses that had sprung up under a protecting cover of dead weeds. Although the fawn by this time was well grown and in the full winter coat, his mother stood at attention and remained on guard while her offspring fed with his head hidden in the weeds and grass.

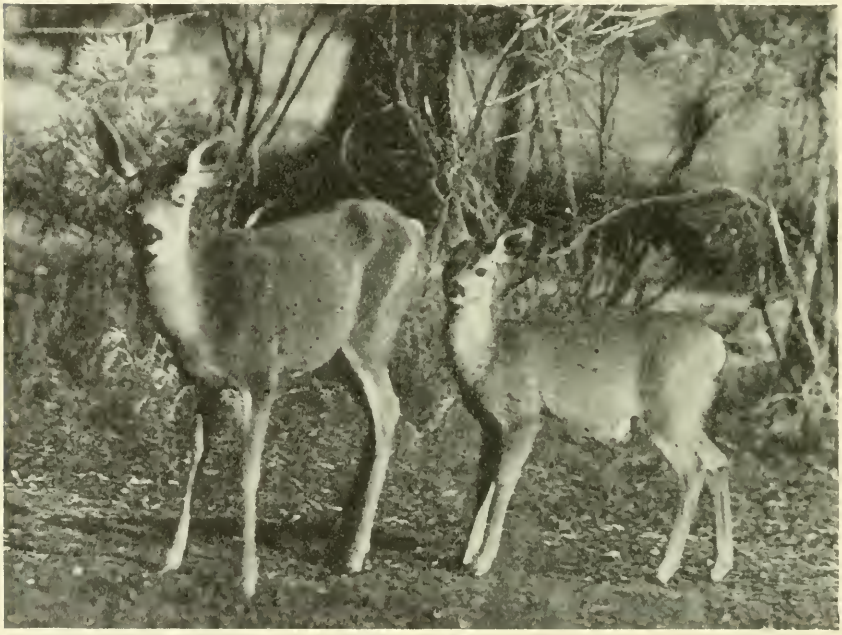

FIG. 103. This fawn was not properly weaned and continued to nurse, thereby endangering his own as well as his mother's life. Note the thinness of this doe. Subsequent observations proved that she did not survive the following winter's cold and snow. Yosemite, December 8, 1927. Mus. Vert. Zool. No. 5643.

During the December snowstorms, the more venturesome fawns root about independently in the fresh snow for fallen oak leaves and acorns. In Yosemite on December 9, 1927, some of the fawns were found still by their mother's side foraging on dead weeds that stuck up through the snow. As a matter of fact, in many cases, the mother's active care extends through the entire first winter of the fawn's life, and it is not unusual to find a doe in early summer followed by both a small young fawn and her nearly-grown last year's fawn. I have found, in certain cases where the fawns bore some distinguishing ear-mark so that positive recognition was possible, that they followed their mothers about during the second summer of their lives. In these cases

the final break between the mother and her fawn did not take place until the following fall, when the fawn was fifteen months old.

From extensive observation over a period of ten years, it has been my experience that the weaning time is a most critical one in the fawn's life. If green food is available and the fawn makes the transfer from milk to a green food diet, there is an excellent chance that the young animal will not only make a good growth, but that it will fatten up in the fall and enter the winter in excellent physical condition. On the other hand, experience has shown that where, through lack of suitable green forage, the fawns are not properly weaned but continue to nurse, they not only endanger their own future welfare but may even be the means of the untimely death of their mothers. In Yosemite Valley on December 8, 1927, I found a pair of such fawns that had not been promptly weaned and which still sought to nurse. As a result of nursing them, their mother was exceedingly thin, being so gaunt that her ribs could be counted. The mother's physical condition was so poor (see Fig. 103) that it was a question of serious doubt if she could survive the winter. In fact, subsequent investigations proved that she did not. In December, the physical condition of the two fawns was good, but they had not properly learned to seek their own food and to get along without their mother so that, with her death, their existence was also jeopardized.

It has been my observation that on our forest lands serious complications result if the range is overstocked early in the summer with domestic sheep or cattle; so that little or no green grass remains by the time the fawns should be weaned. In one instance in Fresno County early in September, I found the range so grazed over by cattle that we had to take in feed for our pack burro. The physical condition of the does, and particularly of the fawns that we saw, was decidedly poor, and their chance of resisting disease, escaping natural enemies, and surviving the hardships of winter was greatly decreased.

## NATURAL ENEMIES

In conversation on July 18, 1930, J. Bruce stated that he had found hundreds of deer killed by mountain lions in the snow, but he had not found a single instance in which the lion had sprung from a tree upon a deer for which it had lain in wait. He has never known lions to go up a tree except when they have been pursued by dogs. Mountain lions sneak up to and often rush out from behind boulders and strike down deer, but I have been unable to find any well-authenticated instance where they have lain in wait in trees and sprung upon deer that passed by. Mountain lion tracks in the snow show that they ordinarily capture deer by first sighting or scenting them. The big cats then sneak up behind some tree trunk, boulder, or screening clump of brush until they get within rushing distance of the deer which varies from 25 to 75 feet. At this point the lion waits until the deer has its head down feeding. It then makes a few gigantic bounds, covering from 10 to 16 feet at a leap, and hits the deer, knocking it off its feet. The massive forelegs of the lion receive the shock of the impact. Mountain lions thus strike down deer by the impetus or force of their fast moving bodies. Deer that have been knocked down are promptly disemboweled by the lion's strong canine teeth. Lions do not "ride deer around" and then reach over and "cut" the deer's throat, as is popularly believed. Only one deer out of several hundred killed by lions and examined by Bruce was found to show any tooth or claw marks *on the throat*. Young deer are often killed by being bitten through the neck at the base of the skull or through the back of the shoulder blades.

The mountain lion does not catch every deer that it seeks to capture. Careful investigation by the writer shows that only about one out of every three attempts is successful. Usually only one rush is made by the lion, and it rarely pursues the deer more than 300 feet. If the deer discovers the lion's attack in time, it usually escapes through quick action by jumping to one side and then running rapidly away. On two occasions I have found where a lion "missed" two deer in succession. Bucks, does and fawns all fall victims, although young deer are killed more frequently than are adults.

On February 5, 1918, John J. McCauley killed a medium-sized female mountain lion that his dogs had treed at 4500 feet on the south side of Pilot Ridge in Mariposa County. After this female had been skinned, she was cut open and found to contain three unborn kittens about the size of woodrats. These kittens were alive and opened their mouths. They were spotted and covered with short dense fur and probably would have been born within a few days. By back-tracking the trail of this pregnant lioness, McCauley found that only the previous night she had killed and partly eaten a large three-point buck. This proves that a pregnant female cougar, although heavy with young, was able to strike down and kill a large full-grown buck deer.

In this same region on January 28, 1921, McCauley treed and killed a lion kitten that was about ten months old and weighed 55 pounds. This half-grown kitten had killed a small deer, and its tracks in the snow showed that it had stayed in an area of approximately one acre

for over a week, during which time it lived on the one deer that it had been able to kill.

At Lynchburg, Placer County, on July 19, 1920, the writer and State Lion Hunter Bruce found a spotted fawn, which we judged to be about three weeks of age, that had just been killed and partly eaten by a one-third grown mountain lion kitten. The vegetation where the fawn lay showed that there had been quite a struggle before the kitten had been able to kill the fawn. When I went back to photograph this dead fawn the following day, I found that a large black bear had discovered it during the night and had "cleaned up" the fawn carcass.

This brings out an important point which is often overlooked. I have found that the deer *eaten* by both bears and coyotes have in many instances really been killed by mountain lions. The fact that deer hair or other remains of deer are found in feces of bears and coyotes is therefore not conclusive evidence of guilt, since both bears and coyotes are notorious scavengers. My experience, extending over thirty years in California, indicates that only about one-third of the deer eaten by the black bear and the coyote are really killed by these predators. This point was strikingly illustrated on January 15, 1921, on the south side of Pilot Ridge in Mariposa County, when the writer and J. Bruce found the remains of a deer that had recently been killed and partly devoured by a mountain lion. This deer had been struck down by a lion while it was feeding in seeming security on an open slope. The lion had then dragged the deer forty feet down the hill to the shelter of a buck brush bush, where the lion ate his fill. Tracks in the soft earth showed that after the lion had left, a coyote had located the "kill" and had proceeded to clean up the remains of the carcass (see Fig. 104). I tracked this coyote, a large female, down the trail to a goat camp where it had been shot. I personally examined the stomach of this coyote and found that its contents consisted entirely of the hair, meat and bones of a deer. Had I not examined the condition and the source of this coyote's meal, I would have naturally supposed that it had killed a deer.

## MOUNTAIN LION

From a study of the lion skins which have been presented for bounty, and from field work covering all sections of the State over a period of years, I have come to the conclusion that the adult mountain lion population in California in 1932 was about 600 individuals. Records show that about 42 per cent of the lion hides that have been presented for bounty have been those of females. This is rather surprising since the present bounty is $30 on females and only $20 on males. However, it should be stated that the $20 is paid in all cases in which there is any question or doubt of the sex of the animal, and since careless skinning often destroys the evidence of sex on the pelt, there is an understandable loss in the number of females reported.

A careful check on the numerous spotted mountain lion kittens by State Lion Hunter Bruce has shown that at birth the male kittens are only slightly more numerous than females.

If we place the number of breeding females at 300 we will not be far from the facts. Under normal conditions, female cougars breed every other year and the average number of young in a litter has been found by the writer to be 2.3 kittens. The annual crop of mountain

lions in California would therefore be 345 kittens per year. Death from natural causes plus the toll taken by bounty hunters (which has averaged 326 per year over a long period) together with observed facts would indicate that the number of mountain lions in California is gradually being reduced.

The mountain lion or cougar is, in my estimation, the most important natural enemy of deer in California. In one lot of 43 cougar stomachs from all sections of California, 34, or 80 per cent, contained remains of deer. Since the mountain lion in a natural state rarely if ever eats carrion, practically all the deer meat and hair found in a lion's stomach may be safely assumed to have been killed.

If we accept 50 deer per year as the usual kill of the average adult mountain lion, we find that this would about equal the number of deer killed annually by the licensed hunters of California.

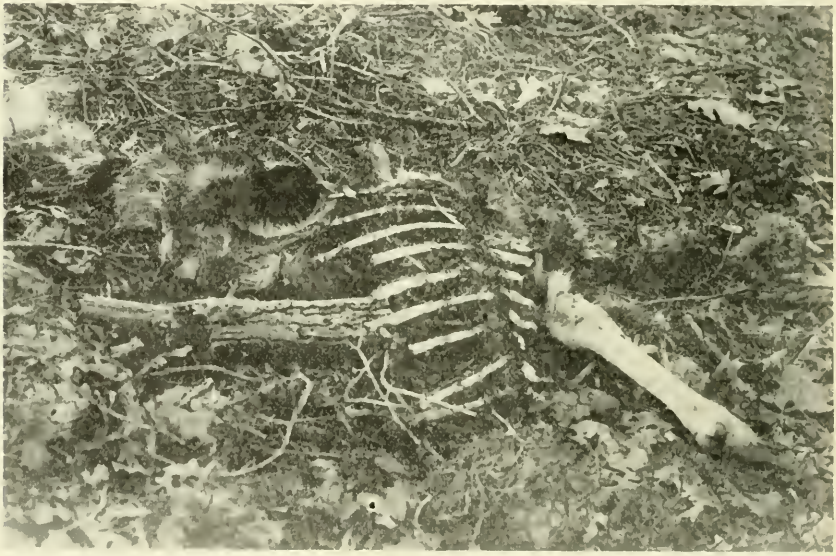

FIG. 104. Remains of a California mule deer killed by a mountain lion and the carcass later cleaned up by a coyote. Pilot Ridge, Mariposa County, January 15, 1921. Mus. Vert. Zool. No. 3429.

### WILDCAT

Wildcats are known to kill deer in winter in deep snow. Out of 71 wildcat stomachs that I have examined, from deer country in California, only two contained remains of deer. Out of 186 wildcat stomachs from 62 localities in California, field examinations showed that 16 contained deer remains. As has been related in this paper in the section, "Extent and causes of seasonal migration," an actual attempt of a wildcat to kill a grown California mule deer doe was witnessed by Sam Cookson and Joe Gann in Yosemite on February 2, 1932.

During my study, which has extended over many years, I have failed to find evidence to substantiate the general belief that wildcats kill large numbers of young mule deer fawns.

### COYOTE

On July 8, 1928, as we came into Yosemite Valley at 7 o'clock in the morning, the sun was shining brightly. At the base of El Capitan, a mule deer doe was seen in close pursuit of a coyote. The coyote was first sighted running rapidly across the road directly in front of our automobile. It was evident that it was in a hurry to escape from something that was pursuing it. Just at the moment the coyote crossed the main paved highway, the doe was first observed, being only a few jumps behind. The two animals were so close to our car that the doe stopped suddenly, being unable to get across the road ahead of it. However, the moment the car passed, she immediately renewed her pursuit of the coyote, making effective stabs at it with the sharp hoofs of her forefeet. The coyote, although large and able-bodied, made no effort to fight back but crawled as quickly and quietly as possible into a dense clump of brush where it tried to escape notice by remaining motionless. However, the doe jumped high in the air and came down stiff-legged upon the brush pile with all four feet gathered directly beneath her, making repeated efforts to land with her sharp hoofs upon the coyote hidden in the thicket. The coyote, finding its attempt to hide unsuccessful, finally sneaked out and made a rapid dash for liberty. The condition of the doe's udder and reproductive organs indicated that she had a newly born fawn hidden somewhere in the near vicinity.

The relation of coyotes and wildcats to mule deer is further discussed under the heading of seasonal migration.

### BLACK BEAR

At 4 o'clock on the morning of July 22, 1929, a large, lanky, brownish-colored black bear caught and killed a week-old fawn within a few yards of our camp in Yosemite. Our attention was attracted by the agonized bleating of the fawn when the bear first caught it. One of the men who was camped nearest to the scene rushed over to the spot where the fawn was bleating and caught the bear "red-handed." The bear had the fawn down and was just tearing it to pieces. This same bear was seen to catch another fawn out in the meadow the previous morning, and appeared to comb the meadows regularly searching for fawns during the early morning hours from 3 to 6 o'clock. None of the other black bears that I noted in the vicinity seemed to specialize in fawn hunting as did this individual.

### GOLDEN EAGLE

The golden eagle is, in my experience, the only important avian enemy of mule deer in California, and its attacks are usually upon spotted fowns. Stephen Headington of Escondido, California, witnessed such an attack by a pair of eagles upon a fawn along the upper San Luis Rey River in San Diego County. This reliable observer informed me that the doe did her utmost to protect her fawn by standing directly over it. However, she was unable effectively to guard against the onslaught of the two eagles which attacked at the same moment, first from above and then successfully from both sides. It is my belief that in most instances the fawn escapes by crawling off and hiding under some dense thicket of brush. I personally know of only three mule deer fawns having been killed by golden eagles in my years of field experience in California. Out of sixty nests of the golden eagle that I have examined in this State, none has held any remains of deer.

## DISEASES

### MODOC DEER DISEASE

In the middle of August, 1924, reports came to the California Fish and Game Commission that deer were dying in large numbers in the central portion of Modoc County, just east of Mount Shasta. At the request of the Commission, I proceeded at once to this locality and, together with game wardens Miller and French, went thoroughly over the ground in question.

The general situation we found to be as follows: The area concerned lies largely in the lava bed formation where even under normal conditions forage is scarce and water scarcer. In order to provide a larger water supply, stockmen had created artificial reservoirs by building dams and holding back the water which accumulated from melting snows in certain natural shallow depressions, the permanent natural springs in the region being very few, of limited capacity, and scattered over a wide area, as much as 15 to 30 miles distant from each other. Our investigations showed that the deer which were found dead or dying were all in the near vicinity of the artificial reservoirs which served as water holes both for domestic stock and for deer. The season had been one of unusual dryness, and both forage and water supply had become almost exhausted through the grazing of domestic animals, particularly sheep. As soon as the sheep had begun to die, they had been moved out of the country to better range, but the deer were left to shift for themselves as best they could.

Our first stop was made at Lower Mud Lake. This lake normally covers ten or fifteen acres, but at the time of our visit (August 18, 1924) it was found to cover less than half an acre and to be nearly dry. Here I found three dead deer within 100 feet of the water. These were two adult does and one spotted fawn. All had been dead for over ten days, but they had not died at the same time. One dead domestic sheep was found near the water's edge. Thirteen dead deer were counted about this pond.

Our next step was to visit an area at Happy Camp, where we knew there was a spring of permanently good water, to see if deer were dying there also. Our tour of inspection showed no sick or dead deer in the vicinity of Happy Camp. We then went back to Lower Mud Lake, where Warden Miller and I, in half a day's hunt, found seven more dead deer, as follows: two large four-point bucks, one three-point buck, one spike buck, two does, one spotted fawn. All of these deer were found within 250 yards of Little Mud Lake, which was nearly dry. These deer had been dead from one to four weeks. They had not all died at once, and each one was found lying headed away from the water. They had apparently become so weakened that they had fallen down and had not been able to return to their search for food after visiting the water holes to get a drink.

The country for miles around this water hole had been heavily "sheeped" so that food was difficult for the deer to secure. One

domestic sheep and one steer were found dead near the water hole, so that it was evident that other animals besides deer were affected.

Our investigations were continued at Spaulding's Reservoir, where deer were dying apparently from the same malady. At the latter place I examined the stomach of a doe that had recently died. The examination showed that the heart, liver, and lungs were normal, but that the stomach had ulcers from three-fourths to one and one-half inches long and nearly as wide, over one-third of its inner surface.

On September 24 our investigations were continued at Hackamore Reservoir, which is located about eight miles due north of Happy Camp ranger station. When full, Hackamore Reservoir covers about three hundred acres, and it is shown on the Forest Service map as being on national forest land and not on privately owned or patented land. This reservoir had apparently been made by sheepmen to catch snow water in a shallow basin, so as to provide water for their flocks. The dam which holds back the water is made of earth and faced with rock. It was found to be about one hundred fifty feet long and ten feet high at the highest point. At the time of our visit, the water was practically dried up, there being only a mud bog about one hundred feet long and twenty feet wide with a shallow sheet of water which was very foul and filthy, with decayed vegetation located at one end. Within a distance of one-fourth of a mile from this water hole we found dead deer as follows: adult does, 26; yearling does, 3; adult bucks, 2; yearling bucks, 2; fawns, 28. A total of 61 deer had died within a quarter of a mile of the water hole. It will be seen from the above that does and fawns suffered much more severely than did the bucks. It was found that a four-point buck and a large doe had waded out into the pond and had eaten mud, the water being so nearly dried up that they could not get any to drink. We carefully inspected the stomachs of these deer and found that they were over half full of mud. Vegetation found consisted of service berry leaves (20 per cent) and manzanita leaves (20 per cent). The intestines of both the buck and the doe contained only mud. Forage plants in this vicinity had been severely browsed, service berry bushes having been browsed to a height of fifty inches. Manzanita bushes, being the least desirable, were about the only plants left.

From our investigations, which revealed as many as sixty-one dead deer at one water hole, we concluded that several hundred deer had died in the Modoc region during the one summer. Representatives from the State Veterinary Office, Bureau of Animal Industry, as well as local physicians, examined the deer that had died but failed to agree on the cause of their death. On cutting open numerous deer that had recently died, including one large four-point buck (see Fig. 105), I found that there were well-marked points of infection at the roof of the mouth and particularly at the base of the back upper molar teeth. A further investigation showed that the infection had spread from this point and had involved the optic nerve, which accounts for the blindness noted in some of these diseased deer.

From recent investigations in California and elsewhere (see W. M. Rush, *Northern Yellowstone Elk Study*, 1932, p. 55, published by Montana Fish and Game Commission) it now seems fairly certain that the "Modoc" deer disease was caused by infection of wounds or mechanical injuries in the mouths of the deer by an organism known as *Actinomyces*

*necrophorus* causing serious necrotic sores which break down not only the soft tissue and nerves but even attack the bones. It seems probable that this and more recent outbreaks in the Modoc region were caused by mechanical mouth injuries sustained while the deer were browsing excessively on sharp spines of snow brush, becoming infected with *Actinomyces necrophorus* through drinking stagnant water at the reservoirs where hundreds of sheep and cattle watered.

In this same region, as at Happy Camp, where there were permanent secluded springs where the deer watered, I found no dead or diseased deer and no signs of the infection. It was found that at Hackamore Reservoir and at Lower Mud Lake when the snow came and the deer spread out and left the polluted reservoirs the disease soon disappeared. It is therefore suggested that in the future at the first outbreak such reservoirs be thoroughly fenced against deer so that they

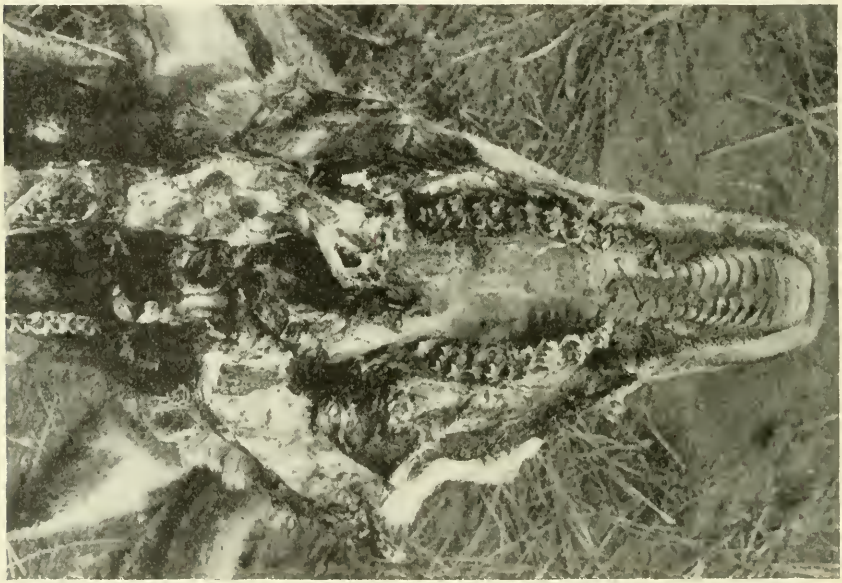

FIG. 105. A close examination of the teeth of this dead 4-point buck showed extensive pus areas at the base of the back upper molar teeth. Recent investigations indicate that these necrotic sores were caused by infection of mouth sores by an organism called *Actinomyces necrophorus*. Hackamore Reservoir, Modoc County, California, September 24, 1924. Mus. Vert. Zool. No. 4556.

will be forced to leave the vicinity instead of remaining until they perish.

### FOOT-AND-MOUTH DISEASE

For a full account of the 1924 outbreak of this disease the reader is referred to *The Epizootic of Foot and Mouth Disease in California* by Dr. Charles Keane, California Department of Agriculture, Special Publication No. 65, 1926. Keane (p. 7) states that "prior to the California outbreak foot-and-mouth disease had gained entrance into the United States on six occasions." The outbreak in California extended from February 17, 1924, until June 10, 1926. The presence of this disease among California mule deer on the Stanislaus National Forest

was definitely established on July 12, 1924. Keane (p. 50) states: "The outbreak among these wild animals was due to spread from infected cattle * * *." This point needs to be stressed for future reference. At the request of our State Fish and Game Commission, I proceeded to Niagara Creek, to determine positively that the native mule deer actually had contracted the disease. This fact was definitely attested to by both Dr. Day and Dr. Snyder. On September 2, 1924, on Niagara Creek I examined a dead doe that showed characteristic sloughed patches between the two parts of each hoof, and also slight lesions of the gums and other parts of her mouth. The same day I examined and photographed the feet of a dead forked-horn buck. The hoofs of both front and hind feet of this buck were nearly ready to drop off (see Fig. 106), as they had sloughed at the base, and showed conclusively that this deer had a bad case of foot-and-mouth disease when he died. Examination at this time showed that in "clean" deer the dried hoofs of dead deer remain firm and show no signs of slough-

FIG. 106. Foot of dead California mule deer buck showing presence of foot-and-mouth disease. Niagara Creek, Stanislaus National Forest, September 2, 1924. Mus. Vert. Zool. No. 4532.

ing. Investigation showed that the disease was wide-spread among the deer of the region, 30 per cent of 43 deer killed at this time showing infection, and that there was danger that the deer might spread the disease up and down the Sierra Nevada with gravest consequences. An attempt was made, while the infected area was small, to kill all the deer on the limited area by use of strichnine mixed with salt and placed on salt logs after all domestic stock in the immediate region had been destroyed. Prior to this 3400 cattle and 3000 head of sheep were killed and buried on account of the disease, within a radius of a few miles. As the disease continued to spread among the deer, an intensive campaign to eradicate the epizootic in the known infected area, which eventually covered about 1000 square miles, was begun on December 1, 1924. In this campaign a total of 22,214 deer were slaughtered and examined by veterinarians. Of this number, 2279 showed lesions of

foot-and-mouth disease. The last deer showing old lesions was killed on September 12, 1925, and all quarantine was removed on June 10, 1926. Perhaps the most important lesson to be learned from this tragic experience is that such infectious diseases are similar to forest fires. Prevention is much better than cure, and where an outbreak or fire does occur it should be controlled promptly while still in the "ten-acre" class.

### INTERNAL PARASITES

Internal parasites such as lung worms, round worms and tape worms, cause considerable loss of mule deer in California at certain times when climatic and other conditions engender a heavy infestation of such parasites among the deer. As regards ordinary conditions when

FIG. 107. California mule deer doe protecting her nose from attack of deer bot fly. Note position of nose between hind leg and body. Yosemite June 20, 1927. Mus. Vert. Zool. No. 5416.

the deer are in good physical condition and well scattered over the entire range losses from this source are relatively small, but when the deer are in poor flesh and are concentrated on limited areas as sometimes occurs on winter range during heavy snowy winters, then losses from internal parasites may become acute. These parasites usually kill indirectly by so weakening the deer that during the stress of a hard winter such infected deer frequently die off through exposure and cold or become so weak that they are easily captured by predators. In California the most serious infection of lung worms noted among deer has occurred in the Columbian black-tailed deer in the Trinity region. In my experience with deer in California, I have found the various races of mule deer to be relatively free from this disease. Now and

then I have found a mule deer with a tape worm (*Moniezia*), but both these and round worms have not been found in more than 2 or 3 per cent of the dead deer I have examined.

### EXTERNAL PARASITES

External parasites such as bot flies, wood ticks, and deer flies, are the indirect causes of serious loss among mule deer. The deer bot fly (*Cephenomia pratti*) is widespread and causes much suffering and loss among our mule deer. On June 20, 1927, in Yosemite, I watched an adult doe attempting to escape the attack of a bot fly. In domestic sheep and in reindeer bot flies have been observed to deposit their eggs directly into the nostrils of their victims. Although I have watched bot flies in deer for many hours I have never been able, although close enough (15 to 20 feet) to follow clearly with binoculars all the movements of the bot fly, to detect the depositing of eggs directly into the nostril of the deer. Whenever the doe observed in Yosemite found that

FIG. 108. Larva of deer bot fly (x2) which infests the internal nares and turbinal passages of the deer's nose, causing much pain and loss among both mule and black-tailed deer. August 3, 1928. Mus. Vert. Zool. No. 5793.

the bot fly came within six inches of her nose she would shake her head violently and stamp her front feet. At other times she would raise her hind leg and extend it forward so that her nose was protected on the inside by her body and on the outside by her hind leg (see Fig. 107). At such times she was observed to lick her hind leg, possibly using her tongue also to protect her nostrils from the bot fly.

Some of the bot flies are successful in depositing eggs, for in the majority of fresh mule deer heads that I have examined in California I have found from 1 to 34 larvae of the deer bot fly in the frontal sinus or throat of the deer. I have been unable to detect any difference between the bot flies which infest Columbian black-tailed and California mule deer. Apparently the same bot fly attacks both species of deer in Yosemite. The larvae of the bot fly have a row of dark, stiff, bristle-like organs along the top and on both sides of their bodies (see Fig. 108) which protrude and prevent the living larvae from being

blown out of the internal nares and turbinal passages of the deer. In extreme cases these parasites work up through the turbinal passages of the deer's head and have been known to penetrate nearly to the brain. In other instances they cause inflammation, and some drop down into the anthrum where they cause infection and sometimes even the death of the host.

It has been suggested that if large auger holes were bored in salt logs and filled with salt and the sides of such holes smeared with pine tar, the deer might in getting salt also collect enough pine tar on their noses to prevent ovipositing of the bot flies. The bot fly larva is a serious and widespread drain upon our mule deer, but corrective measures are difficult to apply.

The commonest external parasite of mule deer in California is the woodtick (*Dermacentor occidentalis*), which is given by Essig (*Insects of Western North America,* 1926, p. 21) as the "most abundant tick on the Pacific Coast and the deer is the preferred host." He also states that this is the tick commonly acquired in brushy areas in central California. California mule deer are often heavily infested with these ticks. In Yosemite on July 6, 1929, I counted 50 woodticks on an area 4 inches square of thin skin on the inside of a doe's leg (see Fig. 101). In winter when the deer are in full coat the presence of woodticks is often revealed by the irregularities in the pelage. This was particularly noticeable in a doe observed and photographed in Yosemite Valley (see Fig. 109). By close observation I found that woodticks tend to gather where the deer have difficulty in reaching them, as at base of tail (see Fig. 110), at base of ears, and on the neck. However, the deer circumvent the ticks by biting them on each other (see Fig. 83). Thus in Yosemite on July 13, 1928, I watched two does standing side by side nibbling ticks on each other. By watching with binoculars at close range I saw one doe reach over and nip a large woodtick off her companion's body, just behind the front leg. Having pulled the tick off with her incisor teeth, the doe gave it a few hasty bites and then, instead of dropping it, she deliberately swallowed it. The habit of one mule deer biting ticks on another is common to both sexes and to all ages from fawns to old bucks.

The woodticks do not in themselves often directly cause the death of deer, but they do tend to reduce their vitality and resistance so that indirectly they contribute to the loss of deer. I know of no practical management method of eradicating woodticks from wild deer.

At least two species of deer tick flies occur upon deer in California. They are known as *Lipoptena depressa* and *L. subulata.* In both the Modoc and Lassen areas deer tick flies are sometimes said to infest the Rocky Mountain mule deer to such an extent as seriously to weaken the mammals. However, I have never found more than a mild infestation of these parasites.

### EYE DISEASE

An infectious unidentified eye disease, resembling but seemingly different from pink eye, has been found common at times in California mule deer. In Yosemite on December 10, 1927, I found a spike buck that had an infected eye. Many of the young deer in Yosemite contracted this disease that winter. A characteristic symptom is the covering of

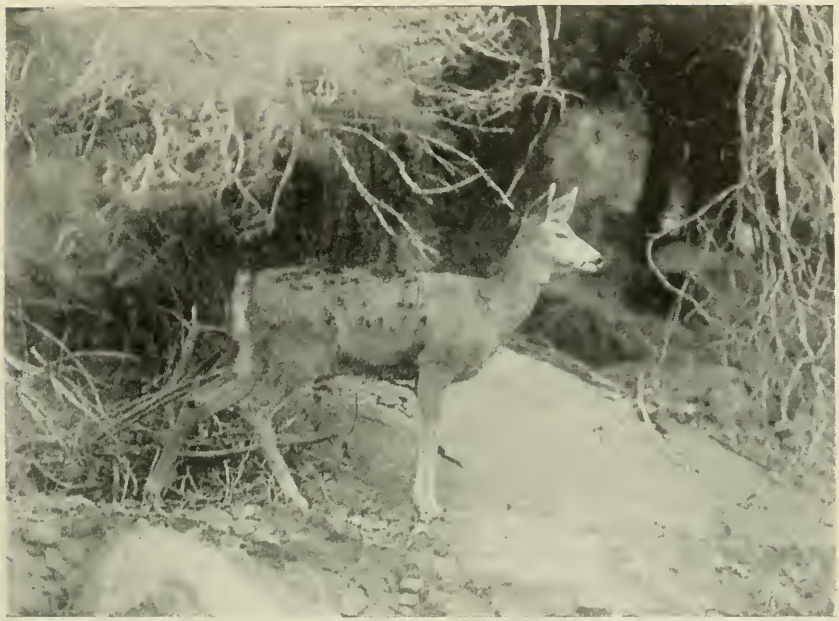

FIG. 109. California mule deer doe heavily infested with wood ticks. The rough spots in the pelage on the side of this deer indicates one or more wood ticks at the base of each spot. Yosemite, January 29, 1929. J. S. Dixon No. 29.

FIG. 110. Mule deer buck trying to reach a wood tick on his back near the base of his tail. Wood ticks choose places difficult or impossible for deer to reach so that the deer often have to bite ticks on each other (see Fig. 97). Yosemite, July 18, 1927. Mus. Vert. Zool. No. 5704a.

the eye with a bluish film, so that the animal's sight becomes impaired or even temporarily lost. An advanced case of such a diseased deer was examined closely at Hospital Rock in Sequoia National Park on December 20, 1929. Here I found a spike buck with badly infected eyes. One eye was so inflamed and filled with yellow stringy pus that the deer could not see out of it. The other eye was also infected and

FIG. 111. Spike buck with eye disease. Note that one eye is closed and filled with yellow pus and the other eye is also badly infected. Deer are thus temporarily blinded and if they escape predators such as the mountain lion and coyote during this period, they usually recover. Hospital Rock, Sequoia National Park, December 20, 1929. Wild Life Division No. 560.

nearly as bad (see Fig 111). If the deer which are thus temporarily blind can escape from predators such as mountain lions and coyotes, they usually recover in about three weeks, as the disease is rarely in itself fatal. This disease was prevalent in Yosemite in 1927 and again in 1933, and at times assumes serious proportions where deer are crowded together in a restricted area on winter range.

*(To be concluded)*

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## DIXON'S MULE DEER STUDY

The editor of CALIFORNIA FISH AND GAME is gratified to be able to present to the readers of this publication in this issue the first installment of J. S. Dixon's "A Study of the Life History and Food Habits of Mule Deer in California." This portion of the paper covers the life history section completely and the remaining installment on the food habits of mule deer will be concluded in the October number.

The subject of mule deer conservation in California is such an important one at the moment and Dixon's paper is such a valuable contribution to it, that other articles on file for publication in our quarterly have been held up in order that this paper might be published at once. Although the author has trimmed his manuscript to the minimum, it was impossible to publish the entire paper in this issue, as was desired, and even at the exclusion of other main articles, publication of the foot habits section must be deferred until the October issue.

Joseph S. Dixon, author of this paper, needs no introduction to most California sportsmen, for his abilities as a field naturalist and wild life photographer are nationally recognized. Dixon, although born in the East, moved to California in his childhood and spent his youth at his family's home at Escondido, San Diego County, where his studies of natural history commenced at an early age. Later he attended the Throop Institute of Technology at Pasadena, and Stanford University. A trip to Alaska in 1913–14 in which he was shipwrecked and forced to spend the winter on the Arctic seacoast near Demarcation Point followed and afforded him wide experience with Arctic collecting and natural history. On his return from this trip, Dixon became affiliated with the University of California Museum of Vertebrate Zoology where for many years he held the position of Economic Mammalogist until his association with the Wild Life Division of the National Park Service in 1929. Besides collecting trips in southeastern Alaska, Dixon had great opportunities for studying wild life in California during his association with the Museum of Vertebrate Zoology and later with the National Park Service. That the author made the best of these opportunities as regards deer, always a favorite study of his, is attested by the excellence of his present paper, which we consider is

by far the most important contribution to the subject that has yet been published.

The Division plans to print a quantity of separates of the two installments of this paper that will be combined in one cover with an index upon completion of the October issue and will then be available to the public at a moderate price covering the cost of printing.—*Ed.*

## PERSONNEL CHANGE

James Moffitt has resigned his position of economic biologist of the Bureau of Education and Research. For some time he has been engaged in investigations relating to the conservation of birds and mammals, particularly the geese, ducks and deer. In the recent past, he acted as editor of CALIFORNIA FISH AND GAME, and is responsible for this issue.

## NEW FOREST SERVICE FISH AND GAME REGULATION

On March 29, 1934, Honorable H. A. Wallace, Secretary of Agriculture, issued Regulation G-20A providing for the control and management of both fish and game in the National Forests by the Secretary of Agriculture. The regulation assumes the right to establish hunting and fishing seasons, to fix bag and creel limits, specify the sex of animals to be killed, fix the fees to be paid for permits, and to describe the terms and conditions under which hunting and fishing shall be conducted.

The Fish and Game Commission addressed the following communication to the Secretary of Agriculture:

May 9, 1934.

Hon. H. A. Wallace,
Secretary of Agriculture,
Washington, D. C.

Dear Mr. Secretary:

We have recently received a copy of Regulation G-20A issued by the Secretary of Agriculture, in which authority is assumed by the Secretary to establish hunting and fishing seasons; fix bag and creel limits; specify the sex of animals to be killed; fix the fees to be paid for permits, etc., in the National Forests.

The members of the Fish and Game Commission of California are quite disturbed over this regulation, which would set up a divided jurisdiction over our fish and game and would seem to indicate that the Secretary is of the opinion that the Fish and Game Commission, and the Legislature of this State, have not properly protected and managed the wild life of California.

The members of the Commission have enjoyed close cooperation with the representatives of the United States Forest Service in this State in handling our wild life, and employees of the Commission have materially assisted the Forest Service in the prevention and suppression of fires. In fact, the relationship has been so mutually helpful that it is difficult to understand the purpose of Regulation G-20A.

Without doubt you know that the fish and game work of California is supported entirely from the revenues received from license sales; consequently, the setting up of special fees for the privilege of hunting or fishing in the National Forests would not only add to the burden carried by the sportsmen of the State, but would result in a serious curtailment of the work being carried on by the State.

It seems obvious that the exercise of the authority assumed in Regulation G-20A could not help but create conflicts of interest and authority between the State and Federal agencies involved, as well as added confusion to the sportsmen whom both are serving.

The Attorney General of California was requested and has submitted his opinion relative to the authority of the Secretary of Agriculture to prescribe rules and regulations for the management of fish and game in the National Forests. It is his belief that authority for such action is lacking. A copy of this opinion is enclosed.

In view of the opinion of the Attorney General, the Fish and Game Commission would appreciate additional information relative to the authority for the issuance of Regulation G-20A, the provisions of which, in so far as they refer to fish and game management, the Fish and Game Commission can not at this time recognize.

Respectfully yours,

JOHN L. FARLEY,
Executive Officer.

Letters were also sent to all members of Congress similar to the following:

May 9, 1934.

(Similar letter sent to all members of Congress from California)

Hon. Hiram W. Johnson,
Senate Office Building,
Washington, D. C.

Dear Senator Johnson:

Honorable H. A. Wallace, Secretary of Agriculture, has recently issued Regulation G-20A, in which authority is assumed for the management of fish and game in the National Forests. This regulation provides for the establishment of hunting and fishing seasons; the fixing of bag and creel limits; specifying the sex of animals to be killed; fixing of fees to be paid for permits, and other related matters.

Such assumption of authority, except as it may pertain to migratory birds, is contrary to the whole background of fish and game management in this country, and the Fish and Game Commission of California doubts the authority of the Secretary to issue such regulations. This question has been referred to Attorney General U. S. Webb, of California, and his opinion is: "that it was not the intent of Congress to authorize the Secretary of Agriculture * * * to promulgate rules or regulations with respect to hunting and fishing in National Forests, which would conflict with the laws upon that subject enacted by the various states in which the National forests are situated." A copy of this opinion is enclosed.

As you well know, the National Forests of California embrace the more important recreational areas of the State, and the assumption of authority to manage fish and game in these areas would result in serious conflict of authority between State and Federal agencies; confusion to the sportsmen; reduced revenues and reduced work by the Fish and Game Commission. This regulation challenges the right of States to manage the wild life within their boundaries.

The regulation is based, in part, upon the statement that the prevention of over-grazing, and erosion, and the protection of watersheds, timber, and other resources are dependent upon the regulation of the wild life population to the carrying capacity of land and water. In California over-grazing by wild life does not exist as a problem, but over-grazing by domestic stock in the National Forests to the detriment of wild life exists in many cases. It would seem that this regulation may be intended to regulate wild life for the benefit of stock and sheep men at a time when an effort is being made to reduce the production of many of our commodities, including live stock. Certainly the management of fish life can not be construed as a necessary factor in the prevention of over-grazing, erosion, and the protection of watersheds and timber.

The members of the Fish and Game Commission have requested me to inform you of this regulation, and to ask you to enter protests in the proper places to secure a change in this order which will make it compatible with the best interests of California.

For your information, I am also enclosing a copy of a letter addressed to the Secretary of Agriculture, covering the same subject.

Very truly yours,

JOHN L. FARLEY.
Executive Officer.

In response to the letter addressed to the Secretary of Agriculture, the following answer has been received:

[COPY]

DEPARTMENT OF AGRICULTURE,
WASHINGTON, May 23, 1934.

Mr. John L. Farley, Executive Officer,
Division of Fish and Game,
450 McAllister Street,
San Francisco, California.

Dear Mr. Farley:

Your letter of May 9th is received.

It would be most disappointing to me if the adoption of Regulation G-20A disturbed, disrupted, or in any way interfered with such friendly and cooperative relations between State and Federal officials as you describe. As a matter of fact, the regulation was designed to improve and cement that relationship. If it does otherwise it will fail to accomplish one of its major purposes.

Public attention has been focused recently on better planning for the development and use of natural resources. Quite naturally, the public demands that land under public ownership be made fully productive. With this awakened interest on the part of the general public, it is important that the interest of public officials be correspondingly increased. Under existing practices there is too much of a tendency to attempt to defend unsatisfactory conditions by a denial of responsibility. This condition should be remedied, and the adoption of Reg. G-20A is a step in that direction.

It would be unfortunate if we failed to accept facts. There are cases where cooperative effort has failed to provide a sensible system of managing a forest or part thereof in the interest of wild-life production. This failure is not due as a rule to a lack of cooperativeness on the part of officials in charge, nor is it due to inadequate knowledge of conditions prevailing and the action required. It is due largely to inadequate and inelastic State laws or other circumstances over which officials have no control. This results in some areas being depleted of wild life, while other areas become overstocked.

The application of Reg. G-20A to such conditions is in no way inconsistent with the primary purposes of State laws or the objective of State officials. It merely provides a means by which these objectives can be attained.

If under the State law all areas on National Forests can be made to produce a maximum of wild life consistent with the requirements of other resources and the needs of the public, State officials need have no fear of the application of Regulation G-20A.

If on the other hand this objective, to which I feel sure all interests will readily agree, can not be obtained under existing practices, then Regulation G-20A should be given a fair trial. In this way it becomes an effective instrument for the accomplishment of a definite goal, and it would appear that the question of jurisdiction should be subordinated to the paramount issue of getting the greatest net public benefit from the public property.

While it is appreciated that the opinion of Attorney General Webb is contrary to the opinion of the Solicitor of this Department on which Regulation G-20A was based, the Department does not feel it would be redeeming its responsibility as a manager of public property if it failed to take such reasonable means as will insure the protection and development of all resources. In the event that any State in which the regulation is to be applied prefers to have the question of jurisdiction settled before reasonable management of a given area is applied, the Department will welcome a clear definition of its responsibility by the courts.

The point should be emphasized, however, that the regulation will be applied to specific cases where cooperation has failed, and that in each case an intensive field investigation by competent authorities selected by the Department will be made in cooperation with representatives of the State and other interested agencies if they care to participate in such examinations.

It is hoped the above explanation of the regulation and its purposes will allay any fears State officials may have of the Department's intention to disrupt cooperative relationships where satisfactory results are being or can be obtained. When the plans of the Department are understood, it is believed State and Federal officials will join wholeheartedly in a constructive measure for the development of the wild life resource.

Sincerely yours,
(Signed) R. G. TUGWELL,
Acting Secretary.

The fundamental problem involved is of such great importance that it has seemed advisable to quote the correspondence in detail, and whatever the decision may be relative to the authority of the Secretary of Agriculture to regulate fish and game in the National Forests, it is hoped that the rights of the public to the fish and game in the National Forests will never be subordinated to the interests of the stock and sheep men for the relatively small revenue which is received for grazing privileges.—*John L. Farley, May 29, 1934.*

## FUNDS FOR FEDERAL WILD-LIFE RESTORATION PROGRAM SHRINK

The recommendations of President Roosevelt's Committee on Wild-life Restoration were published in California Fish and Game, Vol. 20, April, 1934, pp. 163–166. In that account it was stated that $25,000,000 of emergency funds had been made available for the purchase of sub-marginal lands for the purpose of carrying out recommendations of this committee.

It subsequently developed that this sum, which was to be allotted from P.W.A. and C.W.A. funds, is not available for this purpose for the reason that the areas which were considered by the committee for purchase for game refuges and sanctuaries do not qualify with the legal requirements of submarginal lands as defined in Federal acts setting up the funds for their purchase. Nevertheless, we understand that the sum of $1,000,000 has been definitely appropriated for the purchase of Federal game refuges under the plans submitted by the President's committee. This tremendous reduction in funds available for this purpose will largely nullify the constructive program submitted by the President's committee and is, of course, greatly regretted by all sports-men throughout the Nation.—*James Moffitt, May 3, 1934.*

## GAME WARDEN CONFERENCE

The annual conference of game wardens, the first since 1932, was held in Los Angeles April 5 and 6. The entire warden patrol force consisting of 127 men gathered at the Jonathon Club, privileges of which were secured through the efforts of Commissioner Earl B. Gil-more.

Talks were given by the commissioners, Director of the Department of Natural Resources George D. Nordenholt, Supervising Assistant O. M. Thurston of the Los Angeles County Department of Forestry, Fire and Game Wardens, Federal Game Protector George Tonkin, Deputy Attorney General Ralph Marron, Executive Officer John L. Farley, bureau chiefs and other employees of the Division.

The pistol shoot, a much anticipated event of these conferences, was held at the Los Angeles Police Department range, the morning of April 6. Sincere thanks are due this department and Chief of Police James Davis for the many courtesies extended to the wardens at this event. The shoot was won by Game Warden C. O. Fisher, and on behalf of the Division, President J. Dale Gentry presented the silver trophy donated by Commissioner I. Zellerbach in 1926.—*E. L. Macaulay, May 28, 1934.*

## IN MEMORY OF F. W. VAN SICKLEN

### (1855–1934)

F. W. Van Sicklen, Fish and Game Commissioner from June 25, 1907 to November 3, 1910, died suddenly in San Francisco on March 6, 1934 of heart failure, following a minor operation.

Van Sicklen, a native of Vermont State, moved to California when he was 24 years of age and settled in Alameda, where he resided until 1910, after which date he made his home in San Francisco, where he had been prominent in business for many years.

Former Commissioner Van Sicklen was, throughout life, an ardent sportsman and conservationist. He pursued his favorate recreations, hunting and fishing, over the entire State and engaged in them up to a short time preceding his demise.

During his regime, Van Sicklen was highly influential in bringing about several important accomplishments on the part of the Commission. Noteworthy among these were the establishment in 1908 of the first State Game Farm, at Hayward, Alameda County; the importation from Illinois and planting in this State in the same year of a carload of fresh water fishes (crappie, blue-gilled sunfish and yellow perch); transplanting many rainbow and golden trout in the southern Sierra in 1909 and 1910; the purchase in 1908 of the first fish distributing car; and the establishment in the years 1908 and 1909 of branch offices in Los Angeles and in Fresno, which greatly facilitated the dispatch of the Commission's business in these centers.

While serving as Commissioner, Van Sicklen gave unstintingly of his time and sound counsel, and since his resignation in 1910 he always continued to have a keen interest in the Commission's activities. His passing is a matter of sincere regret to a number of older Division employees who worked under him and to a host of friends among California sportsmen.—*James Moffitt, May 3, 1934.*

## MORE TULE ELK PLANTED IN OWENS VALLEY

The transfer of the Yosemite elk into Owens Valley has previously been reported in this magazine (see CALIFORNIA FISH AND GAME, Vol. 20, 1934, pp. 37–51) and now I believe all those who are interested in wild life would like to know of the progress of this magnificent herd of Tule elk.

The Yosemite herd arrived in Owens Valley on October 11 of last year and, although they were penned up in a small paddock for about ten days, they were given their freedom on October 20, 1933. For the first month I visited these animals on an average of twice a week and soon had some of them eating apples out of my hands.

We had one old bull who had apparently been struck across the nose whom we called "Roman Nose" or "Geronimo." To game wardens Carl J. Walters and Eugene Walker this bull stood out with a great deal of prominence, as shortly after he was released he left the herd and was always found from a half mile to a mile from the rest of the animals.

It soon became apparent that the whole community was very much interested in the welfare of these elk, for scores of people visited the pasture where they were released and in which they stayed for nearly

two months before venturing into other fields. We were told by a number of people that they had taken apples by the box to feed to the elk so it is evident that they fared pretty well on fresh fruit during the first two months of their existence in Owens Valley.

With the Yosemite elk being so contented and doing so well the Fish and Game Commission decided that they would transplant some of the elk from the Kern County elk refuge, which at that time was greatly overcrowded and, to the writer, it seemed that Owens Valley was a paradise as compared with the Kern County refuge in regard to feed.

In order to make this transfer from the Kern County refuge it seemed necessary that we meet with the authorities of that county so that we might explain to them just where an allotted portion of their elk would be taken to and what kind of a range they would have in Owens Valley. Wardens Carl Walters and Eugene Walker and I made a trip to Bakersfield January 26 where we met Captain O. P.

FIG. 112. Part of the tule elk herd in Owens Valley. Photo by G. W. Dow, May 20, 1934.

Brownlow and Game Warden Lester Arnold of that district, and after gathering up some sportsmen and county officials we had a meeting the next day which resulted in their consent to move a certain number of their herd to Owens Valley.

The first step necessary was to see that proper traps were made at the refuge so the elk could be transferred without any fatalities. Under the able direction of Captain Brownlow a large wire fence was built forming a trap and at one end was a board corral where the animals could be roped and placed into crates for shipping.

Game wardens Walters and Walker left Independence, February 2, to trap the elk and I left Lone Pine February 9 for Bakersfield, where I stayed overnight and there met E. L. Macaulay, Chief of Patrol. The next morning at 6.15 we left Bakersfield for the refuge. At Tupman we met Captain Brownlow and game wardens Arnold, Walters, Walker, R. J. Bullard, W. I. Long and Roswell C. Welch.

After having a fine breakfast we left for the corrals, arriving there at 7.30, where the elk were penned up. We started loading immediately and at 12.30 p.m. 22 head had been loaded and were ready to start for Owens Valley.

The Fish and Game Commission truck, supplied by Warden Walters, was loaded with five cows and one large bull. The next truck, which was supplied by the Rainbow Club of Bishop, was loaded with ten cows and six calves. Two of these calves were bulls and the other four were heifers.

Walters' and Walker's truck arrived at its destination at about 10 o'clock that night and the other truck arrived at 1.30 o'clock the next morning and was unloaded at 2.45 with the weather good and cold. Warden Arnold and John Loustalot accompanied the trucks in a pickup to supervise their transportation and I followed in my car until we were well up on the Tehachapi grade, where I left them to come ahead to make arrangements to get some help to unload at the destination.

We did not unload these animals into a corral as we did the ones from Yosemite, which was a mistake, in my estimation. I believe they would have been much better off if they had been put in a corral and fed for at least ten days. However, they did not wander very far before becoming thoroughly acclimated.

Walters and Walker left Monday, February 12, for the second load and they returned the following day with four cows and two big bulls, making a total of 28 head in this shipment from the Kern County refuge, which, combined with the Yosemite herd, gives us a total of 54 head now in Owens Valley.

During the latter part of March one of the big bulls made the longest known journey for the newly transported herd by coming about twenty-five miles south to Lone Pine to feed in an alfalfa field. A remark was made around town that old Geronimo had gotten lonesome to see me and was wondering why I had not been up to give him some apples. After I heard that he was here I started him back and he has never been seen down here since.

During the month of March we were able to count as many as 52 head of the 54 that are in the Valley. I wish I could report at this time the number of calves that we have this year but I can not as I have not seen a single calf.* However, on May 20 I was able to find 23 head of female stock in one bunch and while I located some bulls with their antlers about two-thirds grown, they were separated by about a mile from the cows. We feel very proud of the fact that the 54 head were transplanted without a single fatality.

With a strip of land along the Owens River averaging five miles wide and 70 miles long it is apparent that we have room for a large herd of elk.

In addition to this elk herd I am very much interested in bringing into Owens Valley some buffalo and antelope, as I am sure that it would be an ideal place for them.—*G. W. Dow, Lone Pine, California, May 23, 1934.*

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* Editor's Note.—Mr. Dow reports that on June 25, subsequent to the writing of this article, he has seen as many as nine new calves playing in the fields with their mothers.

## EARLY BLACK-TAILED DEER BREEDING RECORD

Game Warden R. L. Sinkey reported seeing twin fawns of the Columbian black-tailed deer (*Odocoileus columbianus columbianus*) on the Lowery Range in Capay Valley, Yolo County, California, on March 16, 1934. Sinkey wrote that these fawns were active and were walking and nosing around when he first saw them. They quickly sighted him when they immediately stepped out of sight. The Game Warden, no doubt correctly, judged from these actions that the fawns were at least ten days old.

The gestation period of black-tailed deer is said to range from 206 to 212 days and is usually accepted as averaging 210 days. Figuring that these fawns were born on March 6 and the gestation period at the latter interval means that the mother bred on August 8, 1933. This is an exceptionally early breeding record for deer in this vicinity, where the rut does not normally commence until the latter half of September or early in October. Nevertheless, the fact that some individuals breed in August in this section is further substantiated by Sinkey's statement that he has often seen bucks and does together during the first half of August and that week old fawns have been noted in other years around April 1.—*James Moffitt, May 3, 1934.*

## ANTELOPE DOE COVERS FAWNS TO CONCEAL THEM

A few antelope does from what is usually known as the Mt. Dome antelope herd have, for the past seven or eight years, crossed the Southern Pacific Railway tracks between Macdoel and Dorris and have worked west to the fenced brush range of Charles Lough in the Indian Head country. This is on the western flank of Butte Valley.

Lough, an old-time cattleman, informed me that about June 15, 1933, he was walking along the inside of one of his pasture fences when he came upon a low pile of sage and bitterbrush that he could not remember placing there, and which he could see no reason for anyone else having done. As he stood over this little brush heap, he was surprised to see that it raised and lowered slightly but rhythmically. After ascertaining that this was no delusion on his part, he gently lifted the brush and found two very young antelope fawns under it that had presumably been cached there by the mother who had gone off to water.

This is the only instance I have heard of where antelope have covered up their very young fawns in an effort to conceal them. Perhaps this action is to protect them from the sight of golden eagles, which are fairly numerous in this vicinity and are said to prey on young antelope fawns.—*F. R. Starr, Game Warden, Macdoel, Calif., December 23, 1933.*

## UNUSUAL AGE ATTAINED BY WILD GEESE

Captain of Game Wardens John O'Connell reported on April 30, 1934, that Louis Springer, P. O. Box 35, Lodi, California, has in his possession four captive live wild geese that were crippled and caught by W. W. Andrews, Springer's grandfather, eight miles west of Lodi in 1868. Old time residents in this vicinity, when questioned by O'Connell, stated that the Springer family has had these geese in their possession

as long as they could remember. There is, of course, no way of determining how old the birds may have been when wounded, but if all were only in their first year, they would now be 66 years old, which presents an unusual record of longevity even for geese.

Captain O'Connell wrote that Andrews secured six geese in 1868, three of which were lesser snow geese (*Chen hyperborea hyperborea*) and three white-fronted geese (*Anser albifrons albifrons*). Two of the white geese escaped from the pen last winter and were shot by some boys so but one white goose and three "gray" ones survive at this time. The white-fronted geese mate but do not lay eggs. One of them is blind in one eye and its other eye is now starting to turn white. The accompanying illustration (Fig. 113) is from a photograph taken prior to the escape of the snow geese and shows two of these birds with the three "gray" ones.—*James Moffitt, May 3, 1934.*

FIG. 113. Three white-fronted and two lesser snow geese wounded near Lodi in 1868 and now in possession of Louis Springer of that city.

## SAND-GROUSE LIBERATED IN CALIFORNIA

An experimental introduction of sand-grouse was made to Anaverde Valley, west of Palmdale, Los Angeles County, in March, 1934. Twenty-one birds, ten pairs and an extra female, comprised this initial California planting.

Sand-grouse, of which there are 17 species and three genera, comprise an order of birds having characters of grouse and pigeons. Most species of sand-grouse, including the birds recently liberated in California, superficially resemble ptarmigan or red grouse in size and conformation excepting that they have weaker feet and legs than grouse and longer, more pointed wings like pigeons. On account of their weak feet and legs, sand-grouse are said to be unable to alight elsewhere than on the ground, where they also roost at night. In spite of this fact, they are said to be well able to cope with natural enemies, for an open situation is selected for roosting where the birds remain exceptionally alert and escape their enemies by rapid flight. Their power of

flight is said to be extraordinary, swift and soaring in nature, and permits the birds in their native habitat to range many miles from the limited water supply of the arid regions which they inhabit.

Sand-grouse are native to most of Africa including Egypt, Arabia, Persia, India and Southwestern and Central Asia. Some migratory forms enter southern Europe in summer and sporadic invasions of this bird have occurred in northern Europe even as far as the British Isles. Some species are highly migratory and others are permanent residents of the regions which they inhabit. All are birds of open, more or less barren regions and since they are said to fly as much as 20 to 25 miles daily for water, they are able to forage in arid regions at great distances from this element which is so necessary for the survival of our native desert quail. For this reason, the fact that it seems possible that sand-grouse may be successfully introduced into certain arid regions of the

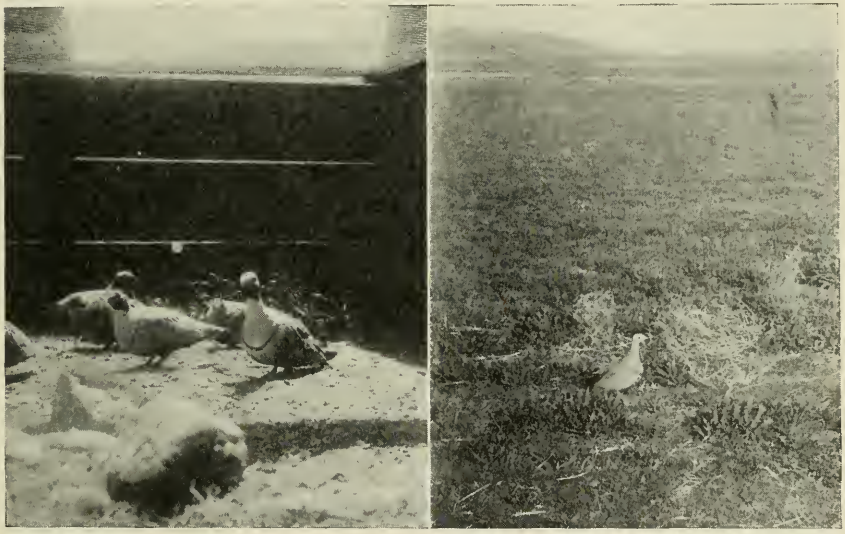

FIG. 114. Sand-grouse in Anaverde Valley, Los Angeles County. At left, birds in holding pen, two males in foreground, females at rear. Right, female after liberation. Photos by G. H. True, Jr. March 2, 1934.

State where native game birds are unable to exist on account of lack of water, the present experiment is being watched with great interest.

Sand-grouse normally lay but two or three eggs to the clutch, varying with the species, but literature at our disposal fails to inform whether or not they breed more than once in a season. Perhaps, on account of their pigeon-like relationship, they may breed twice or more in a year. At any event, their low egg production, if they nest but once a year, indicates that they are birds well able to cope with the natural enemies of their native land. How they will fare against our predatory species remains to be seen. The State Game Farm, at Yountville, has experimented with two pairs of these birds for the past two seasons and has found them to be hardy and to propagate successfully in captivity.

The Division was enabled to make this interesting introduction of sand-grouse through the generosity of M. E. Lombardi, vice president, Standard Oil Company of California, San Francisco, who purchased the birds and donated them to the State for stocking purposes. Mr. Lombardi was introduced to the writer in the fall of 1933 by G. Dallas Hanna and H. S. Swarth of the California Academy of Sciences, when the possibility of this introduction was first discussed. It has always had the support and endorsement of these scientific gentlemen and of the Academy.

Mr. Lombardi has kindly written, for inclusion in this note, the observations he made upon these birds in their native habitat, which prompted his interest in them that finally resulted in the present introduction. His recent letter is quoted as follows:

I first became interested in these birds when I saw them in countless numbers on the northern Mesopotamia Desert. I was traveling by automobile from Nisibin to Mosul in Iraq and thence to Kirkuk. This was in the spring of 1933 and great flocks of sand-grouse appeared to be coming down out of the foothills to the north and onto the desert. I was told that this movement was made in the spring when the new grass appeared after the spring rains on the desert. They seemed to assemble around the small rock-strewn hills but were sometimes seen covering as much as half an acre in flocks on the flat desert floor. While on the ground they look surprisingly like white-tailed ptarmigan, being somewhat larger, however. In flight they resemble a large pigeon as their wings are more the shape of pigeon wings than the usual round wing of a grouse. Their flight is very rapid and they can fly for long distances going and coming from water. They are shot for sport by the few Europeans in that area but are said to be not particularly good for the table. I do not think the Arabs destroy many of them since the Arabs are armed with rifles for the most part, and shotgun ammunition is very expensive.

I later saw these birds in Arabia near the head of the Persian Gulf and also in traveling from Bagdad to Damascus across the desert some distance south of the locality of my first observation of them. Later in the spring they seemed to be in smaller flocks and pairs.

The Mesopotamia Valley has many physical characteristics which are similar to the southern part of the San Joaquin Valley. It is entirely treeless and grass appears only in the springtime. The climatic conditions are similar, being featured by a very hot summer, and rains only in the winter and spring. Instead of sagebrush, there appears a thorn bush and some other shrubs similar to those seen in our desert valley. I also saw filaree, wild mustard and a grass similar to foxtail. Water is scarce during the summer, being confined to the large rivers (Euphrates and Tigris and a few of their tributaries) as well as some of the ancient canals now unused. The foothills encircle the upper end of the Mesopotamia Valley just as they do the lower part of the San Joaquin. On them, there is more vegetation, very similar in appearance to the vegetation on our foothills. I saw plants which are almost the same in appearance as manzanita and also others that might be identified as near relatives to our desert foothill shrubs although, not being a botanist, I could not identify them.

The fact that sand-grouse live in an environment so similar to ours, with climatic conditions approaching our southern deserts, led me to believe that they might be successfully introduced in certain sections of California.

After much discussion in the winter of 1933-1934 regarding the advisability of importing wild trapped birds direct from Asia for this planting, it was finally determined to purchase the present stock from a local game breeder, because these birds were thoroughly acclimated to California weather, having been originally imported from Calcutta in January, 1933. This decision was reached in Janury, 1934, when Mr. Lombardi agreed to purchase and to donate to the State, the 21 sand-grouse recently planted. Delivery of the birds was made to the Division at Palmdale on February 14, whence they were transferred

to holding pens in Anaverde Valley, the ultimate point of liberation. Eleven birds occupying one pen were freed here on March 2 from a point adjoining a State quail refuge caretaker's house in the center of the Valley. Some of these birds made a rather long flight toward the neighboring hills where released, but later returned to join others that had remained close to the pens. The second pen of ten birds was liberated a week later. Most of the first lot worked southwest into the hills bordering the valley shortly after liberation and the last one seen near the house was noted on March 24. The birds from the second pen remained longer in the valley floor, but they too later joined the others in the rolling foothills.

These birds were liberated on land posted as State quail sanctuary and patrolled daily by Refuge Caretaker C. H. Edmondson. Predatory animal control work has been carried on here by Edmondson for two years and is to be continued. The situation was selected for this planting only after most careful consideration of many sites and it promises to be an ideal one. Thus conditions appear to be promising for the success of this planting of sand-grouse, yet it should be borne in mind that many factors involve the successful introduction of any foreign species, the lack of any one of which may cause failure. Therefore, should the present planting prove to be a disappointment it will in no wise conclusively demonstrate that this species can not be successfully introduced into some other type of desert habitat in the State.

The Division wishes again, on behalf of the sportsmen of California, to acknowledge with gratitude Mr. Lombardi's generosity in making this introduction possible.—*James Moffitt, April 25, 1934.*

## NOTES ON STREAM SURVEY WORK IN CALIFORNIA *

As noted in the last issue of this magazine, three stream survey parties are now operating in California under the direction of the writer on funds allotted to the U. S. Bureau of Fisheries from the Public Works Administration. Each party consists of one leader and three scientific assistants. Intensive stream survey work is being carried on in the following areas: Klamath-Trinity, Sierra and Mono-Inyo, National Forests.

The Klamath-Trinity party left Stanford May 1 for Copco, where they began operations. The field work of this party is under the direction of A. C. Taft, Assistant Aquatic Biologist of the Bureau of Fisheries. The other four members are Leo Shapovalov, Peter Doudoroff, Mitchell Hanavan and Kelshaw Bonham. Two trucks were assigned this unit for the entire period of five months' operations.

The Mono-Inyo and Sierra parties left Stanford June 1, going to North Fork in the San Joaquin drainage, where a brief training period was inaugurated for the members of these parties. Afterwards, the Sierra party began actual field work on the streams and lakes in this National Forest, and the Mono-Inyo party began working the streams that flow to the east from the crest of the Sierra in the southern end of the Owens Valley. Each of these parties is to spend four months in the field.

* Published by permission of the U. S. Commissioner of Fisheries.

Dr. Osgood Smith is in charge of the Mono party, and also attached to this group are Emmett Hooper, Francis Sumner and Arthur Welander. Dr. Waldo Furgason is in charge of the Sierra party, and has the following scientific assistants: Allan De Lacy, Harry Hanson and Hugh Israel. Practically all of the personnel are well-trained fisheries men which will greatly facilitate securing the necessary biological, physical and chemical data required.

The Mono-Inyo group is to have two trucks for its use at all times, and only one truck has been assigned to the Sierra party by reason of lack of roads in this region. Pack stock for entrance into inaccessible regions is to be secured as needed.

Each party is completely equipped with nets and seines for making quantitative studies of the density of trout populations in various waters, chemical apparatus for determination of gasses dissolved in water, thermometers, instruments for measuring the food supply in both lakes and streams, air rubber boats for securing data on high Sierran lakes and many other pieces of equipment. The information obtained will be used to develop balanced stocking policies for the waters in the areas surveyed.

As noted previously, this work is being conducted as an integral part of the program of the California trout investigations, a cooperative project between the U. S. Bureau of Fisheries and the California Division of Fish and Game. Direct cooperation of the stream surveyors is to be had on stream and lake improvement projects inaugurated by the U. S. Forest Service and the California Division of Fish and Game.

In summary, intensive field investigations are being carried on by a force of 14 men including the writer, supplied with adequate scientific apparatus for obtaining detailed facts on the waters investigated, and it is hoped that the information obtained will prove most useful in the working out of sound measures for the conservation of trout in these areas.—*P. R. Needham, U. S. Bureau of Fisheries, Stanford University, California, June 1, 1934.*

## COMMERCIAL FISHERY NOTES

### CHANGE IN FORM OF FISHERY STATISTICS

Beginning with this number of CALIFORNIA FISH AND GAME, the tables giving the California fresh fish landings will be changed in form. Beginning with the first quarter of 1934 (January, February, March), the fresh fish landings, including all fish, mollusks and crustaceans, irrespective of their origin, will be shown on one table under eight geographical fishing regions. Region 10, Del Norte, includes the Klamath River, Smith River and waters from the Oregon line to Trinidad Head; Region 20, Eureka, includes waters from Trinidad Head to Point Arena; Region 30, Sacramento, includes the delta of Sacramento and San Joaquin river systems, San Pablo and Suisun bays, and Lake County; Region 40, San Francisco, includes San Francisco Bay and the coast from Point Arena south to Pigeon Point; Region 50, Monterey, includes Monterey Bay region from Pigeon Point to Piedras Blancas; Region 60, Santa Barbara, includes the section from Point Dume to San Mateo Point; and Region 80, San Diego, covers the waters from San Mateo Point to the Mexican line and includes Salton Sea.

In addition to the large table showing the complete landing, there is a table showing the fish imported into the State by region of landing, with a third table showing the importations by point of origin.

This change of form has been adopted after careful consideration and trial over a three-year period since the installation of tabulating machines for compiling the commercial catch statistics.—*N. B. Scofield, May 28, 1934.*

### GIANT SQUID TAKEN AT LAGUNA BEACH

On April 14, 1934, Captain O. B. Ayres brought to the California State Fisheries Laboratory a giant squid, *Moroteuthis robusta,* that had been captured alive that morning in the surf at Laguna Beach, California. This squid was over nine feet long, which great size, however, is not unusual for this species. *Moroteuthis* is very rare in California, being a more northern form. The present specimen is probably the first record for southern California.

The total length of the squid was 112½ inches, including the tentacles, which measured 65½ inches. The distance from the tip of the fin to the front of the eye was 47 inches. The eight sessile arms measured 30 inches. A description of this species is given in volume 19 (1933) of California Fish and Game (J. B. Phillips, "Description of a giant squid taken at Monterey, with notes on other squid taken off the California coast," pp. 128-136).—*R. S. Croker, California State Fisheries Laboratory, April 16, 1934.*

### ADEQUATE FRESH FISH INSPECTION AND GRADING

The per capita consumption of fishery products in this country is lower than in any important country of the world.

The failure on the part of the fishing industry to recognize and enforce among themselves the standards of quality has prejudiced the consuming public against this valuable foodstuff and is the principal cause for their inability to increase the per capita consumption.

The Federal and State agencies for meat inspection have proven very effective in eliminating undesirable practices. They also have established adequate standards of quality and have functioned as guarantors of the public health by establishing and enforcing minimum hygienic and sanitary standards. The inspection and grading of fish would be no more difficult than the grading of agricultural products, which has been carried on by the Division of Markets of the State Agricultural Department with the cooperation of the producers, for many years. A similar service to include fish and shellfish would do much to make these valuable foods more important elements in human diet than they have been in the past.

Article VIII, Title B, Section F of the National Fishery Code, provides: "To encourage the distribution of strictly high quality products of the industry and otherwise to protect the consumer against inferior merchandise." Under this section the producers of fresh fish should sponsor legislation to extend the same privileges and advantages of State inspection and grading as are now given to other producers of food commodities.

### FRESH FISH SALES

In gathering statistical information on fresh fish sales from 400 side line fish dealers, we find that the meat dealer who carries fish as a side line dislikes very much to handle fish. In most instances they would be satisfied if meat markets could be restrained from selling fish and have it sold by exclusive dealers only. In this way the consuming public should be able to get a wider variety to choose from, and could be sold fish six days a week, displayed and handled in a sanitary manner and sold at a price considerably less than that necessarily charged by the side line dealer. The following table indicates the statistical information procured from side line dealers:

Fish carried as a profitable item—30 per cent.
Fish carried as an accommodation—70 per cent.
Average number of varieties carried—4.
Best seller—1, salmon; 2, halibut; 3, sole; 4, rock cod.
Frozen fish sales—Unfavorable, 74 per cent; fair, 10 per cent; good, 16 per cent.
Method of refrigeration—Mechanical, 76 per cent; ice, 24 per cent.
Push sales by advertisement—Yes, 62 per cent; no, 38 per cent.
Days of sale—Monday, 4 per cent; Tuesday, 13 per cent; Wednesday, 13 per cent; Thursday, 45 per cent; Friday, 100 per cent; Saturday, 14 per cent.

*—A. A. Alstrom, May 25, 1934.*

## THE 1934-1935 SARDINE SEASON

At the beginning of the 1933-1934 sardine season the staff of the California State Fisheries Laboratory drew up a statement predicting the relative abundance and size of sardines to be expected in the 1933-1934 season. A discussion of the success of these predictions and predictions for the 1934–1935 season are submitted in the following report.

### RESULTS OF THE 1933-1934 PREDICTIONS

Because of the differences between the fall and winter fisheries along the entire California coast, it is necessary to consider the two as separate units. The fall fishing at San Francisco and Monterey extends from August through November, at San Pedro through November and December. The winter fishery at San Francisco and Monterey lasts from December to February, at San Pedro from January to March.

With one exception the predictions for 1933-1934 proved remarkably accurate. The forecast for the fall fishing at San Francisco and Monterey was that sardines would be relatively scarce and of large sizes, roughly 11 inches in total length. This proved to be the case. Fishermen had difficulty locating large schools of fish, and at times during the fall months the Monterey crews were forced to range as far north as San Francisco. The fish were as a whole large, though there were a few more small fish in the catch than had been expected.

For the San Pedro fall fishery, it was predicted that a new abundant group would enter the fishery, that these fish would be small, 8 to 9 inches, and that larger fish would be very scarce. These expectations were fulfilled.

For the winter fishery at all ports a relative scarcity of fish was anticipated. Off Monterey and San Francisco this held true. In the San Pedro area this prediction was wrong, as fish were exceptionally

available to the fishermen. Since there is no way in which the actual abundance of winter fish could have increased, it is probable that an unusually large part of the coast's sardine population gathered in the San Pedro area during the 1933-1934 winter season.

### PREDICTIONS FOR THE 1934-1935 SARDINE SEASON

*Fall Fishery: San Francisco and Monterey (August-November).*

The moderately abundant year-class which entered the San Pedro fishery in the fall of 1933 will be the main support of the Monterey fishery in the fall of 1934 and, as a consequence, fish will be quite abundant. These fish will average 9½ to 10 inches in total length. The San Francisco fall fishery will also be influenced by this same year-class but more large fish will occur in the fishery than at Monterey. The boats in both the Monterey and San Francisco fall fisheries should not have great difficulty in making catches and sardines will be considered fairly abundant.

*Fall Fishery: San Pedro (November-December).*

Studies of young fish indicate that the year-class entering the fishery in the fall of 1934 will be below normal in abundance. Consequently in the San Pedro fall fishery the year-class which entered in the fall of 1933 will be the main support of the fishery. As at Monterey these fish will be satisfactorily abundant and average 9½ to 10 inches in total length.

*Winter Fishery: All Localities.*

During the winter in all localities sardines will be no more abundant and perhaps less so than in the winter of the 1933-1934 season. The group which entered the San Pedro fall fishery in 1933 will play a small role in the winter fishery and help somewhat to increase the abundance. A small proportion, perhaps one-fourth, of the winter fish will be approximately 10 inches in length but the majority will be 11 inches or greater.

### POSSIBILITY OF OVERFISHING

The California sardine population has been subjected to very heavy fishing for the last decade and has withstood the strain remarkably well. Whether it can continue to do so is a question of considerable doubt. Many people have compared the California fishery with the far larger sardine fishery of Japan and the huge herring fishery of the North Sea. Each of these is nearly four times the size of our California sardine fishery and the natural assumption is that there can be no danger of depletion here if we are taking less than one-third as much as these other fisheries. The answer is that the fishing areas off the California coast are comparatively meager and comprise only a small fraction of those of Japan or the North Sea, and that in terms of tons

of fish per square mile of fishing area the California catch is by far the largest of the three. The figures are as follows:

| | Average catch 1929, 1930, 1931, tons | Area within the 100-fathom line,* square statute miles | Tons per square mile |
|---|---|---|---|
| Japan | 946,000 | 443,000 | 2.2 |
| North Sea | 926,000 | 177,000 | 5.2 |
| Pacific Coast (United States and British Columbia) | 320,000 | 33,000 | 9.8 |
| California alone | 241,000 | 14,000 | 17.2 |

*For practical purposes the fishing area of a district can be considered to be the area within the 100-fathom line, since it is only in or close to relatively shallow water that fish find an adequate food supply. Areas around islands are included.

Since many fisheries have been badly depleted by far less intensive fishing than we are giving the California sardine, it is obvious that this fishery must be carefully and continually watched for further signs of overfishing. This is being done. Besides this it should be made possible to restrict the catch at any time that it seems necessary, in order to give the fish a chance to recover from the strain. To be fully effective, such restrictions should affect the entire industry instead of only a part of it, as is now the case. At present the State can not regulate the catch of the floating reduction ships.

In addition to the need of placing the entire industry under uniform regulations it would be very desirable to readjust the industry so that part of the present strain would be shifted from the fall to the winter fishery. During the fall months most of the available sardines are comparatively young fish which are decidedly smaller than those taken in the winter. They have spawned only once, twice or not at all. The winter fish are older, and have had several spawnings. Also they are larger and it takes only seven-tenths as many of them to make a ton. At present 50 to 60 per cent of the sardine catch (by weight) is fall fish, and a readjustment so as to throw more of this strain on the winter fish would be a great aid in maintaining the supply.—*Contribution No. 140 from the California State Fisheries Laboratory, May 18, 1934.*

## THE CATCH OF SARDINES IN CALIFORNIA *

The fluctuations in the seasonal sardine catch of this State furnish an outstanding example of the changes from year to year in the total catch as governed by changing economic conditions rather than changes in the supply of fish in the sea.

Before 1916, the catch was insignificant because fishermen were not seeking sardines. The sardine canning industry developed during the period of the World War and the catch rose to what was considered in those years a huge tonnage. The business slump of 1921 caused the sag in the total catch for the two seasons 1920-21 and 1921-22. The revival of business prosperity with its boom period up to 1930 was responsible for the great increase in the cannery utilization of sardines. This was a period of increasing sales abroad with the consequent enlargement of canneries, employment of additional fishing crews, the building of

* Contribution no. 138 from the California State Fisheries Laboratory, May, 1934.

larger boats, and a steady increase in plant capacity to keep pace with the enlarged shipments to foreign countries. During the prosperity period of 1922 to 1930, the catch rose steadily to more than five times what it had been previously. One break appeared in this steady upward trend. During the season 1924-25, the unusually large catch resulted from adverse court decisions, so that for several months the laws against unlimited reduction of sardines were not operative and extra boat catches were reduced to fish meal and oil to take advantage of the good prices for by-products then prevailing.

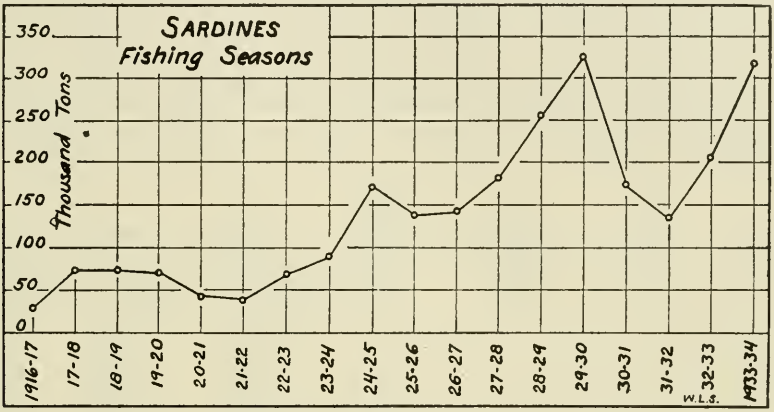


FIG. 115. Graphic representation of California sardine catches per thousand tons from 1916 to 1934.

The world-wide economic slump after 1929 reduced the sales to Asiatic and European countries so that the total catch of sardines dropped with the slump in the purchasing power of foreign countries. The rates of foreign exchange almost prohibited the purchase of goods in this country. The upward swing in the sardine catch for the last two seasons is the direct result of a business recovery policy of the Division of Fish and Game, by which permits were issued for the reduction of sardines into salable fish oil in order that fishermen and cannery workers might find employment and be rescued from the county charity rolls. It is just as absurd to assume that the recent increased catch is due to an increasing supply of sardines, as to claim that the two slumps in catch for the depression years of 1921 and 1930 were caused by a sudden scarcity of sardines in the ocean.

**TABLE 1**

**California Sardine Catch by Fishing Seasons**

| Season | Tons | Season | Tons |
|---|---|---|---|
| 1916–17 | 29,430 | 1925–26 | 137,690 |
| 1917–18 | 74,610 | 1926–27 | 147,700 |
| 1918–19 | 73,270 | 1927–28 | 182,870 |
| 1919–20 | 69,570 | 1928–29 | 254,450 |
| 1920–21 | 40,930 | 1929–30 | 324,240 |
| 1921–22 | 38,410 | 1930–31 | 173,820 |
| 1922–23 | 65,160 | 1931–32 | 133,440 |
| 1923–24 | 84,090 | 1932–33 | 205,530 |
| 1924–25 | 172,860 | 1933–34 | 315,150 |

The sardine catch for the State is shown by fishing seasons in Table 1, which is a summation of the records of the California Division of Fish and Game. This catch represents deliveries made chiefly to canning plants with small additional amounts used by fresh fish markets. In addition to these records, deliveries have been made during the past four seasons to reduction ships off the California coast outside the jurisdiction of this State. In order that we may know the drain upon our sardine supply, these deliveries to the offshore reduction ships have been calculated and added to the cannery catch in Table 2. In Table 3, the tonnage delivered to reduction ships has been segregated into months, although this separation is only approximate and may not accurately indicate the exact month in which the fish were caught. There is a lack of data showing daily deliveries to these ships, whereas in the case of cannery deliveries we have the records showing not only daily landings but also the tons delivered daily by each individual fishing boat.

TABLE 2

Cannery and Reduction Ship Catch of Sardines in California for Last Four Seasons

| Season | Cannery and market catch | Reduction ship catch | Total tons |
|---|---|---|---|
| 1930–31 | 173,820 | 10,200 | 184,020 |
| 1931–32 | 133,440 | 14,100 | 147,540 |
| 1932–33 | 205,530 | 55,890 | 261,420 |
| 1933–34 | 315,150 | 77,130 | 392,280 |
| Totals | 827,940 | 157,320 | 985,260 |

TABLE 3

Sardines Delivered to Reduction Ships

| | Tons | | Tons |
|---|---|---|---|
| 1930–31 | | 1932–33 | |
| November, 1930 | 600 | September, 1932 | 7,056 |
| December, 1930 | 2,490 | October, 1932 | 7,662 |
| January, 1931 | 4,560 | November, 1932 | 18,174 |
| February, 1931 | 2,550 | December, 1932 | 7,284 |
| | | January, 1933 | 13,734 |
| Total | 10,200 | February, 1933 | 1,980 |
| | | Total | 55,890 |
| 1931–32 | | 1933–34 | |
| August, 1931 | 3,800 | August, 1933 | 10,074 |
| September, 1931 | 1,500 | September, 1933 | 4,632 |
| October, 1931 | 5,446 | October, 1933 | 9,144 |
| November, 1931 | 354 | November, 1933 | 19,706 |
| December, 1931 | 3,000 | December, 1933 | 14,544 |
| | | January, 1934 | 8,352 |
| Total | 14,100 | February, 1934 | 10,680 |
| | | Total | 77,132 |

Total for four seasons (1930-31 to 1933-34): 157,322 tons.

Since the beginning of the large scale sardine industry in California, the two chief canning centers have been Monterey and the region about Los Angeles. In recent years new canneries have been located at various places in the bay region about San Francisco, so that this

northern region is becoming increasingly important as a sardine canning center. (See Table 4.) Fishing seasons for Monterey and northward have been calculated from May 1 through April 30 of the following calendar year. For the areas about Los Angeles and San Diego the season from July 1 through June 30 has been used. This arrangement of dates was chosen in the past to conform to the natural sardine season which is earlier in the northern part of the State. The sardine fishing season was regulated later by State law establishing a closed season. Beginning with the summer of 1929, the open season for Monterey and northward was legally defined as August 1 to February 15, and for southern California as November 1 to March 31.

**TABLE 4**

**California Sardine Catch by Areas for Seven Seasons**

| Season | San Francisco | Monterey | Los Angeles | San Diego | Total tons |
|---|---|---|---|---|---|
| 1927-28 | 11,660 | 99,480 | 67,480 | 4,250 | 182,870 |
| 1928-29 | 13,510 | 120,280 | 119,250 | 1,410 | 254,450 |
| 1929-30 | 20,940 | 160,110 | 140,540 | 2,650 | 324,240 |
| 1930-31 | 25,800 | 109,340 | 38,650 | 30 | 173,820 |
| 1931-32 | 21,600 | 68,880 | 42,650 | 310 | 133,440 |
| 1932-33 | 18,760 | 102,990 | 83,600 | 180 | 205,530 |
| 1933-34 | 36,320 | 152,360 | 124,880 | 1,590 | 315,150 |

**TABLE 5**

**Monthly Sardine Catch at Four Areas of California**

| Area | 1933 | | | | | | 1934 | | |
|---|---|---|---|---|---|---|---|---|---|
| | July | August | Sept. | October | November | December | January | February | March |
| San Francisco | 100 | 1,856 | 2,675 | 2,822 | 11,167 | 6,302 | 8,283 | 3,048 | ---------- |
| Monterey | 59 | 18,310 | 12,258 | 15,024 | 30,183 | 25,157 | 26,845 | 24,387 | 38 |
| San Pedro | 2 | 3 | 4 | 5 | 17,932 | 27,629 | 21,640 | 43,800 | 14,020 |
| San Diego | 1 | ---------- | 1 | ---------- | 96 | ---------- | 585 | 680 | 224 |
| Total tons | 162 | 20,169 | 14,938 | 17,851 | 59,378 | 59,088 | 57,353 | 71,915 | 14,282 |

In Table 5, the recent monthly catches are shown at the four principal sardine fishing areas of the State, illustrating the concentration of heavy catches in the fall and winter months.—*W. L. Scofield, California State Fisheries Laboratory.*

## STATEMENT OF INCOME

### For the Period July 1, 1933, to March 31, 1934, of the Eighty-fifth Fiscal Year

| | | |
|---|---|---|
| Departmental income—current year: | | |
| License sales: | | |
| Angling licenses, 1932 | $5,475 00 | |
| Angling licenses, 1933 | 300,146 00 | |
| Angling licenses, 1934 | 10,471 50 | |
| Commercial hunting club licenses, 1933–34 | 1,750 00 | |
| Commercial hunting club operators' licenses, 1933–34 | 395 00 | |
| Deer tags, 1932 | 1,143 25 | |
| Deer tags, 1933 | 95,776 00 | |
| Fish breeders' licenses, 1933 | 20 00 | |
| Fish breeders' licenses, 1934 | 305 00 | |
| Fish importers' licenses, 1933 | 5 00 | |
| Fish importers' licenses, 1934 | 40 00 | |
| Game breeders' licenses, 1933 | 130 00 | |
| Game breeders' licenses, 1934 | 742 50 | |
| Hunting licenses, 1931 | 261 30 | |
| Hunting licenses, 1932–33 | 8,387 18 | |
| Hunting licenses, 1933–34 | 217,383 50 | |
| Kelp licenses, 1934 | 10 00 | |
| Market fishermen's licenses, 1933–34 | 25,040 00 | |
| Market fishermen's licenses, 1934–35 | 290 00 | |
| Trapping licenses, 1933–34 | 1,392 00 | |
| Wholesale fish packers' and shell fish dealers' licenses, 1933–34 | 915 00 | |
| Total license sales | | $670,078 23 |
| Other income: | | |
| Contributions from importers | $264 15 | |
| Court fines | 21,804 12 | |
| Fish packers' tax | 149,419 10 | |
| Fish tag sales | 1,238 00 | |
| Game tag sales | 94 59 | |
| Interest on bank balances | 4,281 52 | |
| Income from Department of Agriculture Fund, Chapter 825–33 | 45,131 65 | |
| Kelp tax | 17 15 | |
| Lease of kelp beds | 1,309 20 | |
| Miscellaneous sales | 1,155 67 | |
| Publication sales | 328 50 | |
| Dividends California National Bank, 50 per cent | 18,545 08 | |
| Dividends Trinity County Bank at Weaverville, 25 per cent | 178 50 | |
| Total other income | | 243,767 23 |
| Total departmental income, current year | | $913,845 46 |

## STATEMENT OF EXPENDITURES

**For the Period July 1, 1933, to March 31, 1934, of the Eighty-fifth Fiscal Year**

| Function | Salaries and wages | Materials and supplies | Service and expense | Property and equipment | Total |
|---|---|---|---|---|---|
| Administration: | | | | | |
| Executive | $6,269 94 | | | | $6,269 94 |
| Clerical and office | 4,140 00 | $608 20 | $163 28 | | 4,911 48 |
| Printing, Fish and Game Magazine | | 550 45 | | | 550 45 |
| Printing, general | | 2,254 37 | | | 2,254 37 |
| Automobile | | 399 79 | 266 48 | | 666 27 |
| Traveling | | | 2,350 22 | | 2,350 22 |
| Postage | | | 3,203 29 | | 3,203 29 |
| Telephone and telegraph | | | 2,883 32 | | 2,883 32 |
| Freight, cartage and express | | | 520 35 | | 520 35 |
| Rent | | | 10,249 05 | | 10,249 05 |
| Accident and death claims | | | 3,779 89 | | 3,779 89 |
| Accounting pro rata | 3,374 98 | | | | 3,374 98 |
| Legal | 493 56 | | 1,694 62 | $73 32 | 2,261 50 |
| Premiums on bonds | | | 22 50 | | 22 50 |
| Publicity | | | 183 00 | | 183 00 |
| Pro rata General Fund expense, Chap. 923–33 | | | 1,461 57 | | 1,461 57 |
| Total administration | $14,278 48 | $3,812 81 | $26,777 57 | $73 32 | $44,942 18 |
| Bureau Education and Research: | | | | | |
| Chief | $1,079 85 | | | | $1,079 85 |
| Clerical and office | 1,440 00 | $32 23 | $49 34 | $3 07 | 1,524 64 |
| Automobiles | | 366 11 | 222 84 | | 588 95 |
| Traveling | | | 1,630 85 | | 1,630 85 |
| Postage | | | 14 80 | | 14 80 |
| Library | 810 00 | 3 48 | 57 27 | 56 22 | 926 97 |
| Research | 3,949 03 | 100 61 | 49 60 | 10 50 | 4,109 74 |
| Publicity | 1,737 50 | | 25 29 | | 1,762 79 |
| Telephone and telegraph | | | 1 26 | | 1 26 |
| Freight, cartage and express | | | 2 05 | | 2 05 |
| Photography | | 3 23 | 75 87 | | 79 10 |
| Total bureau education and research | $9,016 38 | $505 66 | $2,129 17 | $69 79 | $11,721 00 |
| Bureau patrol and law enforcement: | | | | | |
| Chief and assistants | $8,325 00 | | | | $8,325 00 |
| Clerical and office | 2,385 00 | $35 83 | $10 95 | $56 86 | 2,488 64 |
| Automobiles | | 17,352 03 | 6,654 04 | 3,388 85 | 27,394 92 |
| Traveling | | | 32,573 95 | | 32,573 95 |
| Postage | | | 452 16 | | 452 16 |
| Telephone and telegraph | | | 1,179 47 | | 1,179 47 |
| Freight, cartage and express | | | 10 82 | | 10 82 |
| Rent | | | 421 28 | | 421 28 |
| Captains and wardens | 132,105 00 | 1,210 04 | 945 77 | 11 60 | 134,272 41 |
| Launches | | 2,019 21 | 1,057 69 | | 3,076 90 |
| Fish planting | 3,465 00 | 425 53 | 1,071 00 | | 4,961 53 |
| Premiums on bonds | | | 214 50 | | 214 50 |
| Cooks | 1,125 00 | | | | 1,125 00 |
| Game refuge guard | 495 00 | | | | 495 00 |
| Commercial fisheries patrol: | | | | | |
| Chief and assistants | 2,070 00 | | | | 2,070 00 |
| Captains and wardens | 10,725 50 | 10 04 | 13 66 | | 10,749 20 |
| Launches | 8,362 42 | 3,800 79 | 1,605 78 | 207 45 | 13,976 44 |
| Fish cannery inspectors, seasonal | 8,493 18 | | | | 8,493 18 |
| Traveling | | | 3,845 54 | | 3,845 54 |
| Rent | | | 575 00 | | 575 00 |
| Automobiles | | 352 98 | 294 07 | | 647 05 |
| Temporary help | 283 14 | | | | 283 14 |
| Total bureau patrol and law enforcement | $177,834 24 | $25,206 45 | $50,925 68 | $3,664 76 | $257,631 13 |
| Bureau commercial fisheries: | | | | | |
| Chief and assistants | $10,215 00 | | | | $10,215 00 |
| Clerical and office | 7,196 34 | $69 73 | $19 96 | | 7,286 03 |
| Automobiles | | 271 74 | 119 25 | | 390 99 |
| Traveling | | | 4,005 68 | | 4,005 68 |
| Postage | | | 60 | | 60 |
| Telephone and telegraph | | | 397 31 | | 397 31 |
| Freight, cartage and express | | | 99 82 | | 99 82 |
| Rent | | | 108 93 | | 108 93 |
| Heat, light, water and power | | | 251 57 | | 251 57 |
| Research | 1,710 00 | 24 01 | | | 1,734 01 |
| Laboratory | 16,927 58 | 695 22 | 531 12 | $93 36 | 18,247 28 |
| Statistics | | 701 80 | 1,512 00 | 83 75 | 2,297 55 |
| Temporary help | 88 39 | | | | 88 39 |
| Total bureau commercial fisheries | $36,137 31 | $1,762 50 | $7,046 24 | $177 11 | $45,123 16 |

## STATEMENT OF EXPENDITURES—Continued

For the Period July 1, 1933, to March 31, 1934, of the Eighty-fifth Fiscal Year

| Function | Salaries and wages | Materials and supplies | Service and expense | Property and equipment | Total |
|---|---|---|---|---|---|
| Bureau fish culture: | | | | | |
| Chief and assistants | $5,370 00 | $13 20 | $160 50 | | $5,543 70 |
| Clerical and office | 3,060 00 | 9 47 | 8 75 | $12 30 | 3,090 52 |
| Automobiles | | 4,640 92 | 1,702 32 | 725 47 | 7,068 71 |
| Traveling | | | 5,606 39 | | 5,606 39 |
| Postage | | | 150 19 | | 150 19 |
| Telephone and telegraph | | | 855 39 | | 855 39 |
| Freight, cartage and express | | | 457 27 | | 457 27 |
| Rent | | | 2,019 28 | | 2,019 28 |
| Heat, light and power | | | 1,035 77 | | 1,035 77 |
| Hatcheries | 80,575 00 | 32,413 39 | 653 13 | 789 41 | 114,430 93 |
| Fish cars | 2,655 00 | 274 39 | 645 63 | | 3,575 02 |
| Blue printing | | | 6 42 | | 6 42 |
| Cooperative research | 2,480 71 | 449 60 | 1,381 94 | 1 15 | 4,313 40 |
| Temporary help | 802 40 | | | | 802 40 |
| Fish hatchery assistant, seasonal | 13,231 29 | | | | 13,231 29 |
| Hydraulic engineering | 1,800 00 | 36 55 | 635 39 | 29 21 | 2,501 15 |
| Special field | 5,504 94 | 72 79 | | 94 79 | 5,672 52 |
| Total bureau fish culture | $115,479 34 | $37,910 31 | $15,318 37 | $1,652 33 | $170,360 35 |
| Bureau game propagation: | | | | | |
| Chief and assistants | $4,095 00 | | | | $4,095 00 |
| Automobiles | | $521 42 | $202 16 | | 723 58 |
| Traveling | | | 1,722 80 | | 1,722 80 |
| Postage | | | 51 61 | | 51 61 |
| Telephone and telegraph | | | 132 54 | | 132 54 |
| Freight, cartage and express | | | 18 55 | | 18 55 |
| Heat, light and power | | | 759 33 | | 759 33 |
| Maintenance | 9,681 71 | 6,951 72 | 391 60 | | 17,025 03 |
| Temporary help | 610 55 | | | | 610 55 |
| Quail trapping and expansion of quail program | 3,571 07 | 1,112 22 | 1,710 69 | $492 18 | 6,886 16 |
| Purchase of quail and pheasants | | 1,917 86 | | | 1,917 86 |
| Total bureau game propagation | $17,958 33 | $10,503 22 | $4,989 28 | $492 18 | $33,943 01 |
| Bureau fish rescue: | | | | | |
| Chief and assistants | $3,600 00 | | $18 63 | | $3,618 63 |
| Traveling | | | 66 00 | | 66 00 |
| Rent | | | 59 00 | | 59 00 |
| Temporary help | 69 00 | | | | 69 00 |
| Heavy truck service | | | 760 20 | | 760 20 |
| Total bureau fish rescue | $3,669 00 | | $903 83 | | $4,572 83 |
| Bureau game refuges: | | | | | |
| Chief and assistants | $6,374 97 | | | | $6,374 97 |
| Clerical and office | 1,440 00 | $3 62 | $12 50 | | 1,456 12 |
| Automobiles | | 356 44 | 108 37 | | 464 81 |
| Traveling | | | 3,326 24 | | 3,326 24 |
| Telephone and telegraph | | | 95 | | 95 |
| Lion hunters | 4,106 00 | | | | 4,106 00 |
| Refuge posting | 450 00 | | | | 450 00 |
| Predatory animal control | | | 4,210 00 | | 4,210 00 |
| Refuge maintenance | 6,105 50 | 2,140 70 | 1,129 48 | | 9,377 68 |
| Predatory animal hunters and trappers, seasonal | 4,100 00 | | | | 4,100 00 |
| Temporary help, seasonal | 2,628 50 | | | | 2,628 50 |
| Total bureau game refuges | $25,204 97 | $2,502 76 | $8,787 54 | | $36,495 27 |
| Bureau licenses: | | | | | |
| Clerical and office | $9,855 00 | $38 68 | $13 29 | | $9,906 97 |
| Printing, licenses and applications | | 8,515 11 | | | 8,515 11 |
| Traveling | | | 296 38 | | 296 38 |
| Postage | | | 696 50 | | 696 50 |
| Freight, cartage and express | | | 661 94 | | 661 94 |
| Premiums on bonds | | | 1,090 00 | | 1,090 00 |
| Total bureau licenses | $9,855 00 | $8,553 79 | $2,758 11 | | $21,166 90 |
| Total eight-fifth fiscal year expense paid from support appropriations | $409,433 05 | $90,757 50 | $119,635 79 | $6,129 49 | $625,955 83 |

**STATEMENT OF EXPENDITURES—Continued**

**For the Period July 1, 1933, to March 31, 1934, of the Eighty-fifth Fiscal Year**

| Function | Salaries and wages | Materials and supplies | Service and expense | Property and equipment | Total |
|---|---|---|---|---|---|
| Special items: | | | | | |
| Claim of chief accounting officer of Department of Finance, Chapter 991–33 | | | | $2,259 11 | |
| Construction of Russian River jetties, Chap. 989–33 | | | | 6,176 91 | |
| Deer tight fences, Chapter 872–31: | | | | | |
| From January 1, 1934, to June 30, 1934 | | | $73 80 | | |
| From July 1, 1933, to December 31, 1933 | | | 1,498 05 | | |
| Total deer tight fences, Chapter 872–31 | | | | 1,571 85 | |
| Electro Metals Company's claim, Chap. 599–31 | | | | 18,750 00 | |
| License commissions | | | | 30,463 08 | |
| State Fair and other exhibits | | | | 440 91 | |
| Total special items | | | | | $59,661 86 |
| Permanent improvements: | | | | | |
| Construction, improvements and equipment | | | | | $48,295 13 |
| Prior year expense: | | | | | |
| Eighty-third fiscal year | | | | $71 70 | |
| Eighty-fourth fiscal year | | | | 26,009 19 | |
| Total prior year expense | | | | | $26,080 89 |
| Bureau commercial fisheries, Chap. 825–33, fresh fish marketing: | | | | | |
| Chief and assistants | $3,012 97 | | | | $3,012 97 |
| Clerical and office | 809 03 | $44 99 | $11 55 | | 865 57 |
| Automobiles | | 6 50 | 2 50 | | 9 00 |
| Traveling | | | 604 63 | | 604 63 |
| Postage | | | 130 00 | | 130 00 |
| Telephone and telegraph | | | 2 61 | | 2 61 |
| Freight, cartage and express | | | 129 84 | | 129 84 |
| Rent | | | 18 04 | | 18 04 |
| Exhibits | | 136 23 | 2,713 91 | | 2,850 14 |
| Temporary help | 315 00 | | | | 315 00 |
| Total bureau commercial fisheries, Chap. 825–33, fresh fish marketing | $4,137 00 | $187 72 | $3,613 08 | | $7,937 80 |
| Grand total, proprietary group | | | | | $767,931 |

## SEIZURES OF FISH AND GAME

January, February, March, 1934

| | |
|---|---|
| Fish: | |
| Abalones | 1,250 |
| Bass— | |
| Black | 4 |
| Rock, pounds | 33 |
| Striped, pounds | 1,099 |
| Barracuda, pounds | 175 |
| Clams | 3,295 |
| Crabs | 16 |
| Cockles | 463 |
| Crappie, perch, sunfish, pounds | 165 |
| Halibut, pounds | 56 |
| Lobsters | 450 |
| Mussels, pounds | 75 |
| Smelt, pounds | 781 |
| Scallops, pounds | 400 |
| Trout | 118 |
| Steelhead, pounds | 1,802 |
| Spotfin croaker, corbina, pounds | 1,806 |
| Yellowfin | 2,533 |
| Nets, seines | 2 |
| Lobster traps, spears | 26 |
| Game: | |
| Deer | 14 |
| Deer meat, pounds | 756 |
| Deer hides | 6 |
| Ducks, geese | 465 |
| Doves | 6 |
| Non-game birds | 20 |
| Pheasants | 2 |
| Pigeons | 2 |
| Quail | 21 |
| Rabbits | 21 |
| Tree squirrels | 1 |

## FISH CASES

January, February, March, 1934

| Offense | Number arrests | Fines imposed | Jail sentences (days) |
|---|---|---|---|
| Abalones; small; closed season | 50 | $624 00 | 92 |
| Angling without license | 29 | 410 00 | |
| Bass— | | | |
| Striped; small; closed season | 5 | 200 00 | 85 |
| Black; closed season | 2 | 50 00 | |
| Barracuda; small | 2 | 50 00 | |
| Clams; small; overlimit | 63 | 720 00 | 351½ |
| Crabs; small | 3 | | |
| Cockles; small | 1 | 25 00 | |
| Commercial fishing; no license | 3 | 25 00 | 25 |
| Crappie; perch; closed season | 8 | 110 00 | |
| Lobsters; closed season | 6 | 110 00 | |
| Nets; seines; illegal use of | 17 | 125 00 | 75 |
| Scallops; selling of local | 4 | 25 00 | |
| Steelhead; untagged; spearing of; and netting of | 5 | 150 00 | 50 |
| Sturgeon; possession of | 1 | | |
| Illegal fishing apparatus | 14 | 360 00 | |
| Trout; closed season | 23 | 460 00 | 110 |
| Totals | 236 | $3,444 00 | 788 |

## GAME CASES

**January, February, March, 1934**

| Offense | Number arrests | Fines imposed | Jail sentence (days) |
|---|---|---|---|
| Elk meat, possession of | 1 | | 180 |
| Deer; meat in closed season; killing does, spike bucks | 52 | $1,655 00 | 620 |
| Ducks; closed season; selling of | 29 | 855 00 | 270 |
| Doves; closed season | 1 | 25 00 | |
| Hunting without license | 22 | 240 00 | 37½ |
| Non-game birds, killing of | 18 | 380 00 | 30 |
| Night hunting | 3 | 25 00 | 50 |
| Pheasants, closed season | 5 | 100 00 | 100 |
| Pigeons; closed season | 1 | 25 00 | |
| Quail; closed season | 2 | 25 00 | 10 |
| Rabbits; closed season | 6 | 75 00 | 75 |
| Squirrel; tree; killing of | 1 | | |
| Woodducks; killing of | 2 | 50 00 | |
| Shooting from highway | 1 | 10 00 | |
| Firearms in refuge | 2 | 35 00 | |
| Spotlight hunting | 8 | 50 00 | |
| Using a Maxim silencer | 1 | | |
| Trapping game birds | 1 | | |
| Totals | 156 | $3,550 00 | 1,372 |

## CALIFORNIA FRESH FISH LANDINGS* FOR JANUARY, FEBRUARY AND MARCH, 1934

Compiled by Division of Fish and Game, Bureau of Commercial Fisheries

| Species of fish | Region 10 Del Norte | Region 20 Eureka | Region 30 Sacramento | Region 40 San Francisco | Region 50 Monterey | Region 60 Santa Barbara | Region 70 Los Angeles | Region 80 San Diego | Total pounds |
|---|---|---|---|---|---|---|---|---|---|
| Anchovy | | | | | 5,361 | | 29,282 | | 34,643 |
| Barracuda | | | | | | 3,801 | 166,237 | 58,742 | 228,780 |
| Cabezone | | | | 575 | 127 | | | | 702 |
| Cabrilla | | | | | | | 13,704 | 24,433 | 38,137 |
| Carp | | | 67,964 | | | | | | 67,964 |
| Catfish | | | 40,926 | | | | | | 40,926 |
| Corbina, Mexican | | | | | | | 45,213 | | 45,213 |
| Cultus, Pacific | 19,168 | 48,257 | | 118,951 | 23,918 | 71 | 199 | | 210,564 |
| Flounder, Starry | | 6,388 | 420 | 99,559 | 2,306 | | 1,436 | | 110,109 |
| Flying Fish | | | | | | | 120 | | 120 |
| Grouper | | | | | | | 281 | 3,959 | 4,240 |
| Hake | | | | 1,341 | | | 116 | | 1,457 |
| Halibut, California | | | | 10,789 | 9,239 | 43,873 | 143,518 | 89,774 | 297,193 |
| Halibut, Northern | 176 | 31,224 | | 5,525 | | | | | 36,925 |
| Hardhead | | | 95,709 | | | | | | 95,709 |
| Herring, Pacific | | 3,500 | | 401,866 | 5,985 | 30 | | 3,027 | 414,408 |
| Kingfish | | | | 2,740 | 69,721 | | 122,194 | 651 | 195,306 |
| Mackerel, Horse | | | | | 1,339 | | 157,757 | | 159,096 |
| Mackerel, Pacific | | | | | 22,283 | 4,605 | 2,431,350 | 1,623,787 | 4,082,025 |
| Mackerel, Spanish | | | | | | | | 146 | 146 |
| Mullet | | | | | | | 1,077 | 680 | 1,757 |
| Perch | | 3,557 | | 49,056 | 8,024 | 3,785 | 17,915 | | 82,337 |
| Pike | | | 1,315 | | | | | | 1,315 |
| Pompano, California | | | | | | | 513 | | 513 |
| Pompano, Mexican | | | | | | | 35 | | 35 |
| Rock Bass | | | | | 8 | 2,781 | 35,993 | 23,877 | 62,659 |
| Rockfish | 8,820 | 47,207 | | 251,923 | 322,306 | 65,678 | 409,523 | 170,218 | 1,275,675 |
| Sablefish | | 12,131 | | 73,163 | 92,396 | 395 | 295,164 | 1,009 | 474,258 |
| Salmon | | | 29,845 | | 71,495 | | | | 101,340 |
| Sand Dab | | | | 208,144 | 3,660 | | 7,498 | | 219,302 |
| Sardine | | | 16,032,780 | 6,629,550 | 102,539,731 | 161 | 158,919,162 | 2,977,635 | 287,099,019 |
| Sculpin | | | | | | | 8,359 | 4,869 | 13,228 |
| Sea-bass, Black | | | | | | 4,500 | 95,179 | 42,657 | 142,336 |
| Sea-bass, Shortfin | | | | | | | | 25 | 25 |
| Sea-bass, White | | | | | 1,255 | | 15,457 | 36,635 | 12,445 | 65,792 |
| Shad | | | 47,280 | | 43 | | | | 47,323 |
| Shark | | | | 62,756 | | 18,106 | 48,432 | 12,876 | 142,170 |
| Sheepshead | | | | | | 3,443 | 45,530 | 1,677 | 50,650 |
| Skate | | | | 71,161 | 7,610 | | 8,530 | 3,989 | 91,290 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Smelt | 20 | 12,421 | | 102,204 | 3,901 | 7,919 | 55,255 | 13,622 | 195,342 |
| Sole | | | | 2,378,335 | 22,775 | 66,146 | 9,117 | 1,899 | 2,478,272 |
| Split-tail | | | 27,914 | | | | | | 27,914 |
| Striped Bass | | | 354,324 | 18,811 | | | | | 373,135 |
| Sucker | | | 32,956 | | | | | | 32,956 |
| Tomcod | | | | 250 | | | | | 250 |
| Totuava | | | | | | | 581,801 | 6,223 | 588,024 |
| Tuna, Albacore | | | | | | | 1,002,850 | | 1,002,850 |
| Tuna, Bluefin | | | | | | | 15,504 | | 15,504 |
| Tuna, Bonito | | | | | | | 16,292 | 13,665 | 29,957 |
| Tuna, Skipjack | | | | | | | 741,917 | 908,523 | 1,650,440 |
| Tuna, Yellowfin | | | | | | | 2,782,304 | 5,181,551 | 7,963,855 |
| Turbot | | | | 20,943 | 6,315 | 12 | | | 27,270 |
| Whitebait | 5,681 | 16,673 | | 404 | 317 | | | | 23,075 |
| Whitefish | | | | | | 2,052 | 24,882 | 17,597 | 44,531 |
| Yellowtail | | | | | | | 227,826 | 79,209 | 307,035 |
| Miscellaneous Fish | | 1,309 | | 47,606 | 196 | 21 | 1,471 | | 50,603 |
| Crustacean: | | | | | | | | | |
| Crab | 3,368 | 41,064 | | 1,192,512 | 82,704 | | | | 1,319,648 |
| Crab, Rock | | | | | | | 3,662 | | 3,662 |
| Lobster, Spiny | | | | | | 8,912 | 120,371 | 446,232 | 575,515 |
| Prawn | | | | | 671 | | | | 671 |
| Shrimp | | | | 211,765 | | | | | 211,765 |
| Mollusk: | | | | | | | | | |
| Abalone | | | | | 431,125 | 23,450 | | | 454,575 |
| Clam, Cockle | | | | 18,015 | | | 5,380 | 12 | 23,407 |
| Clam, Great Washington | | 2,016 | | 300 | | | | | 2,316 |
| Clam, Pismo | | | | | 6,658 | 16,775 | | | 23,433 |
| Clam, Soft-shell | | | | 55,062 | | | | | 55,062 |
| Clam, Washington | | 13,970 | | 319 | | | | | 14,289 |
| Octopus | | 275 | | 5,215 | 1,556 | | 19 | | 7,065 |
| Oyster, Eastern | | | | 125,564 | | | | | 125,564 |
| Oyster, Japanese | | | | | 50,240 | | | | 50,240 |
| Oyster, Native | | | | | | | | | |
| Squid | | | | | 192,595 | | 4,140 | 4,321 | 201,056 |
| Reptile: | | | | | | | | | |
| Turtle | | | | | | | 290 | 100 | 390 |
| Total pounds | 37,233 | 239,992 | 16,731,433 | 12,164,404 | 103,985,860 | 291,973 | 168,634,033 | 11,729,430 | 313,814,358 |

*Fresh fish importations from foreign countries included. See importation table.

## FRESH FISH IMPORTATIONS* FROM FOREIGN COUNTRIES FOR JANUARY, FEBRUARY AND MARCH, 1934

Compiled by the Division of Fish and Game, Bureau of Commercial Fisheries

| Species of fish | Landed in Region 7), Los Angeles | Landed in Region 80, San Diego | Total pounds |
|---|---|---|---|
| Barracuda | 8,500 | 19,955 | 28,455 |
| Cabrilla | 13,704 | 24,433 | 38,137 |
| Corbina, Mexican | 45,213 | | 45,213 |
| Grouper | 281 | 3,959 | 4,240 |
| Halibut, California | 17,107 | 63,591 | 80,698 |
| Mackerel, Pacific | | 109 | 109 |
| Mackerel, Spanish | | 146 | 146 |
| Mullet | 980 | | 980 |
| Pompano, Mexican | 35 | | 35 |
| Rock Bass | 5,423 | 1,890 | 7,313 |
| Rockfish | 1,292 | 61,523 | 62,815 |
| Sablefish | | 394 | 394 |
| Sea-bass, Black | 92,854 | 30,626 | 123,480 |
| Sea-bass, White | 2,228 | 1,897 | 4,125 |
| Shark | 1,065 | 1,326 | 2,391 |
| Sheepshead | | 434 | 434 |
| Smelt | | 134 | 134 |
| Sole | | 10 | 10 |
| Totuava | 581,801 | 6,223 | 588,024 |
| Tuna, Albacore | 1,002,850 | | 1,002,850 |
| Tuna, Bluefin | 15,504 | | 15,504 |
| Tuna, Bonito | 16,272 | 470 | 16,742 |
| Tuna, Skipjack | 741,917 | 908,523 | 1,650,440 |
| Tuna, Yellowfin | 2,782,304 | 5,181,551 | 7,963,855 |
| Whitefish | 12,957 | 15,498 | 28,455 |
| Yellowtail | 221,151 | 69,932 | 291,083 |
| Crustacean: | | | |
| Lobster, Spiny | 101,166 | 444,535 | 545,701 |
| Reptile: | | | |
| Turtle | 290 | 100 | 390 |
| Total pounds | 5,664,894 | 6,837,259 | 12,502,153 |

*These importations are included in tables of landings.

## FRESH FISH IMPORTATIONS BY POINT OF ORIGIN, JANUARY, FEBRUARY AND MARCH, 1934

Compiled by the Division of Fish and Game, Bureau of Commercial Fisheries

| Species of fish | Costa Rica | Galapagos Islands | Gulf of California | Hawaiian Islands | Japan | Panama | West Coast Mexico* | Total pounds |
|---|---|---|---|---|---|---|---|---|
| Barracuda | | | | | | | 28,455 | 28,455 |
| Cabrilla | | | 11,072 | | | | 27,065 | 38,137 |
| Corbina, Mexican | | | 44,713 | | | | 500 | 45,213 |
| Grouper | | | | | | | 4,240 | 4,240 |
| Halibut, California | | | | | | | 80,698 | 80,698 |
| Mackerel, Pacific | | | | | | | 109 | 109 |
| Mackerel, Spanish | | | | | | | 146 | 146 |
| Mullet | | | 29 | | | | 951 | 980 |
| Pompano, Mexican | | | | | | | 35 | 35 |
| Rock Bass | | | | | | | 7,313 | 7,313 |
| Rockfish | | | | | | | 62,815 | 62,815 |
| Sablefish | | | | | | | 394 | 394 |
| Sea-bass, Black | | | 2,261 | | | | 121,219 | 123,480 |
| Sea-bass, White | | | | | | | 4,125 | 4,125 |
| Shark | | | | | | | 2,391 | 2,391 |
| Sheepshead | | | | | | | 434 | 434 |
| Smelt | | | | | | | 134 | 134 |
| Sole | | | | | | | 10 | 10 |
| Totuava | | | 588,024 | | | | | 588,024 |
| Tuna, Albacore | | | | 25,900 | 976,950 | | | 1,002,850 |
| Tuna, Bluefin | | | | | | | 15,504 | 15,504 |
| Tuna, Bonito | | | | | | | 16,742 | 16,742 |
| Tuna, Skipjack | 1,627 | | | | 720,131 | 16,192 | 912,490 | 1,650,440 |
| Tuna, Yellowfin | 225,059 | 268,834 | | | | 215,014 | 7,254,948 | 7,963,855 |
| Whitefish | | | | | | | 28,455 | 28,455 |
| Yellowtail | | | | | | | 291,083 | 291,083 |
| Crustacean: | | | | | | | | |
| Lobster, Spiny | | | | | | | 545,701 | 545,701 |
| Reptile: | | | | | | | | |
| Turtle | | | | | | | 390 | 390 |
| Total pounds | 226,686 | 268,834 | 646,099 | 25,900 | 1,697,081 | 231,206 | 2,406,347 | 12,502,153 |

* Includes fish from international waters south of boundary.

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12731 8-34 3M

# 1933–ABSTRACT CALIFORNIA SPORTING FISH & GAME LAWS–1935

THIS ABSTRACT WILL BE VALID UNTIL 90 DAYS AFTER ADJOURNMENT OF THE 1935 LEGISLATIVE SESSION

## OPEN AND CLOSED SEASONS

WHITE SQUARES INDICATE OPEN SEASON. NUMBERS IN SQUARES ARE OPEN DATES

| GAME | DISTRICTS | JAN | FEB | MAR. | APR. | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC. | BAG AND POSSESSION LIMITS, ETC. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEER | 1½ | | | | | | | | | | 15 | | | No Does, Fawns or Spikæ Bucks<br>No Forked Horned Deer in Dist. 1¾<br>No sale of Venison or Deer Skins<br>Two Bucks per Season<br>except in 1¾ where limit is one<br>See Notes 6-9-10-12 |
| | 2-2½-3 | | | | | | | | | 14 | | | | |
| | 2¾-4-4¾ | | | | | | | | 16 | 15 | | | | |
| | 1-1¾-4½-23-25 | | | | | | | | | 16 | 15 | | | |
| Rabbits—Cottontail and Brush | ALL EXCEPT 4, 4¾, 19, 21 | | | | | | | | | | | 15 | 1 | 15 per day. 30 per week Season always open in 4, 4¾, 19, 21 |
| Bear, Fur Animals | ALL | | | | | | | | | | | 16 | | See Note 7 |
| Ducks, Geese, Jack Snipe, Mud Hens | ALL FEDERAL LAW | See Note → | | | | | | | | | | | | Federal regulations will be enforced in California and will be published as soon as announced by Federal authorities. |
| | ALL STATE LAW | 15 | | | | | | | | | | | | 15 Ducks daily, 30 weekly, possession limit, 25 Snipe daily, possession limit. Geese & Mud Hen limit see note 1 See notes 9 to 11 inc. |
| Quail—Valley, Desert and Mountain | ALL EXCEPT 1½ | | | | | | | | | | | 15 | | Valley - Desert - Mountain<br>Each Variety<br>10 per day. 10 in possession.<br>20 per week |
| | 1½ | | | | | | | | | | | | | |
| Dove | ALL EXCEPT 4-4½-4¾ | | | | | | | | | | | | | 15 Per Day 15 in possession<br>30 Per Week |
| | 4-4½-4¾ | | | | | | | | | | | | | |
| Pheasant | | | | | | | | | | | | 15<br>30 | | 2 Male birds per day<br>2 in possession |
| Pigeon | | | | | | | | | | | | | 15 | 10 per day 10 in possession<br>20 per week |

There is no open season on Elk, Antelope, Mountain Sheep, Sea Otter, Beaver, Tree Squirrel, Sierra Hare, Rail, Wood Duck, Swan, Shore Birds (except Jack Snipe), Grouse, Sage Hen, Imported Quail, Partridge, or Wild Turkey

| FISH | DISTRICTS | JAN | FEB | MAR. | APR. | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC. | BAG AND POSSESSION LIMITS, ETC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Steelhead and all Trout (except Golden) Whitefish<br>Unlawful to take trout in waters closed by Governor's proclamation | 1-1½-1¾-2-2½-3-4-4½-4¾ 15 Klamath River, Lake Almanor | | | | | | | | | | | | | Bag limit for taking and possession, 25 trout or 10 pounds and one trout.<br>No Sale<br>No Spearing<br>For other restrictions See Notes<br>12-15-16-20<br>21-22-27-28<br>30-32<br>On this Card |
| | 2½ | | 28 | | | 30 | | | | | | | | |
| | 23-25 | | | | | 10 | | | | | | | | |
| | Truckee River | | | | | 15 | | | | | | | | |
| | See Note 22 | | | | | | | | | | | | | |
| | 1½-5 and Winter Klamath River | | 28 | | | | | | | | | | | 5 Trout regardless of weight |
| | Russian, Napa, Navarro, Eel in 2, 2-, 12, Tidewater 2-3-15 | | 28 | | | | | | | | | | | 3 Trout regardless of weight |
| | Sacramento River between Sand Ferry and Meddle Creek, Shasta County | | | | | | | | | | | | | 3 Trout regardless of weight |
| Golden Trout | ALL EXCEPT 1-4½ | | | | | | | | | | | | | 20 per day. None under 5 inches<br>Not more than 10 lbs. and one<br>See Note 22 |
| | 1-4½, Except Cut Tenwood Lakes group | | | | | | | | | | | | | |
| BLACK BASS | ALL EXCEPT 4¾ | | | | | 20 | | | | | | | | 15 per day<br>No fixed season in 4¾<br>No Black Bass under 9 in. |
| | CLEAR LAKE | | | | | | | | | | | | | Clear Lake<br>10 per day<br>No sale<br>Hook and line only |
| Sunfish | ALL | | | | | 20 | | | | | | | | 25 per day |
| Sacramento Perch and Crappie | ALL EXCEPT CLEAR LAKE | | | | | 20 | | | | | | | | 25 per day<br>Hook and line only |
| | CLEAR LAKE | | | | | | | | | | | | | 10 per day<br>No sale |
| Striped Bass | ALL | | | | | | | | | | | | | Feather River from mouth to Oroville closed January 1st to April 15th<br>None under 12 inches, 5 per day 5 in possession None to be taken from Suisun Bay See Notes 19 and 24 |
| Crabs | ALL EXCEPT 1¾-6-7-8-9 | | | | | | | 30 | | | | | 15 | Season Districts 1¾-6-7-8-9 December 15 to August 30<br>See Note 23, None under 7 inches. No female |
| Abalones | 17 | 16 | | | 16 | | | | | | | | | Only for food. Must be brought to shore alive in shell<br>Angling license Required. See Note 26 |
| Pismo Clams | 17 | | | | | | | | | | | | | None under 5 inches. No shipment. 15 per day<br>Angling license Required District 18a Closed |
| Spiny Lobster | ALL | | | | | | | | | | | | | No Sale of Meat. None under 10½ or over 15 inches<br>See Note 23 |
| GRUNION | ALL | | | | | | | | | | | | | |

**SALMON, See Note A.** **STURGEON, No Open Season (possession prohibited).**

### NOTES

### IT IS ALWAYS UNLAWFUL

1. To hunt, kill, possess wild birds or mammals, to possess firearms, except under written permit from the Commission, in Dists. 1a, 1b, 1c, 1d, 1e, 1f, 1g, 1h, 1i, 1j, 1k, 1m, 1n, 1o, 1p, 1q, 1r, 1s, 1t, 2a, 2b, 3a, 3b, 3c, 3d, 3e, 3f, 3g, 3h, 4a, 4b, 4c, 4d, 4e, 4f, 4g, or General Grant Refuge, or Mt. Tamalpais Game Refuge, including Richardson Bay, or San Francisco Refuge, or Silver Lake Refuge (water fowl may be killed in 4a and 4e), or to hunt quail in Bolinas Quail Refuge, or to hunt or discharge firearms in Huntington Lake Refuge, San Leandro Bay Refuge, or Monterey Peninsula Refuge.

2. To hunt birds or mammals excepting predators without a hunting license. To hunt in areas closed by proclamation.

3. To possess any bird net or to net, trap or to hold protected game or birds of any kind, their nests or eggs except under written permit from the Commission.

4. To take more than 4 geese per day, 8 per week of all varieties, and 12 Canada geese and black sea brant. To take more than 25 mud hens per day, 50 per week. To have more than 1 daily bag limit of geese and mud hens in possession by 1 person in 1 day.

5. To take or kill nongame birds, except blue jay, butcher bird, English sparrow, sharp-shinned, Cooper or duck hawk, great horned owl, linnet, crow, black-billed magpie, white pelican, shag, and in Dists. 1, 2, 3, 4 and 4g, blackbirds.

6. To hunt deer without deer tag license. To fail to attach to horns of deer immediately on killing, properly filled out deer tag or at same time to send duplicate tag to Division. To carry deer into closed district without having deer tag countersigned, or to have untagged deer in possession. To fail to retain in possession during open season and for 10 days after, skin and portion of head bearing horns of deer killed and to produce upon demand. To use more than 1 dog to hunter in hunting deer or to allow dogs to run deer in closed season, or to possess doe or fawn skins, or deer skins not bearing evidence of sex.

7. To trap for profit without first procuring a trapping license bear, ring-tailed cat, coon, pine marten, skunk, fisher, wolverine, mink, river otter, fox or muskrat, or to kill same during closed season, except when destroying property. To interfere with traps of licensed trappers. To use saw tooth or spike-jawed traps for taking fur bearers.

8. To use any animal other than dog to stalk wild birds.

9. To shoot game from power boat, sailboat, auto, airplane, or to hunt waterfowl from scull boat in Dists. 8, 9, except on Wed. and Sun., or at any time in Dist. 12 or Napa River south of Edgerly Island, and in Mare Island Straits from the Napa River to Carquinez Strait, or to use shotgun larger than 10 gauge, or to possess an extension automatic or cane gun. To have in possession any device capable of or to be used in silencing the report of any firearm.

10. To shoot resident game between ½ hour after sunset and ½ hour before sunrise. To use a spotlight in hunting game.

11. To drive game birds by means of auto, airplane, or power boat over shooters.

12. To hold game or fish longer than 5 days after close of season; venison 15 days.

13. To sell wild game, except cottontail and brush rabbits.

14. To make a false statement in applying for license. To fail to show license upon demand to any officer.

15. To take game or fish from one district to another when season is not open in both. (Special law for deer, trout and black bass.) Trout legally taken may be transported from open district into closed district by the consignor making an affidavit in duplicate setting forth his name, address, number of angling license and name and address of consignee. Original must be attached to shipment; copy left on file with officer before whom sworn. Trout may be shipped into closed district when accompanied by written statement to effect that trout were legal, signed by shipper, countersigned by agent to whom offered for shipment. Black bass legally taken may be transported from open district into closed district.

16. To ship wild birds, mammals, or fish except smoked or dried fish other than trout by parcels post, or in concealed packages or without a tag bearing name and address of consignee and consignor and contents, or to ship game out of State.

17. To operate a commercial hunting club without license.

18. To place obstructions in streams in Dists. 1, 1½, 2, 2½, 3, 4, 4½, 23 and 25 that will stop or impede fish.

19. To sell striped bass taken with hook and line; to transport or carry striped bass out of State. To ship striped bass less than 20 in. in length or more than 10 lbs. in weight. To possess more than 5 shad per day between June 1 and Feb. 14.

20. To take trout other than with rod and line held in hand or with lure with more than 2 attractor blades or more than 3 hooks. To take trout except by angling in such manner as to cause trout to voluntarily take hook in its mouth.

21. To have in possession any fish spear or gaff (except landing gaff) within 300 feet of any lake or stream when unlawful to spear salmon.

22. To take trout in any lake within 300 feet of mouth of any stream from Oct. 31 to Aug. 1, or in that portion of any stream flowing into any lake in Dist. 23 within 2 miles from its mouth, upstream, from Oct. 31 to Aug. 1. To take golden trout in Cottonwood Lakes group, including South Fork Cottonwood Lakes group and ½ mile of stream below the lower lake in each of said groups, except from July 1 to Oct. 31.

23. To bring to shore crabs or lobsters in such condition that size can not be taken; or to ship or carry crabs out of Dists. 1½, 2½, 5, 6, 7, 8 or 9. To sell any crabs taken in Eel River or tributaries or to possess more than 10 crabs taken there or to take any between ½ hour after sunset and ½ hour before sunrise.

24. To take or possess in Dist. 3 salt water eels of less than 12 in. or more than 15 per day.

25. To take or possess cockles less than 1½ in. in diameter, or to take or possess more than 15 (Dists. 2 and 10) Washington clams or more than 10 horse clams or more than 30 razor or jackknife clams per day, or in Dists. 18, 19, 21 more than 15 lbs. of mussels per day. To take or possess any Pismo clams in Dist. 18 between ½ hour after sunset and ½ hour before sunrise, or to possess any clam digging implement in that district. To possess any clam digging implement in any clam preserve.

26. To take red abalones less than 7 in., in greatest diameter; green, 6½; pink, 6; black, 5; to dry abalones; to dive for abalones in Dists. 7, 15, 16, 17, 19, 20 and 20a; to take more than 10 per day or 20 per week in Dists. 7, 15, 16, 17, 19, 20 and 20a. To take more than 10 per day from shore in Dists. 7, 10 and 18; to take more than 10 black abalones per day in Dists. 15, 16, 17, 18, 19, 20, 20a, 21. To possess more than 10 per day in Dist. 2.

27. To fish for game fish without having an angling license.

28. To take game fish between 1 hour after sunset and 1 hour before sunrise in Dists. 1, 1½, 1¾, 2, 2½, 2¾, 3, 4, 4½, 4¾, 23, 25. To take striped bass by hook and line between sunset and sunrise.

29. To fish with nets except in commercial districts or to injure any legal net.

30. To fish through ice for any fish or to take fish in Dist. 14.

31. To place, cause to be placed, or discharge into any waters substances deleterious to fish or plant life.

32. To fish within 250 ft. of fishway or 150 ft. of upper side of fish screen, or lower side of dam, or to take fish except salmon within ½ mile of either side of spawning station, or any lake within ½ mile of spawning station when station is in operation.

33. To kill, injure or capture Cal. sea lions in Dists. 19, 20, 20a.

34. To take invertebrates or marine plants in Hopkins Marine Refuge (Monterey Co.) or in that area between the west line of the property of the Scripps Institute and a line 1,000 feet west of low tide line (San Diego Co.).

35. To take more than 5 white sea bass from May 1 to June 30, or to take at any one time more than 5 under 28 in.

36. To take more than 30 lbs. of halibut under 4 lbs. each, or to take more than 5 barracuda less than 3 lbs. each.

37. To take frogs less than 4 in. in length measured from tip of nose to posterior end of body between hind legs, or to take or possess more than 24 frogs per day or 48 frogs per week.

NOTE A.—SALMON. Salmon can not be taken on spawning beds, or within 10 miles of spawn-taking station, or 3 miles north and south of mouth of Klamath River. All salmon boats must have landing net, and no Chinook less than 27 in. or silver less than 24 in. can be taken in ocean and Humboldt Bay Dists. Undersized salmon can not be gaffed or clubbed, or brought ashore in such condition that size can not be determined. Salmon may be taken with hook and line in any district when trout season for said district is open.

In Dist. 1, salmon may be taken with hook and line or spear between May 29 and Oct. 31, except (a) in Feather River from its mouth to mouth of its Yuba; (b) in American River from its mouth to Fair Oaks bridge. In Dist. 2, (c) in Russian, Napa and Navarro rivers; (d) in Eel River and (e) in tidewater in Dists. 2, 3 and 15, with hook and line from May 1 to last day of Feb., bag limit 2 per day. In Feather River between mouth of Yuba and Thermalito bridge, with hook and line between May 1 and Dec. 31, bag limit 2 per day. In San Joaquin River, from mouth to Mendota bridge, with hook and line from April 1 to Dec. 31. In Dist. 1½, with hook and line from May 29 to Dec. 31; with spear from Aug. 1 to Oct. 31, bag limit 2 per day. In Dists. 2, 2½, with hook and line from May 1 to Feb. last; with spear from Nov. 1 to Feb. last, bag limit 2 per day. In Dist. 3, with hook and line from May 1 to Oct. 31, bag limit 2 per day. In Klamath River Dist. above tidewater, with hook and line from May 29 to Dec. 31; with spear, from Aug. 1 to Oct. 31, bag limit 2 per day. In Klamath River Dist. in tidewater, with hook and line from May 29 to Dec. 31. Bag limit is 5 per day from May 29 to Sept. 5, and 2 per day from Sept. 6 to Dec. 31, not more than 1 daily bag limit in possession. In Dists. 6, 7, 8, 9 with hook and line from April 1 to Sept. 15, no bag limit. In Dists. 10, 11, with hook and line from May 1 to Aug. 30, no bag limit. In Dists. 12, 12B, 12C, 13, with hook and line at any time, no bag limit. In Dist. 12A, with hook and line from May 1 to Feb. last, bag limit 3 per day. In Dists. 15, 16, 17, 18, with hook and line from Mar. 1 to July 15.


*Issued by*
*Dept. of Natural Resources*
*Division of Fish and Game*
*Sacramento*
*San Francisco*
*Los Angeles*

# FISH AND GAME DISTRICTS OF CALIFORNIA

1933 1935

## LICENSES MUST BE SHOWN UPON DEMAND

Districts 1a, 1b, 1c, 1d, 1e, 1f, 1g, 1h, 1i, 1j, 1k, 1m, 1n, 1o, 1p, 1q, 1r, 1s, 1t, 2a, 2b, 3a, 3b, 3c, 3d, 3e, 3f, 3g, 3h, 4a, 4b, 4c, 4d, 4e, 4f, 4g, are Game Refuges. Hunting prohibited. Angling in accordance with law relating to main districts in which refuge is located.

Districts 5, 6, 7, 8, 9, 10, 11, 12, 12a, 12b, 12c, 13, 16, 17, 18, 19, 19a, 20, 20a, 21, 22, are Commercial Fishing Districts. Honing and angling in accordance with law relating to main district in which small district is located.

District 14 is a Fish Reservation. All fishing prohibited.

District 2½ includes those townships in Mendocino County bordering on the Pacific Ocean (except 15 and 16 W., 11 N.) and townships 13, 14, 15, 16, 17 and 18 N., R. 16 W.

District 2¾. Those parts of Mendocino, Lake and Colusa counties lying east of the Redwood Highway and north of the Lake Tahoe Ukiah Highway, and all of Glenn County.

District 23. The water shed of Truckee and Truckee River, Rubicon and Little Rubicon above confluence. Water shed of American River and Silver Creek above confluence. Includes waters in water shed of Cosumnes above mother lode highway bridge, waters of South Fork American River between Chili Bar Bridge and mouth of Silver Creek, the waters of the Carson, West Carson and all tributaries, Twin Lakes, Silver, Twin, Blue, Meadow, Wood, Winnemucca, Scott, Burnside Lake and all tributary streams and the drainage area of Webber Creek above mother lode highway bridge.

*Sporting fishing licenses are required for the taking of the following fish and mollusks only: Tuna, yellow tail, marlin, broad bill swordfish, yu-fish or black sea bass, albacore, barracuda, bonito, rock bass, California whiting (also known as corbina and queen fish), yellow fin, croaker, spotfin croaker, salmon, steelhead and other trout, shore, whitefish, striped bass, black bass, perch, crappie, rabbit bass, Pismo clams, abalones, and all varieties of sunfishes.*

## LICENSE PROVISIONS

### HUNTING

License year July 1 to June 30

| | |
|---|---|
| Residents under 18 | $1.00 |
| Resident citizens | 2.00 |
| Nonresident citizens | 10.00 |
| Declarant aliens | 10.00 |
| Other aliens | 25.00 |

### ANGLING

License year January 1 to December 31

| | |
|---|---|
| Resident citizens | $2.00 |
| Nonresident citizens | 3.00 |
| Aliens | 5.00 |
| Under 18 no license required | |

### TRAPPING

License year July 1 to June 30

| | |
|---|---|
| Citizens | $1.00 |
| Aliens | 2.00 |
| Under 18 no license required | |

### DEER TAG

License year January 1 to December 31

| | |
|---|---|
| Everyone (2 tags) | $1.00 |

### COMMERCIAL HUNTING CLUBS

License year July 1 to June 30

| | |
|---|---|
| Citizens | $25.00 |
| Aliens | 100.00 |
| Operators, citizens | 5.00 |
| Operators, aliens | 25.00 |

*For Laws in Full See Fish and Game Code*

*For Commercial Fish Laws See Commercial Abstract*

*For Information Regarding Fish or Game Write to the Division of Fish and Game*

# CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

VOLUME 20 SACRAMENTO, OCTOBER, 1934 No. 4

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# A STUDY OF THE LIFE HISTORY AND FOOD HABITS OF MULE DEER IN CALIFORNIA*

*By* JOSEPH S. DIXON

With photographs by the author

(*Concluded from* CALIFORNIA FISH AND GAME, Volume 20, Number 3, July, 1934, pp. 181–282.)

* Contribution from the Wildlife Division, United States National Park Service

## PART II—FOOD HABITS

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### GENERAL STATEMENT OF FOOD HABITS

In general, mule deer in California browse relatively more than they graze, although at certain seasons fresh green grass may form as much as 90 per cent of the food eaten by California and southern mule deer. Browse is a general term applied to shoots, twigs, leaves and fruits of woody plants, vines, bushes and trees. Deer and domestic stock are said to graze on grasses, sedges and clovers.

In California, under normal conditions, mule deer forage in quite a different manner from domestic stock. Unlike domestic sheep or cattle, they scatter out when feeding and do not forage and trample the meadows in closely packed flocks or herds. There is also a decided difference in the degree of utilization of forage plants. Deer tend toward repeated but light utilization taking a nip here and there as they pass by food plants, whereas under similar conditions, cattle and sheep tend to stop and to browse heavily on such plants. The relatively light pruning by deer permits bushes and plants to keep up a continuous growth and is not so destructive to the range as is the heavy utilization and trampling of domestic stock. When mule deer breed and become overabundant, then serious damage to the range may result. Then even seedlings of coniferous trees may be killed by overbrowsing (see Fig. 116).

FIG. 116. Western yellow pine seedling killed by repeated browsings of mule deer. Yosemite, March 30, 1930. Wildlife Division No. 566.

### METHODS USED IN THIS STUDY

In my study of mule deer in California, it soon became apparent that one of the critical factors which called for close observation and attention was that of their food habits and food preferences. Hunters, ranchers and stockmen, as well as naturalists, have given accounts of the food habits of deer at different localities and different seasons. Some observers have even gone so far as to state that deer never eat this or that plant, that grass is "seldom touched," and have made various other statements which need verification. In my study of the mule deer in California, I have purposely selected certain typical regions and have made detailed observations on the food preferences of deer in Modoc, Lassen, Plumas, Mariposa, Fresno and San Diego counties.

My study of deer has covered all seasons and extended over nearly a score of years and has involved a counted total of over 1000 deer that have actually been watched, for a total of approximately 680 hours, in order to see what their food preferences might be at different seasons of the year and under different conditions. In Yosemite Valley during a single period of observation extending from June 20 to July 2, 1927, a total number of 136 deer were watched for a total of 1218 minutes. By making such a comprehensive study, it is believed that a more accurate and a better general understanding of the food preferences of deer has been obtained than was previously known. It has been my experience that under certain conditions and in certain seasons of the year, mule deer will feed almost exclusively on certain types of foods and plants. If we took into consideration only such observations, a very biased picture would result.

In order to approach sufficiently close to deer to be able to see what they actually ate, it was necessary that the deer be fairly tame and not fearful of the presence of man. Another important point was that if the free, natural food preferences were to be studied it was necessary that the full complement of food plants be present, because it was soon recognized that deer on range lands or other areas that have been heavily grazed by domestic stock, of necessity ate whatever plants remained and were available at that time. For these and other reasons, it was found expedient to make a special study of the food preferences of deer in our National parks because there grazing by domestic stock has been practically eliminated and because there the full complement of native plants was present. Furthermore my study in Yosemite was made early before deer became overly abundant there.

Kentucky blue grass, meadow fescue and velvet grass are all present on the floor of Yosemite Valley. This not only gave the observer an opportunity to detect the food preferences of deer as regards native vegetation, but also gave opportunity to ascertain what the reaction of deer might be toward some of our most important introduced range plants and forage grasses.

In order to insure accuracy, I have verified my findings through the use of 8-power binoculars, which has made it possible for me to be able to see with certainty just what species of plant the deer were feeding on.

The duration of browsings has been recorded accurately "by the watch," and is not mere guess work.

Four methods of recording the findings regarding the food preferences of deer have been utilized. The first was to secure actual photographs of the deer in the act. In order to do this, it was necessary to use a fast, long focus lens, and to be within 25 feet of the deer. For this type of work, I found that a Ross teleccntric lens of 17-inch equivalent focal length, with a value of F 5.4, fitted to a 4x5 Graflex camera, gave good results. By means of such apparatus, I have been able to secure graphic and dependable evidence showing what deer eat. In many instances I have not only been able to observe but actually to photograph deer eating certain plants or the foliage of certain trees

that I had been told were not eaten by them. The second means of recording such findings was my field notebook which I carried with me so that the findings could be recorded on the spot. In order to secure proper identification of certain species, it was found desirable to prepare regular herbarium specimens, which were dried in the usual manner, and later submitted to botanists. Field identifications have been based upon Sudworth's, *Forest Trees of the Pacific Slope* and Jepson's, *Manual of the Flowering Plants of California.* A fourth method of ascertaining and recording food habits of deer is by examination of stomach contents of animals that have died in winter or that have been killed during the open hunting season. This method furnishes a fair idea of the amount of food eaten at a meal and since mule deer usually browse twice a day, morning and evening, the daily food requirement of an individual can thus be obtained. For instance, the full stomach of an average sized fork-horn buck was found to weigh 12 pounds, which would represent a meal for that deer.

### KINDS OF FOOD EATEN BY MULE DEER

Up to January 1, 1934, over 200 different kinds of vegetation have been found to have been eaten by the various races of mule deer in California. I have attempted to list these items of food under various groups, namely, (1) trees, (2) brush or shrubs, (3) herbs, (4) grasses and sedges, (5) fungi and miscellaneous (see tables).

An attempt has also been made in these tables to indicate under each species the parts of the plant eaten, locality and seasonal use, availability and the author's estimation of the palatability and relative importance of the article as food. Thus it will be seen from the tables that coniferous trees, although occurring commonly in the habitat of mule deer, have low palatability and are, as a class, little used as food. Contrasted to this, certain species of deer brush and oaks with a wide distribution are both palatable and abundant so that they are much eaten and have a relatively high importance as deer food. Mushrooms and other fungi are eaten at various seasons. Acorns and berries are regular items of diet. Mistletoe, mosses and lichens are eaten when available in winter.

### DEER AS EATERS OF GRASS

Many people, including some hunters and a few scientists, maintain that deer do not eat grass. Dr. E. Raymond Hall, in writing on *The Deer of California* (California Fish and Game, vol. 13, 1927, p. 242), states: "As with other deer, grass is seldom touched." Dr. A. W. Sampson, Associate Professor of Forestry at the University of California, and a recognized specialist in grazing studies and range management in the West, in discussing the seasonal variation in the food of mule deer in California in a letter of March 14, 1928, to the author states: "At this time of year grasses, particularly *Bromus hordeaceus* and *Bromus rigidus,* constitute in some cases at least three-fourths of the food of deer."

In California there is no question but that at certain seasons of the year fresh green grass is eaten extensively by deer. I have made special efforts to ascertain the facts regarding this disputed point, and have found that at certain seasons when the ground is covered with snow and also in the dry season of early fall, relatively little grass is eaten because at such times green grass is not available. However, a careful observer under such conditions will not jump to the conclusion that grass is "seldom touched," because adequate field investigations have proven that such a statement is not in accord with the real fact. My observations, which have been made in every month of the year, indicate that some grass is eaten whenever it is available and that at certain seasons, fresh green grass forms as high as 90 per cent of the food eaten by mule deer.

On the winter range of mule deer in the upper foothills of California, the rainy season normally begins in October and continues until April or May. This rainy season is accompanied by moderate temperatures in the foothills during the winter, so that the annual grasses germinate and start to grow as soon as the rains begin. Usually, in the foothill region, the annual grasses have developed a new growth of three or four inches in height by Christmas time. This succulent green forage is an important source of food supply to the mule deer on its winter range.

In Yosemite Valley on October 31, 1929, I found a buck working over a pile of fallen black oak leaves. In addition to acorns, which were eagerly sought for, he made special effort to secure the fresh green blades of grass that had grown and developed under the protective covering of leaves.

During the first week of December in 1927 and in 1928, I found all ages and both sexes of mule deer feeding extensively on the blades of freshly-sprouted annual grasses. On February 8, 1930, in Yosemite, I watched two old bucks that had recently shed their antlers and found that they were eating a considerable amount of recently-sprouted annual grasses which, at that time, had reached a height of about one and one-half inches. On this date, I watched two does and five fawns for three hours and found that practically all of their time was spent in grazing on fresh green grass together with an occasional dry oak leaf. Very little browse was taken. On March 28, 1930, at five o'clock in the morning I found deer grazing in the open meadow. By 6.30 o'clock there were 23 there, all feeding on fresh green grass. One buck, two does, and three fawns were carefully observed with binoculars a few feet distant and were found to spend all of their time feeding in warm sunny spots where freshly-sprouted meadow fescue and wild oat grass had reached a height of from two to two and one-half inches. During the entire one and one-half hours that I watched them, these deer fed exclusively on fresh green grass.

On April 29, 1929, in Yosemite, I watched 12 deer for a period of one and one-half hours, during which time they spent the total of 1080 "deer minutes" (one deer minute equals one minute's foraging), feeding on fresh green grass. At this season it was found that the deer spent more time eating grass than all other foods combined.

On May 12, 1929, I watched 13 deer (three bucks, six does and four fawns) as they fed in an open meadow. During the hour that I watched them I had an excellent opportunity to observe that at least 90 per cent of their food at this season consisted of fresh green growing grass which at this date had attained a height of four to six inches. By watching carefully with binoculars at close range, I found that Kentucky blue grass and meadow fescue were being eaten most extensively and that the two together formed about 40 per cent of the food taken, while small annual weeds, too immature and too small to be identified, formed the remaining portion of their diet.

FIG. 117. Dead limbs covered with staghorn lichen are broken off by winter storms. A mule deer fawn is here shown stripping and eating the moss from such a fallen limb. Sequoia National Park, December 19, 1929. Wildlife Division No. 352.

On July 16, 1928, in Yosemite, I watched three large bucks as they grazed in an open meadow. One four-point buck fed steadily for 10 minutes on Kentucky blue grass and for 15 minutes on meadow fescue grass.

Between June 20 and July 2, 1927, I watched 136 different deer feeding for a total of 1217 minutes, and found that green growing grass was selected as food by a larger number of deer than was any other species of plant with the exception of Spanish clover.

A similar condition was found to exist in San Diego County where for many years I found southern mule deer feeding regularly and extensively, in early winter, upon fresh, green and tender wild oats.

AVAILABILITY OF VARIOUS FOODS

A certain species of plant may be palatable and may occur abundantly in the lower foothills of the Sierra Nevada and still have but slight importance as food because it is outside of the mule deer's habitat. Conversely, some preferred plants such at *Ceanothus* may occur abundantly at elevations of 6000 feet in the Sierra Nevada and yet are inaccessible in winter because of being covered with from 3 to 6 feet of snow. However, the same winter storms that snow under the *Ceanothus* thickets break off and bring down on top of the snow tons of green conifer branches, whole clumps of mistletoe and many dead branches that are covered with staghorn lichen or unsea moss. All of these "windfalls" are eagerly sought for and eaten (see Fig. 117). I find that the melting of the snow in the early spring uncovers many fallen

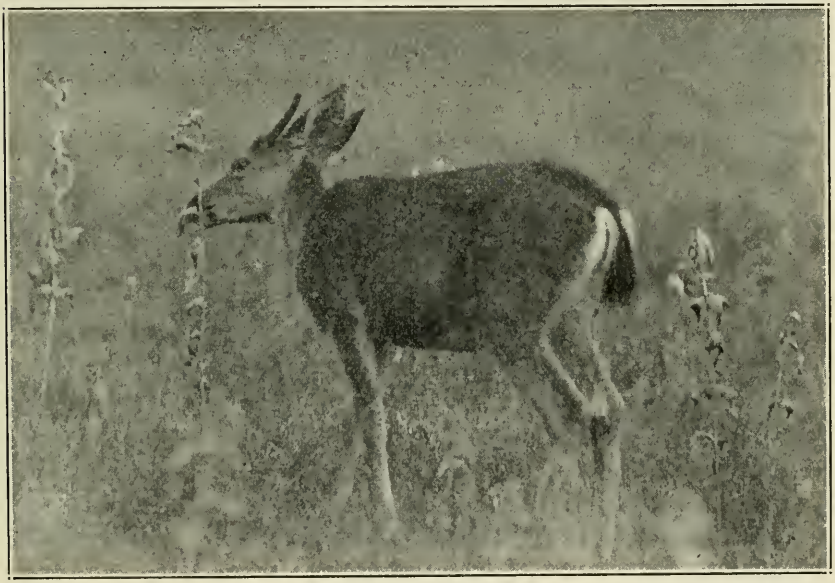

FIG. 118. Green growing milkweed leaves were never noted eaten by deer, but in the fall the dry frosted leaves of this plant were eagerly sought and eaten by bucks, does and fawns. Yosemite, September 17, 1927. Mus. Vert. Zool. No. 5492.

acorns and dead leaves which were unavailable as food during the winter. These hidden items are important to mule deer and are eagerly sought for in early spring. Fungi are eagerly eaten in late summer when they are at hand.

PALATABILITY OF VARIOUS FOODS

In considering the palatability of various grasses, plants, shrubs and trees as food of deer we must take into account all seasons of the year, because a plant which may be scarcely touched under one set of conditions will often be extensively utilized at some other time. For instance, I have watched California mule deer for at least 100 hours feeding amid patches of growing purple milkweed (*Asclepias cordifolia*) without seeing them even taste it. Close inspection of the green plants showed that none was browsed. I was about to conclude that

this milkweed, said by some people to be injurious if eaten by domestic stock, was a total loss as food for deer. However, in the fall after the first hard frost had killed the milkweed plant stalks, I found that the dry leaves were especially sought for and eagerly devoured by bucks, does and even by fawns (see Fig. 118). My final appraisal of the palatability of any given plant is based upon the degree with which deer, at all seasons, utilize it for food (see tables).

### SEASONAL VARIATION IN FOOD HABITS

Both seasonal and geographical variation in food preferences of mule deer in California are great. Many pages would be required to give in detail all of my observations on food habits. Since this is not feasible, I am presenting here the outstanding food plants eaten at various seasons of the year. For convenience these food items are treated under four seasonal heads.

### SUMMER

In summer, mule deer in California feed to a greater extent than at any other season, upon green leaves, growing herbs, weeds and meadow grasses. Table A presents a fair example of mule deer food in summer.

**TABLE A**

**Food Preferences of California Mule Deer, Yosemite Valley, June 20-July 2, 1927**

Determined from actual observation of browsing deer

| Common name | Scientific name | Number of deer browsing on plants | Total deer minutes* |
|---|---|---|---|
| Yard grass | *Polygonum aviculare* | 19 | 404 |
| Meadow fescue | *Festuca elatior* | 27 | 362 |
| Spanish clover | *Lotus americanus* | 27 | 345 |
| Western choke cherry | *Prunus demissa* | 10 | 38 |
| California black oak | *Quercus kelloggii* | 13 | 18 |
| Kentucky blue grass | *Poa pratensis* | 8 | 13 |
| Curly dock | *Rumex crispus* | 8 | 11 |
| Horseweed | *Erigeron canadensis* | 2 | 5 |
| Green manzanita | *Arctostaphylos patula* | 3 | 3½ |
| Deer brush | *Ceanothus integerrimus* | 3 | 3 |
| Creek dogwood | *Cornus californica* | 1 | 2 |
| California wild rose | *Rosa californica* | 1 | 2 |
| Bigelow sneezeweed | *Helenium bigelovii* | 2 | 2 |
| Innocence | *Collinsia tinctoria* | 2 | 1½ |
| California laurel | *Umbellularia californica* | 3 | 1½ |
| Canyon live oak | *Quercus chrysolepis* | 1 | 1 |
| Gooseberry | *Ribes roezlii* | 1 | 1 |
| Black cottonwood | *Populus trichocarpa* | 1 | 1 |
| Yellow monkey flower | *Mimulus rimuloides* | 1 | 1 |
| Staghorn lichen | *Unsea* | 1 | 1 |
| Laceweed | *Gayophytum ramosissimum* | 1 | 1 |
| Blue curls | *Trichostema oblongum* | 1 | ½ |
| Total number deer watched | | 136 | |
| Total actual grazing time (deer minutes) | | | 1217¾ |

*In computing "deer minutes," the number of deer observed feeding upon any one species of plant is multiplied by the number of minutes spent in feeding. Thus, if two deer browse on curly dock, each for a period of five minutes, the result would be totaled as: curly dock, 10 minutes.

NOTE.—Careful watch was kept to see if any of the deer ate plants said to be poisonous to domestic cattle or sheep. Azalea and larkspur, both said to be poisonous, were not only present but abundant. Cow parsley, said to be nonpoisonous, was also abundant but I have never, during over 100 hours of close observation, seen a mule deer eat any of these plants when green.

In Yosemite on June 21, 1927, from five to six o'clock in the evening, California mule deer were seen eating the following: Deer brush, eaten twice by three deer, total time, 3 minutes; green manzanita, eaten twice by two deer, total time, 1½ minutes; tender leaves of California black oak, eaten three times by three deer, total time, 4 minutes; horse mint, eaten by three deer, total time, 2 minutes. From six to seven o'clock, the four deer fed in the open meadow. Here, meadow fescue grass was the favorite food, being eaten by all four deer for a total time of 60 minutes. The deer fed with their heads down in the grass (see Fig. 82), which was in bloom, nipping off the young, short, tender blades. They did not nip off the heads or tops of the grass as

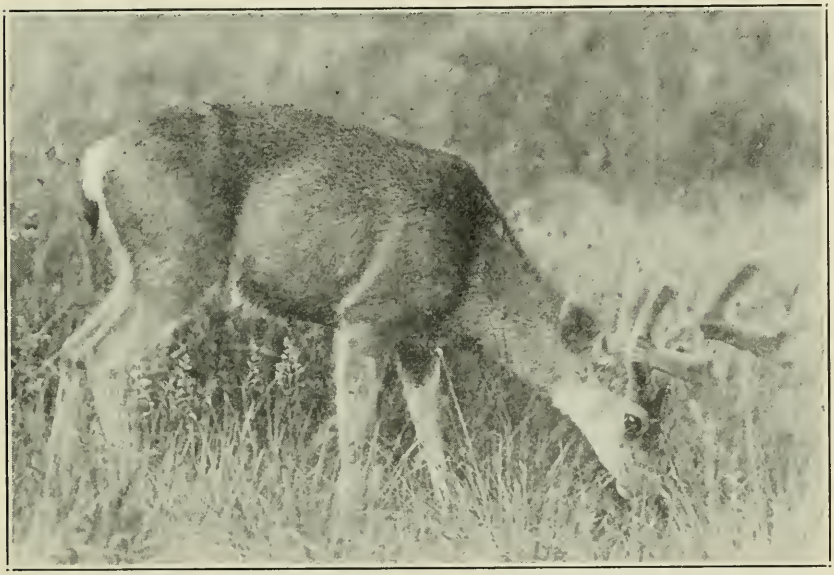

Fig. 119. A buck feeding on deervetch or Spanish clover. This legume is of outstanding importance among all native plants as summer food for mule deer in Yosemite. Wildlife Division No. 213.

horses and cattle often do. This fact might easily lead one to believe that the deer were not eating grass, but close watch at a distance of 20 feet showed positively that it was being eaten.

Near Royal Arches at 6.30 p.m. on June 23, 1927, several deer were feeding on closely grazed open grass land, so that a clear view could be had. At 20 feet, it was possible, with binoculars, to see clearly that the deer were eating young tender blades of meadow fescue grass exclusively.

On June 24, 1927, in Yosemite, I quietly followed a certain buck at a distance of 10 to 15 feet, when I could see even without binoculars, that he was feeding entirely on yard grass. At this time, all the other deer fed greedily on green leaves on a branch freshly broken from a California black oak.

On June 26, 1927, at seven o'clock in the morning, just before the sun struck the meadow, seven deer were feeding on a low lupine-like plant known as Spanish clover or deervetch (*Lotus americanus*) (see Fig. 119). This legume is, among all native herbs, the most important and is more sought for by California mule deer than any other summer forage plant, a fact that should not be lost sight of in deer management.

On June 26, 1927, I watched and photographed a doe that found a Pacific plum sapling that was out of her reach and "rode" it down, holding the branch with her neck while she ate the green leaves. On the same day at eleven o'clock, on a talus slope near Mirror Lake, I followed a fine sleek buck as he returned twice in 15 minutes and browsed on the green pungent leaves of the California laurel or bay

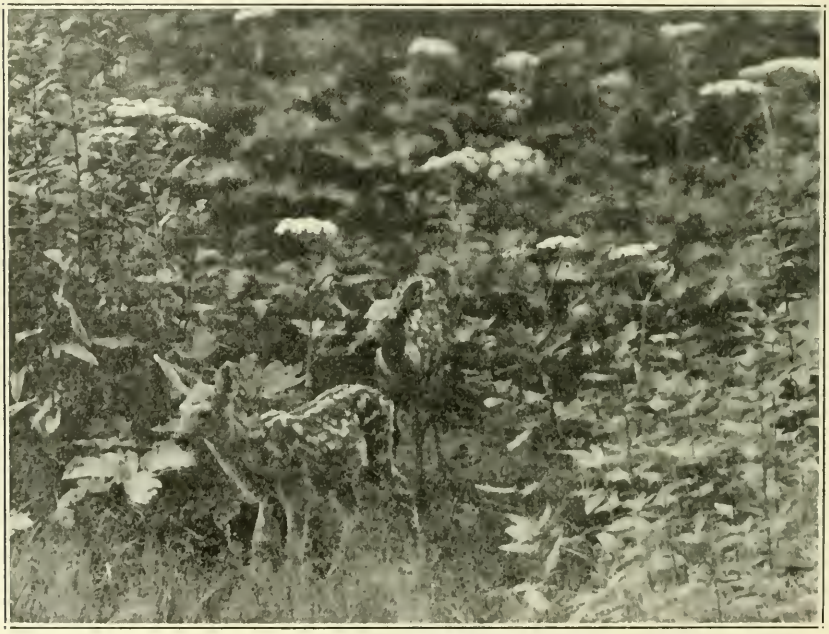

FIG. 120. These twin fawns hid in a patch of cow parsley and tried to eat grass when four weeks old. Sequoia National Park, August 9, 1933. Wildlife Division No. 3100.

tree (see Fig. 75). Many hunters have told me that this was one tree that deer never eat!

On June 27, 1927, in Yosemite, I found a fine California mule deer buck busily feeding on meadow fescue grass (see Fig. 82). At this time mule deer seem to prefer deervetch and yard weed to other forage in the early morning. Meadow fescue and other grasses were eaten regularly in the evening; thus five deer were each seen to eat meadow fescue grass for as long as 10 minutes at a stretch.

On July 9, 1928, at 5.30 in the morning at the foot of Royal Arches, I found two does feeding on meadow fescue and velvet grass. One of these deer was seen to browse on canyon live oak for two minutes but she stopped twice and took a single bite out of a yerba santa shrub.

On July 10, 1928, at Yosemite, a fawn known to be just thirty hours old, was seen to try to eat the tender young blades of meadow fescue. A single blade was with difficulty nipped off, and several moments were spent in trying to chew it without success. The fawn then turned its attention to some dark dry soil and ate several mouthfuls of it, possibly for the mineral salts it contained. On August 9, 1933, at Round Meadow in Sequoia National Park a pair of spotted fawns about a month old hid in a patch of cow parsley (see Fig. 120) and tried to eat green grass.

I have noted many times that just a few days before they give birth to their fawns, mule deer does search for and eat extra large amounts of green willow leaves. This habit has been noted several

FIG. 121. This pregnant doe ate large quantities of elderberry blossoms just before her fawn was born. Yosemite, July 6, 1929. Wildlife Division No. 200.

times in Yosemite and particularly in Sequoia National Park, in 1933 where I watched nine does that were about to give birth to young. I think that this preference for a diet of willow and other leaves at this particular time helps in some way to prepare the does for the fawn's birth; for as soon as the fawns are born and begin to nurse the does at Sequoia ceased hunting willow leaves and ate a large diet of succulent green grass possibly to produce a good milk supply. In another case at Yosemite on July 6, 1929, I watched a California mule deer doe that was unusually heavy with fawn, as she browsed ravenously on a

velvet elderberry bush. She appeared particularly to crave the clusters of elderberry blossoms devouring four great clusters in as many minutes (see Fig. 121).

On July 2, 1929, I was catching grasshoppers in the meadow to feed to a young California pygmy owl when a pregnant doe heavy with fawn, came up and begged to be fed. My young daughter asked me to give this deer some grasshoppers to eat. I replied that deer were vegetarians, but when I held out a nice, fat grasshopper, the doe came up and took it, chewed it awhile and then swallowed it. She then followed me begging for more. I gave her two more grasshoppers which she ate with avidity. She later ate both grasshoppers and green katydids but seemed to prefer the grasshoppers. Her unusual appetite may have been due to her pregnant condition.

Fig. 122. This large yellow evening primrose is a favorite food of mule deer and has, through deer eating it, become almost extinct in Yosemite Valley, outside of fenced areas. Yosemite, July 10, 1928. Mus. Vert. Zool. No. 5778.

In Yosemite on July 6, 1929, I watched one doe that made a special hunt for young seedlings of the California black oak hidden under a thick carpet of fallen leaves. During one 20-minute period, 7.50 to 8.10 a.m., I found that she located the hidden seedlings by aid of her nose. These oak seedlings were then about three inches high, above the acorn, and the tap root extended down about the same distance. The doe sought and ate the sprouted acorn, both halves of which remained tightly attached to the middle stem of the seedlings. In 20 minutes this doe found eleven oak seedlings and ate the sprouted acorns from all of them. In six instances the seedlings were pulled up and destroyed.

In Yosemite Valley when I first visited it, nearly 20 years ago, deer were rare there and in certain spots great fields of tall yellow evening primrose covered large areas (see Fig. 122). There were originally acres of evening primroses in Yosemite Valley. As the mule deer increased, under total protection, they ate more and more of the primrose plants until by 1929, I was able in two weeks' search to find less than six plants outside of fenced gardens. Even in the native wild flower garden at the Ahwahnee Hotel, protected by a supposedly deer-proof fence, I found that with all sorts of native grasses, clovers and herbs present, the deer that managed to "overcome" the fence,

first sought out, ate and destroyed all of the evening primrose plants. They next attacked and ate most of the leaves and tender shoots of a bed of thimble-berry bushes that had been carefully reared there.

On July 16, 1927, I photographed a large four-point buck that was making a meal of the tender, growing frond tips of the common brake or fern (see Fig. 123). The tips of this fern are eaten regularly by California mule deer.

Mule deer browse some even in mid-summer. This was demonstrated by a doe observed and photographed on July 1, 1927, while she was browsing in a thicket of western choke cherry (see Fig. 124),

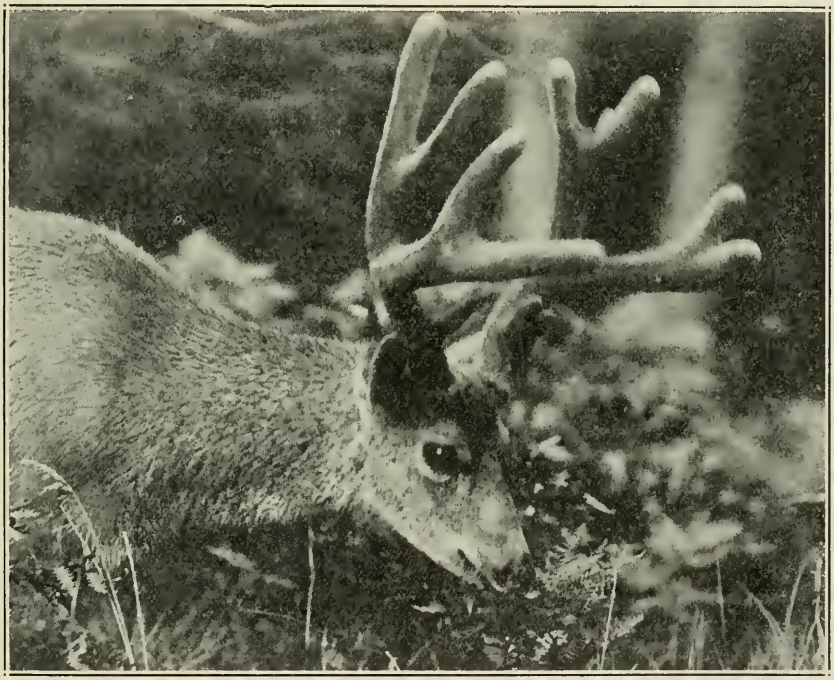

FIG. 123. The tender growing tips of the common brake fern are regularly eaten by mule deer as here shown. Yosemite, July 16, 1928. Mus. Vert. Zool. No. 5709.

and also by a buck which was photographed while he was browsing on a willow on July 4, 1929 (see Fig. 126).

On July 23, 1929, at an altitude just under 10,000 feet at the western base of Mount Dana, I found fresh tracks of six deer, all being of medium size with no large tracks of bucks. By following these tracks I found freshly cropped vegetation which showed that the deer had browsed along the edge of a green meadow and had eaten both grass and shrubs particularly certain alpine willows. In the Mount Whitney region on August 23, on a divide at the very head of Kern River, I found where a large Inyo mule deer buck had crossed a divide at 12,150 feet coming over from the east side. Here again

certain low alpine willows had been browsed so that a decided preference appears to be shown for such shrubs in late summer at high altitudes in the Sierra Nevada.

### FALL

I have found that mule deer in California feed heaviest upon weeds during the fall months. The term "weeds" is here used in the agricultural sense, referring to certain herbs which seriously interfere with agricultural pursuits. Mule deer are fond of many species of such "weed" plants which the rancher or orchardist considers as

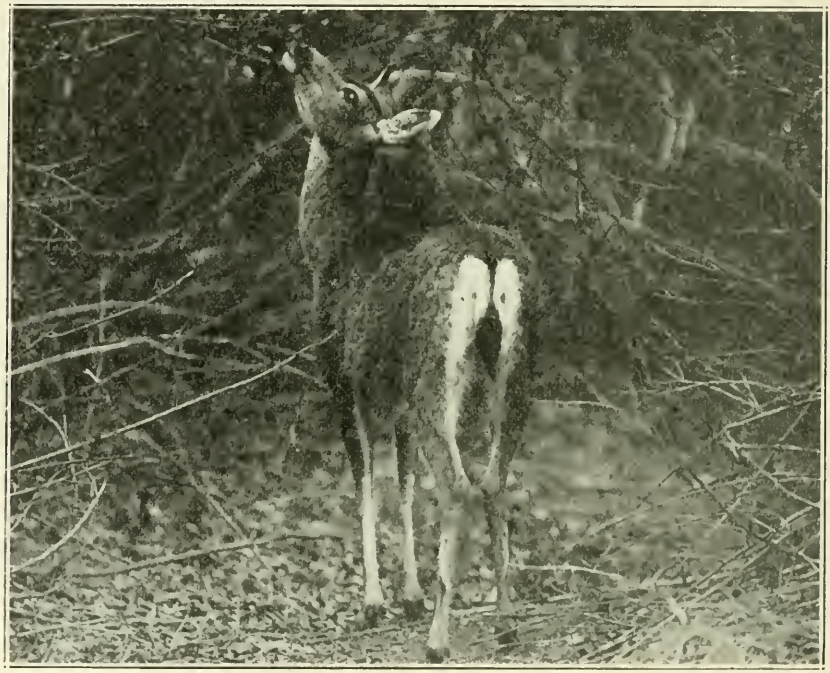

FIG. 124. A California mule deer doe browsing on western choke cherry. Note that all leaves have been eaten to a height of 54 inches. Yosemite, July 1, 1927. Mus. Vert. Zool. No. 5404.

nuisances. Weeds such as tumble-weed, horseweed and curly dock are kept pruned back by deer, the repeated nippings keeping a fresh supply of tender growth coming on in the dry season especially in late summer and early fall when green food is at a premium. Golden rod, sagewort, mugwort and even that fern pest, the common bracken, are all eaten extensively in the early fall. Even milkweed is then eaten.

Among the shrubs we find that buck brush and snow brush which have been lightly utilized during the summer are heavily utilized by mule deer in the fall. In many instances, I have found that poison oak, gooseberry bushes and especially Nevada currant bushes are most heavily consumed by mule deer in the early fall.

The following table has been selected as showing typical food preferences of California mule deer in September.

**TABLE B**

**Food Preferences of California Mule Deer, Yosemite, September 13–18, 1927**

Determined by actual observation of deer eating each plant.

| Plant and scientific name | No. of deer seen eating this plant | | Total deer minutes |
|---|---|---|---|
| Deer brush, *Ceanothus integerrimus* | 5 | does | 150 |
| Velvet grass, *Notholcus lanatus* | 20 | bucks, does, many fawns | 95 |
| Dragon sagewort, *Artemisia dracunculus* | 20 | bucks, does | 90 |
| California black oak, *Quercus kelloggii* | 6 | does, fawns | 90 |
| Western golden rod, *Solidago occidentalis* | 15 | bucks, does | 60 |
| Tumble-weed, *Amaranthus graecizans* | 4 | does | 60 |
| California mugwort, *Artemisia heterophylla* | 8 | bucks, does | 55 |
| Common golden rod, *Solidago californica* | 10 | bucks, does | 30 |
| Lessingia, *Lessingia leptoclada* | 5 | does | 30 |
| Western choke cherry, *Prunus demissa* | 3 | does | 30 |
| (Wire) buckwheat, *Eriogonum virgatum* | 4 | does | 20 |
| (Slender) buckwheat, *Eriogonum nudum* | 3 | does | 16 |
| Creek dogwood, *Cornus c. californica* | 2 | does | 10 |
| Milkweed, *Asclepias cordifolia* | 2 | does, buck | 10 |
| Horseweed, *Erigeron canadensis* | 1 | fawn | 10 |
| Common brake, *Pteris aquilina* | 2 | bucks | 5 |
| Curly dock, *Rumex crispus* | 1 | doe | 5 |
| Mountain hemp, *Apocynum androsaemifolium* | 2 | | 2 |
| Canyon live oak, *Quercus chrysolepis* | 1 | buck | 2 |
| Gooseberry, *Ribes roezlii* | 1 | doe | 2 |
| Meadow fescue, *Festuca elatior* | 5 | fawns | |
| Total deer watched | 120 | | |
| Total actual grazing time (deer minutes) | | | 850 |

In the Lassen section, at 6600 feet on Warner Creek in Shasta County, on September 24, 1923, I found that nearly all of the Rocky Mountain mule deer were feeding on currant bushes which grew abundantly on rocky talus slopes. Earlier in the season these currant bushes had been little eaten by the deer but as soon as the leaves began to turn yellow in the fall, then they were eagerly sought for and devoured in great quantities. At this same date mule deer in the Lassen Peak region were starting to browse heavily on snow brush and huckleberry oak. One large buck, killed by a local hunter, had his stomach nearly full of finely-chewed huckleberry oak leaves. In the late fall at Eagle Lake, Lassen County, considerable tobacco brush is eaten by Rocky Mountain mule deer.

On October 7, 1924, five miles north of Fredonyer Peak in Lassen County, I followed a large Rocky Mountain mule deer buck for several hours as he leisurely fed in early morning across a sage-covered flat. He had browsed along eating the leaves of antelope brush in preference to all other forage, with mountain mahogany second choice. On October 15, 1924, at Observation Peak, in extreme eastern Lassen County I found that mule deer were feeding almost entirely on mountain mahogany which grew abundantly there. On the California-Nevada State line north of Observation Peak, I found that antelope brush (*Purshia*)

known locally as "buck" brush grew abundantly and served as the principal food of Rocky Mountain mule deer in that region in late fall and winter.

On September 24, 1924, at Hackamore Reservoir in Modoc County, I examined two dead Rocky Mountain mule deer, a four-point buck and a doe, and found their stomachs over half full of mud that they had eaten. Vegetation found in these deer stomachs consisted of service berry leaves, 20 per cent; and manzanita leaves, 20 per cent; mud, 60 per cent, made up the rest of the stomach contents. Stomach contents of a dead fawn at this locality consisted almost entirely of manzanita leaves. The intestines of these two adult deer contained only mud which may have been eaten because of the lack of salt.

FIG. 125. California mule deer doe eating tumble-weed. Mule deer are fond of many agricultural weeds, especially in late summer and early fall. Yosemite, September 15, 1927. Mus. Vert. Zool. No. 5500.

In Yosemite, on September 15, 1927, four California mule deer does were watched and photographed as they returned repeatedly to browse on a green tumble-weed (see Fig. 125). Another doe nearby was found feeding on the leaves and twigs of a gooseberry bush (see Fig. 127). At this time in Yosemite, mule deer were feeding more extensively on deer brush than on any other forage plant (see Fig. 128).

This greatly increased use of *Ceanothus* by mule deer in the fall has been noted and recorded by the writer dozens of times in the Lassen, Yosemite and Sequoia sections of the Sierra Nevada as well as in the mountains of southern California. It is my conclusion, after 30 years' experience, that *Ceanothus* is without doubt the most important genus of forage plants for deer in California. Wm. A. Dayton, in his *Important Western Browse Plants* (Miscellaneous Publication No. 101, July, 1931, U. S. D. A.) considers *Ceanothus integerrimus* as "probably the most important single browse species in California." It has been my experience that this holds for deer, as well as for cattle and sheep. However, several other species of *Ceanothus* are nearly as important to mule deer as *integerrimus*. As authorities do not agree on common names for *Ceanothus* I am forced here to use scientific names in order to be definite. In the Lassen, Yosemite and even in Sequoia sections *Ceanothus cordulatus* known as snow brush or white thorn is abundant over hundreds of square miles, being more abundant, if not

FIG. 126. California mule deer browsing on green willow leaves. Yosemite, July 4, 1929. Wildlife Division No. 214.

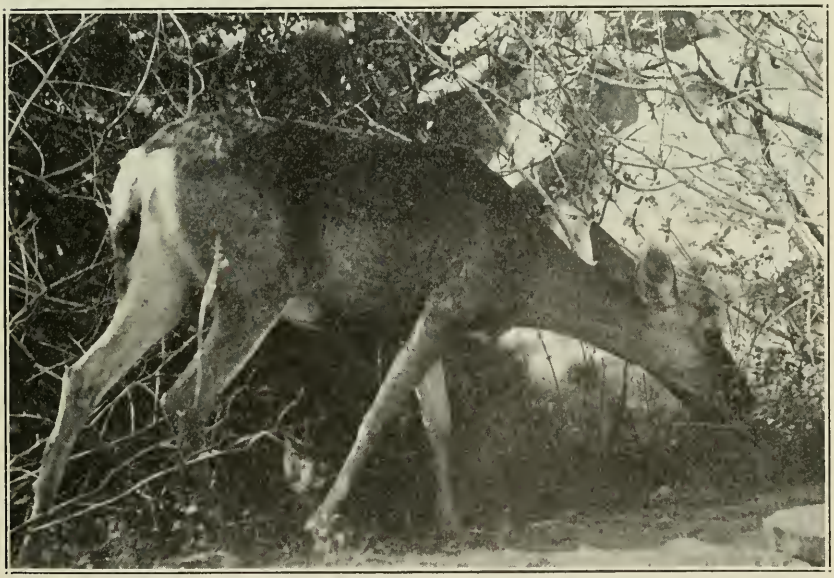

FIG. 127. This mule deer doe fed regularly on gooseberry bushes in the fall. Yosemite, September 15, 1927. Mus. Vert. Zool. No. 5497.

quite so palatable, as *integerrimus*. As far as deer are concerned, I can not agree with Dayton's statement, p. 108, that *cordulatus* is "distinctly inferior as a browse." In southern California *Ceanothus divaricatus* is an important browse shrub for southern mule deer. It has been my experience that in Lassen and Modoc counties, tobacco brush (*Ceanothus velutinus*) is eaten rather extensively at times in the fall by Rocky Mountain mule deer so I can not agree with Dayton's statement, p. 110, that this species is "except for limited use by goats, worthless as browse." Another species of deer brush (*C. diversifolius*) is an important browse shrub but grows at the lower elevations and hence is used chiefly by Columbian black-tailed deer.

FIG. 128. Mule deer browse lightly on *Ceanothus integerrimus* in summer but utilize it heavily in the fall and early winter as here shown. Yosemite, September 15, 1927. Mus. Vert. Zool. No. 5498.

Among the California mule deer in Yosemite, I find that utilization of such plants as sneezeweed, horseweed and California mugwort is most marked in September (see Fig. 129). Even milkweed leaves which had remained untouched all summer were eagerly sought for when killed by frost in the fall (see Fig. 118). By September, fruits of Pacific service berry, bitter cherry and other shrubs become ripe and are eaten extensively at times. Acorns begin to mature and drop at this season but although they are eaten extensively in late fall by mule deer, they become more important in early and late winter. Among the several varieties of oak trees that provide acorns (see tables), I would

place California black oak and scrub oak among the first with canyon live oak and California blue oak in secondary rank. Huckleberry oak is more utilized for its leaves than for its acorns.

In early fall, green grass and other succulent herbage is especially important to fawns that are being weaned. On September 18, 1927, in Yosemite, I watched two spotted fawns feeding by themselves in the edge of the meadow. Their mother had slipped away in an effort to wean them. The fawns were hungry and selected the tenderest grass blades which were eaten exclusively (see Fig. 102). The middle of September, or weaning time, is an important period in the life of a mule deer fawn. When a doe begins to wean her fawn, if a suitable supply of green grass or other green forage is absent it frequently

Fig. 129. A California mule deer buck eating sneezeweed and horseweed. Yosemite, September 14, 1927. Mus. Vert. Zool. No. 5479.

means that the fawn will continue to nurse and thus will be a drag on its mother and both she and fawn enter the winter in poor condition and in several known instances did not survive (see Fig. 103).

On October 31, 1929, in Yosemite, I watched a large four-point buck for an hour as he picked up stray tufts of grass that had been hidden and covered by fallen leaves. I was surprised to find that 60 per cent of what he ate during the hour consisted of fallen leaves of California black oak, many of which had just been blown off the trees. Many brown dry oak leaves were also eaten. Acorns of the California black oak were eagerly sought for and formed 30 per cent of the food eaten during the hour. Considerable fresh green grass was also eaten.

I found that the mule deer were able to tell and reject faulty *i.e.* wormy or blank acorns without even touching them.

In Sequoia National Park, I observed that squaw-root (*Carum gairdneri*) often known in the West as "Queen Anne's lace," and is quite different from "Queen Anne's lace" of eastern United States, and grows abundantly in both Round Meadow and Crescent Meadow forming a white "bedspread" over the meadows. Late in September, 1933, the white flowering heads of this plant were extensively eaten by mule deer.

### WINTER

Winter months constitute the lean season for mule deer. By the first part of the winter, the deer have usually come down from the

FIG. 130. Buck eating *dead* sedge *in winter*. Sedge was rarely eaten in summer. Sequoia National Park, December 18, 1929. Wildlife Division No. 210.

high summer range and are found at low altitudes in the foothills. Normally, the seasonal fall rains insure a good growth of fresh annual grasses in the foothills by December and this green food supply is heavily utilized to supplement their diet of browse. This heavy utilization of green grass in early winter by both California and southern mule deer has been set forth at length under the chapter on "Deer as Eaters of Grass." It may seem paradoxical, but fresh green grass is an important and regular article of diet of mule deer in winter in central and southern California.

For the Rocky Mountain mule deer which winter east of the Sierra Nevada, green grass is in winter just a memory. In Sequoia National Park, on December 18, 1929, I explored an acre thicket of

snow brush (*Ceanothus cordulatus*) that grew on a warm, sunny slope high on a warm ridge. There was a dense thicket of bitter cherry growing just below the snow brush but the deer, two big bucks, two does and three fawns, were all browsing on the leaves and twigs of snow brush. In a meadow nearby the mule deer were eating large quantities of dead, soggy *Carex* stalks. These deer had used this sedge only at rare intervals while it was green and growing, but in the fall after the sedge had become dry and frosted and then soaked up for several weeks by rain and snow until it had become soft like ensilage the deer ate it greedily (see Fig. 130). Does, bucks and fawns all were observed to eat the dead moist stalks of sedge (*Carex*) that had been killed by frost and matted down in shallow water.

Typical food preferences of mule deer at Giant Forest, observed on December 18, 1929, were as follows:

2 does ate sedge (*Carex*) 50 deer minutes.
1 buck ate sedge (*Carex*) 20 deer minutes.
2 does ate snow brush (*C. cordulatus*) 90 deer minutes.
3 fawns ate snow brush (*C. cordulatus*) 90 deer minutes.
2 bucks ate snow brush (*C. cordulatus*) 120 deer minutes.
1 fawn ate chinquapin (leaves) 15 minutes.
2 does, 1 buck and 2 fawns ate staghorn lichen.

Staghorn lichen or unsea moss is an important winter food. Repeated observations in winter revealed that even fawns nibble the moss from fallen limbs and in several instances I have seen deer expectantly waiting until they heard the crash of a fallen limb, whereupon they went directly to the spot and ate the lichen (see Fig. 117). The lichen has an acid flavor not unpleasant to the taste.

In both Sequoia and Yosemite, as well as in San Diego County, I have observed that in January the dead, dry leaves of the California black oak are seldom eaten. However, as soon as it rains or snows and these leaves become moist and soften a bit, the deer eat them in large quantities. Leaves that become matted down and moist from contact with the damp ground are often pawed or rooted up and eaten. Even the fawns locate and eat these leaves after rooting about in the snow (see Fig. 74). The older deer sometimes paw the snow away in order to get at both dead leaves and acorns. On January 30, 1929, in the Yosemite region, I found that acorns from California black oaks formed the chief diet. These acorns were sought for amid the fallen leaves by bucks, does and fawns. The deer are evidently able to detect defective acorns, for without fail I found that a wormy acorn or a blank acorn that contained no meat was always rejected. As a test I experimented by throwing a handful of good acorns broadcast on the ground where the earth was already littered with blank or defective ones. The good acorns were picked out unerringly by the deer while I observed them with binoculars. Now and then a deer would miss a good acorn, but it did not pick up the blank acorns, not touching or coming within

four or five inches of them. I could not tell the good acorns by looking at them or by smelling them but had to test them by weight, but the mule deer know their acorns. Many of the does hunted for acorns at the margins of melting snow banks (see Fig. 131).

In eating acorns, the deer pick them up daintily taking care that no gravel, sticks or stones are included. The acorn is then munched carefully and in from 30 to 60 seconds the hull or outside covering is dropped, sometimes in two or three large pieces, but usually in several smaller ones. The meat of the acorn is then chewed into a fine pulp and swallowed. Old bucks appear to be most appreciative of acorns

Fig. 131. Many deer hunt in late winter for fallen acorns at the margins of melting snow banks, as here shown. Yosemite, January 30, 1929. J. S. Dixon No. 1.

but does and fawns spend considerable time hunting for them under snow and dead weed stalks (see Fig. 132). If they get their nose within four inches of an acorn they usually locate it, but at times they miss good acorns in plain sight within a foot of their nose.

I found that buck brush (*C. cuneatus*) is utilized heavily by mule deer in winter when heavy snows crowd them down into the lower winter range. Yerba santa is likewise largely browsed at this season, many of the bushes being stripped of all their leaves and even all of the twigs and shoots to the size of a lead pencil are eaten. Most of the yerba santa bushes are not browsed on to any extent until heavy snows

come when the deer go after them in earnest. One buck on January 31, 1929, spent 15 minutes at a stretch nibbling at twigs of a yerba santa bush.

Green manzanita bushes are likewise heavily utilized in winter and on January 31, 1929, I found that many of these were being stripped of all foliage up to a height of 60 inches which is about as high as a deer can reach with his front feet on the ground.

Scrub oak is another important food plant in winter. Acorns are usually a heavy crop on scrub oaks and these together with the leaves of this oak are in my experience about the best and most dependable food supply of southern mule deer in winter.

A study of the food habits of burro deer which I made late in December, 1930, in the Chocolate Mountains showed that these were feeding along the desert washes chiefly on palo verde, ironwood (*tesota*), catclaw and mistletoe. Previous investigation along the Colorado River near Blythe, determined that in the fall burro deer feed extensively on the pods and leaves of honey mesquite.

FIG. 132. Doe and fawn hunting for acorns under snow and amid dead weed stalks. Yosemite, December 9, 1932. Mus. Vert. Zool. No. 5642.

## SPRING

In late winter and early spring, California mule deer feed largely on willows, of several species, as well as manzanita and certain coniferous trees such as white fir, incense cedar and western yellow pine. Acorns of the California black oak are important in spring as are also tender blades of newly sprouted wild oats and annual grasses.

The following notes were taken March 28, 1930, in Yosemite.

| | Eaten by | Total deer minutes |
|---|---|---|
| Meadow fescue and wild oats | 6 deer | 30 |
| Meadow fescue | 6 deer | 90 |
| Wild oats | 6 deer | 90 |
| Willow (fallen branch) | 3 deer | 9 |

On April 29, 1929, in Yosemite, I saw mule deer eat:

| | Eaten by | Total deer minutes |
|---|---|---|
| California black oak (acorns) | 8 deer | 80 |
| Western choke cherry (green shoots) | 2 deer | 16 |
| Meadow fescue (3 inches high) | 12 deer | 1080 |
| California laurel (leaves) | 1 deer | 3 |
| Green manzanita (leaves) | 2 deer | 5 |
| Willows (green twigs and buds) | 10 deer | 70 |

FIG. 133. A buck mule deer browsing on Mariposa manzanita. Yosemite, March 29, 1930. Wildlife Division No. 786.

On this date, I found all of the does and fawns hunting acorns under the black oaks at the edge of the meadow. They went about rooting amid dead fallen leaves for acorns that had recently been uncovered by the melting snow banks. Willow twigs were much sought for at this time. The willows had not yet leafed out but the deer were making special efforts, many of them standing up on their hind legs and breaking down the taller branches so as to feed on the yellow buds. In certain instances the deer were seen to straddle and ride down slender saplings or to hold a branch down with their necks while feeding on the willow buds.

On March 28, 1930, in Yosemite at 8.35 a.m., I watched an old buck browse on the lower branches of a young white fir. This buck reached up and at one time stood goat-fashion, with his front feet placed on a horizontal limb, browsing to a measured height of 66 inches. This buck then stood up on his hind legs and getting his neck over some of the lower, limber branches, held them down while he bit off the tender tips. When these branches were finally released, they sprang back to their natural position eight feet above the ground.

On March 30, 1930, I found a young western yellow pine about 30 inches tall that had been repeatedly browsed by mule deer so that no needles were left (see Fig. 116) and the tree had died.

On March 26, 1929, deer in Yosemite were found to be feeding largely on mistletoe that had been knocked or blown off the California

Fig. 134. A California mule deer doe climbing up to browse on green leaves of manzanita which is chiefly utilized in winter. Yosemite, March 29, 1930. Wildlife Division No. 564.

black oaks. On April 6, 1929, deer were seen eating incense cedar boughs and green manzanita. On March 27, 1930, in Yosemite, one mule deer was seen browsing on Douglas fir for three minutes and another one fed on white fir for a similar period. On this day, practically all of the deer in Yosemite were observed to be feeding largely on grass just starting to grow. At 6.30 o'clock on the morning of March 28, 1930, I counted 23 California mule deer out feeding along the edge of the meadow. I watched one buck, 2 does and 3 fawns closely and found that they spent all of their time feeding on warm, sunny exposures under the oaks where wild oats and other annual

grasses grew from 2 to 2½ inches high. They fed exclusively on these grasses. On March 29, 1930, at 6.15 in the morning, I watched an old buck browse continuously for eleven minutes on the leaves of the Mariposa manzanita. The lower limbs had all been stripped of leaves to a height of 60 inches so that the buck had to stretch to the utmost to

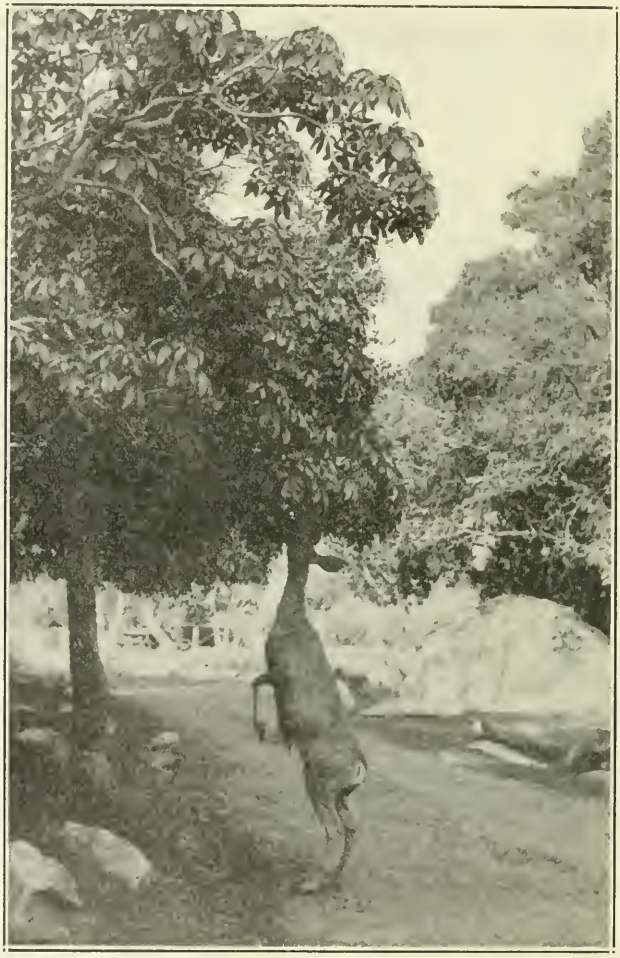

Fig. 135. A California mule deer doe standing on her hind legs to browse on green leaves of California buckeye. Sequoia National Park, April 21, 1933. Wildlife Division No. 2990.

reach fresh forage (see Fig. 133). A few minutes later I watched an old doe browse for seven minutes at a time on green manzanita (see Fig. 134). The Mariposa manzanita was the commoner form at this particular point, and nearly every clump of it was browsed as high as deer could reach keeping their feet on the ground. The manzanitas

are too stiff and too brittle for the deer to "ride" down as they do the willow saplings.

At Hospital Rock in Sequoia National Park on April 21, 1933, I watched a doe repeatedly stand up on her hind legs in order to eat fresh, green leaves of the California buckeye (see Fig. 135). This unusual food preference was apparently due to the overbrowsed condition of the range at that place as I have rarely found deer eating buckeye leaves until they become yellow and drop from the trees.

### COMPETITION WITH HORSES, CATTLE, SHEEP AND GOATS

Some claim that there is little or no competition for food between mule deer and domestic stock. Those who have studied the matter thoroughly think otherwise. Dr. A. W. Sampson, a recognized authority, in his investigation of food habits of deer in California, found that in 46 species, embracing 6 genera, of food plants eaten by deer that 38, or 82 per cent, are palatable to sheep; 33 or 71 per cent are of value as food for goats; 25 or 54 per cent are eaten by cattle and 16 or 34 per cent are grazed by horses.

My own conclusions coincide quite closely with Dr. Sampson's except that I find that if we consider the utilization of trees such as scrub oak and such thorny shrubs as gooseberry and *Ceanothus*, then food preferences of mule deer are most nearly like those of goats. Among the herbs, there is serious competition between deer and sheep and there is competition in the grasses between both horses and cattle and deer. Turning to the genus *Ceanothus* which is, I believe, correctly evaluated by Dayton in his *Important Western Browse Plants*, p. 106, as the "most important single browse species in California," we agree that mule deer prize and utilize this shrub to even a greater extent than do either cattle or sheep. The same, in my experience, is true of antelope brush or bitter-brush (*Purshia tridentata*) which probably shares second place with western choke cherry and Pacific service berry and creek dogwood. These last three species are utilized much more by mule deer than by cattle or sheep and with better results since I have never known a mule deer to suffer any poisonous effect from eating any of them.

**ESTIMATED PALATABILITIES**

| | U. S. Forest Service | | Dixon, Yosemite |
|---|---|---|---|
| Grasses | Cattle | Sheep | Deer |
| *Agrostis*, Red-top grass | 80 | 50 | 70 |
| *Poa*, Blue grass | 90 | 70 | 70 |
| *Phleum*, Timothy | 90 | 70 | 65 |
| **Herbs** | | | |
| *Achillea*, Yarrow | 20 | 40 | 50 |
| *Aster*, Aster | 20 | 40 | 50 |
| *Heracleum*, Cow parsnip | 30 | 70 | 10 |
| *Heuchera*, Alum root | 0 | 10 | 30 |

| Shrubs | U. S. Forest Service Cattle | U. S. Forest Service Sheep | Dixon Yosemite Deer |
|---|---|---|---|
| *Amelanchier*, Service berry | 50 | 70 | 75 |
| *Ceanothus*, Deer brush | 80 | 85 | 90 |
| *Cornus*, Dogwood | 5 | 10 | 30 |
| *Populus*, Aspen | 50 | 50 | 60 |
| *Prunus*, Choke cherry | 30 | 30 | 75 |
| *Ribes*, Gooseberry | 10 | 20 | 30 |
| *Salix*, Willow | 30 | 70 | 40 |

Mule deer in California utilize heavily both *Ceanothus cuneatus* and *Ceanothus cordulatus*. Dayton reports, p. 111, that where *cuneatus* has been "grazed extensively, it has a bad effect on the animal's kidneys, especially the male live stock." No such ill effect on mule deer, which feed extensively on these species in fall and winter, has been found by me.

Since it has been definitely shown that deer and domestic stock, particularly sheep and goats, do compete seriously for food or browse on the range, this fact should be fully considered in any proposed plan of range management of our National forests, National parks and on the public domain.

### CULTIVATED CROPS EATEN BY MULE DEER IN CALIFORNIA

It has been my experience that most of the damage caused by deer to cultivated crops in California is due to depredations of Columbian and southern black-tailed deer rather than mule deer. This is due to the fact that for the most part, mule deer live in rough mountainous areas at higher altitudes where there is a minimum of farming operations. The mule deer is also wilder by nature and has not had such close association with man as has the coast black-tailed deer.

However, damage to deciduous orchards, to vineyards, to truck and to other field crops is sometimes caused by both California and southern mule deer. Most of such damage known to me has been in the foothill sections of the southern Sierra Nevada and in the mountainous parts of San Diego County where I spent several years on a mountain fruit ranch.

Items are here listed in order of frequency of attacks: Among orchard crops, prune, apple, pear, apricot, peach, cherry, plum and almond trees were known to be eaten and damaged by mule deer. Prune trees suffered most severely.

Among truck crops, watermelons, casabas, cantaloupes, squash, corn, cabbage, carrots, potatoes and beans were the main items damaged by deer.

Among forage crops, alfalfa, clover, vetch, oats, barley and wheat.

Among vineyard crops, mission and other wine grapes suffered most followed by tokay, muscat and Thompson seedless. Eastern table grapes such as Concord and Isabella, suffered least of all.

For a full discussion of this subject of *Damage by Deer to Crops in California* see CALIFORNIA FISH AND GAME, April, 1932, pp. 136–147.

## GAME MANAGEMENT

Game management is primarily concerned in securing sustained annual crops of wild game for recreational use. In order to accomplish this, we must know the life history, food habits and other requirements of the game species to be produced.

In general, it may be said that food, shelter and safe breeding places are three most essential requirements. In the case of mule deer in California we must consider in our game management plan:

1. Control of hunting.
2. Control of predatory animals.
3. Control of food and water.
4. Control of disease and parasites.
5. Control of game refuges and cover.
6. Competition with domestic cattle, sheep and goats.

I feel that control of hunting is fairly well provided for under our existing California game laws, but constant watch must be kept to see that closed seasons, bag limit and laws preventing killing of does and fawns are observed by hunters. It may become necessary to reduce the bag limit to one buck per season in districts 4, 4½ and 4¾.

In regard to control of predatory animals, the fine work that has been done by State Lion Hunter Jay Bruce and other men together with the substantial bounty paid on mountain lions by our California Fish and Game Commission has, I believe, been of greatest importance. In southern California, certain counties have paid an additional bounty which has brought the total up to over $50 per lion so that it is believed that this greatest natural enemy of the mule deer is adequately cared for.

Experience may show that further control of coyotes on the "fawning grounds" of the mule deer in California may be good game management. In so far as concerns mule deer, I doubt if any further control of wildcats and golden eagles is justifiable at this time.

It has been my experience that in the Modoc region development and protection of the relatively scant water supply is highly desirable since in many places living springs are rare and far apart. There are, in my experience, many areas in this region that would support a decidedly larger deer population if an adequate water supply could be provided. Ten miles is about the maximum distance that mule deer naturally forage from water and I believe that for best results the "cruising radius" of mule deer should be less than five miles.

Under present grazing practice the salt logs which are provided on the range for domestic sheep and cattle automatically provide sufficient salt for deer also. However, I believe that on game refuges and elsewhere where salting of domestic stock is not practiced, salt logs should be provided especially for deer.

The tragic experience and slaughter of over 22,000 deer in the Stanislaus National Forest which were infected with the foot-and-mouth disease from range cattle should be a constant warning to us of

dangers from such sources. The ordinary diseases and parasites of mule deer are relatively difficult to treat and to control, but epizootics of foot-and-mouth disease in our wild deer of California are probably preventable, since they were unknown among our native deer prior to their introduction by infected domestic stock.

Control and maintenance of the range is of most vital importance. In reality our capital game investment lies in the range or food supply of our mule deer. If the carrying capacity and productivity of the range is kept up to a high standard, it will be possible to maintain a good annual crop. Therefore, an equitable division of forage, particularly of browse, must be made between domestic stock and wild deer. If the range is allowed to be depleted as on the Kaibab Plateau by both domestic stock and deer, it will take years to restore the forage. All of the deer in the world will avail us but little if we lack forage and range to sustain them.

## EXPLANATION OF FOOD TABLES

In the following tables, I have tried to give in condensed form, the main points of interest relating to some 200 different kinds of trees, shrubs, herbs, sedges, grasses and fungi known to have been eaten by mule deer in California. To some this may seem a large number of food plants for one kind of deer to eat, but several geographic races and several life zones are involved. Although the data here presented represent many years of close observation of food habits, I doubt if I have discovered half of the plant species that are eaten by mule deer in California.

I expect that the experience of other observers may vary from mine. I have several times been ready, after months of observation, to conclude that a certain plant was rarely, if ever, eaten by mule deer. Then going out at some unusual season, I have found this same plant highly utilized as food. To get a true estimate of relative values of food plants, the observer must follow the deer every month in the year.

In compiling these tables I have followed: Sudworth, *Check List of the Forest Trees of the United States*, U. S. D. A., Misc. Circ. No. 92, March, 1927, with supplemental list for trees. For all other plants, I have tried to follow Jepson's *Manual of the Flowering Plants of California*, 1925. Among the herbs, it frequently happened that Jepson gave only the scientific name of the plant, no common name being given. In a few instances of this sort, I have had to use the best common name that I could find. In one or two instances, notably in the genus *Lotus* I have rebelled and have used the name "deerveteh" because of the great importance of this genus as forage for mule deer in California.

In the tables, "Chief Seasonal Use" does not mean that the plant is not used at other seasons. Availability is based upon relative abundance and accessibility of a given plant within the range of the mule deer in California. Thus an annual that might be abundant in summer on the winter range of mule deer might have little importance

as food because of the animals being absent at that season in the higher mountains.

Under "Locality," I have given a main use locality. In some instances, utilization may have been noted in a dozen different localities.

"Relative Importance" of a forage plant is based upon all of the above factors and is given as the writer's opinion in the last column.

TABLE I

TREES BROWSED BY VARIOUS RACES OF MULE DEER IN CALIFORNIA

| Name | Parts eaten | Locality and chief seasonal use | Availability | Palatability | Relative importance |
|---|---|---|---|---|---|
| Western white pine, *Pinus monticola* | Needles and terminal tips | Sequoia, summer | Medium | Low | Slight |
| Sugar pine, *Pinus lambertiana* | New needles and terminal shoots | Yosemite, fall | Common | Low | Slight |
| Singleleaf pinon, *Pinus monophylla* | Needles, nuts and branch tips | Mono Lake, fall | Medium | Low | Slight |
| Foxtail pine, *Pinus balfouriana* | Needles and branch tips | Sequoia, summer | Medium | Low | Slight |
| *Western yellow pine, *Pinus ponderosa* | Needles and terminal tips | Yosemite, winter | Common | Fair | Fair |
| Jeffrey pine, *Pinus jeffreyi* | Needles and terminal tips | Sequoia, summer | Common | Low | Slight |
| Lodgepole pine, *Pinus contorta* | Needles and terminal tips | Lassen, summer | Common | Low | Slight |
| Digger pine, *Pinus sabiniana* | Needles and terminal tips | Yosemite, winter | Common | Low | Slight |
| Coulter pine, *Pinus coulteri* | Needles | San Diego, winter | Rare | Low | Slight |
| Douglas fir, *Pseudotsuga taxifolia* | Needles and branch tips | Yosemite, fall | Common | Low | Slight |
| *White fir, *Abies concolor* | Needles and branch tips | Sequoia, fall | Common | Fair | Fair |
| California red fir, *Abies magnifica* | Needles | Sequoia, summer | Medium | Low | Slight |
| Big tree, *Sequoia washingtoniana* | Terminal tips | Sequoia, summer | Rare | Low | Slight |
| Incense cedar, *Libocedrus decurrens* | Tips of branches | Yosemite, spring | Common | Fair | Fair |
| Western juniper, *Juniperus occidentalis* | Tips of branches | Lassen, winter | Common | Low | Slight |
| *Aspen, *Populus tremuloides* | Leaves, buds, sprouts | Sequoia, fall | Common | Good | Fair |
| Black cottonwood, *Populus trichocarpa* | Leaves, buds, sprouts | Yosemite, spring | Medium | Fair | Fair |
| Dudley willow, *Salix gooddingii* | Leaves and sprouts | Yosemite, spring | Common | Fair | Fair |
| Red willow, *Salix laevigata* | Leaves and sprouts | Yosemite, spring | Common | Fair | Fair |
| Western black willow, *Salix lasiandra lancifolia* | Leaves and shoots | Sequoia, spring | Common | Fair | Fair |
| Narrowleaf willow, *Salix exigua* | Buds | Mono Lake, spring | Medium | Fair | Slight |
| White willow, *Salix lasiolepis* | Leaves, buds | Sequoia, spring | Common | Fair | Fair |
| Scouler willow, *Salix scouleriana* | Buds, leaves | Yosemite, spring | Medium | Fair | Fair |
| Mountain alder, *Alnus tenuifolia* | Buds, leaves | Lassen, summer | Medium | Low | Slight |
| White alder, *Alnus rhombifolia* | Leaves, shoots | Yosemite, fall | Medium | Low | Slight |
| Golden chinquapin (?), *Castanopsis chrysophylla* | Leaves | Sequoia, fall | Common | Fair | Fair |
| Tan oak, *Lithocarpus densiflora* | Leaves, acorns | Yosemite, winter | Rare | Good | Slight |
| *California black oak, *Quercus kelloggii* | Leaves, acorns, seedlings | Yosemite, winter | Common | Excellent | Great |

| | | | | | |
|---|---|---|---|---|---|
| Highland live oak, *Quercus wislizenii* | Leaves, acorns | Sequoia, winter | Medium | Good | Fair |
| Canyon live oak, *Quercus chrysolepis* | Leaves, acorns | Yosemite, winter | Medium | Good | Fair |
| *Huckleberry oak (?), *Quercus vaccinifolia* | Leaves, acorns | Lassen, fall | Medium | Excellent | Great |
| *California scrub oak, *Quercus dumosa* | Leaves, tips, acorns | San Diego, winter | Common | Excellent | Great |
| California blue oak, *Quercus douglasii* | Leaves, twigs, acorns | Sequoia, winter | Common | Good | Fair |
| Valley white oak, *Quercus lobata* | Leaves, acorns | Sequoia, winter | Medium | Good | Fair |
| California laurel, *Umbellularia californica* | Leaves | Yosemite, spring | Medium | Low | Slight |
| Christmas berry, *Heteromeles arbutifolia* | Leaves, twigs | Yosemite, winter | Medium | Fair | Slight |
| *Pacific service berry, *Amelanchier florida* | Leaves, twigs, fruit | Yosemite, fall | Common | Excellent | Great |
| *Curl-leaf mountain mahogany, *Cercocarpus ledifolius* | Leaves, twigs | Lassen, winter | Common | Good | Great |
| Birch-leaf mountain mahogany, *Cercocarpus betuloides* | Leaves, twigs | Sequoia, fall | Medium | Good | Fair |
| Pacific plum, *Prunus subcordata* | Leaves, twigs, fruit | Yosemite, fall | Medium | Fair | Fair |
| *Bitter cherry, *Prunus emarginata* | Leaves, twigs, fruit | Sequoia, fall | Common | Good | Great |
| *Western choke-cherry, *Prunus v. demissa* | Leaves, twigs, fruit | Yosemite, fall | Common | Good | Great |
| Catclaw, *Acacia greggii* | Leaves, twigs, pods | Chocolate Mts., fall | Rare | Fair | Slight |
| *Honey mesquite, *Prosopis j. glandulosa* | Leaves, twigs, pods | Colorado River | Medium | Excellent | Great |
| Screw-bean, *Prosopis odorata* | Leaves, twigs, beans | Chocolate Mts., fall | Medium | Excellent | Fair |
| California red-bud, *Cercis occidentalis* | Leaves, twigs | Yosemite, winter | Rare | Low | Slight |
| Paloverde, *Cercidium torreyanum* | Twigs | Chocolate Mts., winter | Common | Good | Fair |
| *Tesota, *Olneya tesota* | Leaves, twigs, pods | Chocolate Mts., winter | Common | Good | Great |
| Dwarf maple, *Acer glabrum* | Sprouts, leaves, twigs | Sequoia, fall | Common | Fair | Fair |
| California buckeye, *Aesculus californica* | Dead leaves (chiefly) | Sequoia, fall | Common | Fair | Fair |
| Cascara, *Rhamnus purshiana* | Leaves, berries | Yosemite, fall | Medium | Fair | Fair |
| Spiny myrtle, *Ceanothus spinosus* | Leaves, twigs | San Diego, winter | Medium | Fair | Fair |
| Pacific dogwood, *Cornus nuttallii* | Leaves | Sequoia, fall | Medium | Low | Slight |
| Madrono, *Arbutus menziesii* | Leaves | Yosemite, winter | Rare | Low | Slight |
| *Velvet elder, *Sambucus velutina* | Fruit, leaves, flowers | Yosemite, summer | Medium | Good | Great |

NOTE.—Species followed by (?) are classed by Sudworth as trees although their normal growth in California is that of shrubs.
*Considered to be of outstanding importance as browse for mule deer in California.

TABLE II

SHRUBS OR BRUSH BROWSED BY VARIOUS RACES OF MULE DEER IN CALIFORNIA

| Name | Parts eaten | Locality and chief seasonal use | Availability | Palatability | Relative importance |
|---|---|---|---|---|---|
| Mexican tea, *Ephedra californica* | Twigs | San Diego County, winter | Rare | Low | Slight |
| Longleaf willow, *Salix melanopsis* | Twigs | Sequoia, spring | Medium | Fair | Slight |
| Coyote willow, *Salix argophylla* | Leaves, twigs | Mono Lake, summer | Medium | Low | Slight |
| Silver willow, *Salix g. argentea* | Leaves, twigs | Sequoia, summer | Rare | Low | Slight |
| Mono willow, *Salix p. monica* | Twigs | Mono Lake, summer | Medium | Fair | Slight |
| Alpine willow, *Salix petrophila* | Twigs | Sequoia, summer | Rare | Low | Slight |
| Lemmon's willow, *Salix lemmonii* | Twigs | Yosemite, summer | Medium | Low | Slight |
| Sierra willow, *Salix commutata* | Leaves, twigs | Sequoia, summer | Rare | Low | Slight |
| California hazel, *Corylus r. californica* | Twigs, leaves | Yosemite, fall | Medium | Low | Slight |
| Quail brush, *Atriplex lentiformis* | Twigs | Colorado River, winter | Medium | Fair | Fair |
| Virgin's bower, *Clematis ligusticifolia* | Shoots | Sequoia, spring | Rare | Low | Slight |
| Spice bush, *Calycanthus occidentalis* | Twigs | Sequoia, spring | Medium | Low | Slight |
| Barberry, *Berberis californica* | Leaves | Yosemite, winter | Rare | Low | Slight |
| Golden currant, *Ribes aureum* | Berries, leaves | Lassen, fall | Medium | Fair | Fair |
| Currant, *Ribes viscosissimum* | Leaves | Yosemite, fall | Rare | Low | Slight |
| *Nevada currant, *Ribes nevadensis* | Berries, leaves | Lassen, fall | Common | Fair | Fair |
| Gooseberry, *Ribes velutinum* | Leaves | Mono Lake, summer | Rare | Low | Slight |
| *Gooseberry, *Ribes roezlii* | Leaves | Yosemite, fall | Common | Fair | Fair |
| Cream bush, *Holodiscus discolor* | Twigs | Mt. Whitney, fall | Common | Fair | Slight |
| Desert-sweet, *Chamaebatiaria millefolium* | Twigs | Mt. Whitney, summer | Medium | Low | Slight |
| *Thimble-berry, *Rubus parviflorus* | Leaves | Yosemite, summer | Medium | Good | Fair |
| Western raspberry, *Rubus leucodermis* | Leaves | Sequoia, fall | Medium | Low | Slight |
| Rose, *Rosa californica* | Leaves | Yosemite, summer | Medium | Fair | Fair |
| *Antelope brush, *Purshia tridentata* | Twigs, leaves | Lassen, winter | Common | Excellent | Great |
| Poison oak, *Rhus diversiloba* | Leaves | Yosemite, fall | Common | Low | Slight |
| Squaw bush, *Rhus trilobata* | Leaves | San Diego, fall | Rare | Low | Slight |
| Deer brush, *Ceanothus diversifolius* | Twigs, leaves | Lassen, fall | Medium | Fair | Fair |
| Tobacco brush, *Ceanothus velutinus* | Twigs, leaves | Lassen, fall | Common | Fair | Fair |

| | | | | | |
|---|---|---|---|---|---|
| Sweet birch, *Ceanothus parvifolius* | Twigs, leaves | Yosemite, fall | Medium | Good | Fair |
| *Deer brush, *Ceanothus integerrimus* | Twigs, leaves | Yosemite, fall | Common | Excellent | Great |
| *Deer brush, *Ceanothus divaricatus* | Twigs, leaves | San Diego, winter | Common | Excellent | Great |
| Deer brush, *Ceanothus tomentosus* | Twigs, leaves | Stanislaus, winter | Rare | Good | Slight |
| *Snow-brush, *Ceanothus cordulatus* | Twigs, leaves | Yosemite, Lassen, fall | Common | Good | Great |
| *Buck-brush, *Ceanothus cuneatus* | Twigs, leaves | Yosemite, Sequoia, winter | Common | Good | Great |
| Deer brush, *Ceanothus rigidus frcsnensis* (var) | Leaves | Sequoia, fall | Medium | Good | Fair |
| Mahala mat, *Ceanothus prostratus* | Twigs, leaves | Lassen, winter | Medium | Good | Fair |
| Deer brush, *Ceanothus crassifolius* | Leaves | San Diego, winter | Common | Good | Fair |
| Flannel bush, *Fremontia californica* | Leaves | Sequoia, spring | Medium | Low | Slight |
| Buffalo berry, *Shepherdia argentea* | Leaves | Mt. Pinos, fall | Rare | Low | Slight |
| Silk tassel, *Garrya veatchii* | Leaves | San Diego, winter | Medium | Low | Slight |
| *Creek dogwood, *Cornus californica* | Twigs, leaves | Yosemite, Sequoia, all seasons | Common | Good | Great |
| Great-berried manzanita, *Arctostaphylos glauca* | Leaves | San Diego, winter | Common | Fair | Fair |
| Mariposa manzanita, *Arctostaphylos mariposa* | Leaves | Yosemite, winter | Medium | Fair | Slight |
| *Green manzanita, *Arctostaphylos patula* | Leaves | Yosemite, winter, spring | Common | Good | Great |
| Pine-mat manzanita, *Arctostaphylos nevadensis* | Leaves | Yosemite, fall, spring | Medium | Fair | Fair |
| Eastwood manzanita, *Arctostaphylos glandulosa* | Leaves | San Diego, winter | Medium | Fair | Slight |
| Manzanita, *Arctostaphylos drupacea* | Leaves | San Diego, winter | Medium | Fair | Fair |
| Yerba santa, *Eriodictyon californicum* | Shoots, leaves | Yosemite, summer | Medium | Fair | Fair |
| Snow berry, *Symphoricarpos albus* | Shoots, leaves | Yosemite, fall | Medium | Low | Slight |
| Chaparral honeysuckle, *Lonicera interrupta* | Shoots, leaves | Sequoia, summer | Medium | Low | Slight |
| Common sagebrush, *Artemisia tridentata* | Twigs, leaves | Modoc, winter | Common | Low | Fair |
| Black sagebrush, *Artemisia arbuscula* | Twigs, leaves | Modoc, winter | Medium | Low | Slight |
| Sagebrush, *Artemisia norvegica* | Leaves | San Diego, winter | Medium | Low | Slight |

TABLE III

HERBS EATEN BY VARIOUS RACES OF MULE DEER IN CALIFORNIA

| Name | Parts eaten | Locality and chief seasonal use | Availability | Palatability | Relative importance |
|---|---|---|---|---|---|
| Corn lily, *Veratrum californicum* | Leaves | Sequoia, fall | Common | Low | Slight |
| Yellow mariposa, *Calochortus lutcus* | Flowers | Yosemite, spring | Common | Fair | Slight |
| Sego lily, *Calochortus nuttallii* | Flowers | Mono Lake, summer | Medium | Fair | Slight |
| Knotweed,[1] *Polygonum bistortoides* | Leaves | Yosemite, summer | Rare | Low | Slight |
| Lady's thumb,[1] *Polygonum persicaria* | Leaves | Yosemite, summer | Rare | Fair | Slight |
| *Yard grass,[1] *Polygonum aviculare* | Tips of stems | Yosemite, summer | Medium | Excellent | Great |
| *Curly dock,[1] *Rumex crispus* | Stalks, leaves | Yosemite, summer | Common | Good | Great |
| Sheep sorrel,[1] *Rumex acetosella* | Leaves | Yosemite, summer | Common | Good | Fair |
| Desert trumpet, *Eriogonum inflatum* | Stems | Chocolate Mts., fall | Common | Fair | Fair |
| Buckwheat, *Eriogonum thurberi* | Stem tips | San Diego, fall | Medium | Low | Slight |
| *(Tall) buckwheat, *Eriogonum nudum* | Tips, flowers | Yosemite, summer | Common | Excellent | Great |
| (Wire) buckwheat, *Eriogonum virgatum* | Flowers, stems | Yosemite, summer | Common | Fair | Fair |
| White pigweed,[1] *Chenopodium album* | Leaves | Yosemite, summer | Medium | Fair | Slight |
| Tumble-weed,[1] *Amaranthus graecizans* | Stems | Yosemite, summer | Common | Good | Fair |
| Common purslane,[1] *Portulaca oleracea* | Stems | Yosemite, summer | Rare | Fair | Slight |
| Columbine, *Aquilegia truncata* | Stems, leaves | Sequoia, summer | Common | Low | Slight |
| Columbine, *Aquilegia pubescens* | Stem tips | Yosemite, summer | Rare | Low | Slight |
| Western buttercup, *Ranunculus occidentalis* | Leaves | Yosemite, summer | Medium | Low | Slight |
| Flix-weed,[1] *Sisymbrium ineisum* | Stem tips | Yosemite, summer | Medium | Fair | Slight |
| *Common yellow mustard,[1] *Brassica campestris* | Leaves, stems | Yosemite, summer | Common | Good | Fair |
| Black mustard,[1] *Brassica nigra* | Leaves | Yosemite, summer | Medium | Low | Slight |
| Rock cress, *Arabis cognata* | Leaves | Yosemite, summer | Rare | Low | Slight |
| Western wall flower, *Erysimum asperum* | Leaves, stems | Yosemite, summer | Common | Fair | Fair |
| Alum root, *Heuchera mierantha* | Leaves, stems | Yosemite, fall | Medium | Good | Fair |

| | | | | | |
|---|---|---|---|---|---|
| Five finger, *Potentilla g. nevadensis* | Stems, buds | Yosemite, summer | Medium | Low | Slight |
| Five finger, *Potentilla campestris* | Stems | Sequoia, summer | Medium | Low | Slight |
| Lupine, *Lupinus bicolor* | Leaves | Stanislaus, spring | Rare | Low | Slight |
| Lupine, *Lupinus concinnus* | Leaves | San Diego, spring | Rare | Low | Slight |
| Lupine, *Lupinus latifolius* | Leaves | Yosemite, fall | Rare | Low | Slight |
| *Bur clover, *Medicago hispida* | Leaves, burs | Yosemite, spring | Common | Good | Fair |
| Medick, *Medicago apiculata* | Leaves, stems | Stanislaus, spring | Rare | Fair | Slight |
| Black medick, *Medicago lupulina* | Leaves | Yosemite, spring | Rare | Fair | Slight |
| Sweet clover, *Melilotus alba* | Leaves, stems | Yosemite, spring | Rare | Fair | Slight |
| Sweet clover, *Melilotus indica* | Leaves, stems | Yosemite, spring | Rare | Fair | Slight |
| Creek clover, *Trifolium obtusiflorum* | Leaves | Stanislaus, spring | Medium | Low | Slight |
| Cow clover, *Trifolium involucratum* | Leaves | Yosemite, summer | Medium | Fair | Fair |
| Carpet clover, *Trifolium monanthum* | Leaves | Yosemite, summer | Rare | Fair | Slight |
| Tree clover, *Trifolium ciliatum* | Leaves | Stanislaus, spring | Medium | Fair | Fair |
| White clover, *Trifolium repens* | Leaves | Yosemite, summer | Medium | Good | Fair |
| Clover, *Trifolium lemmonii* | Leaves | Mono Lake, summer | Rare | Fair | Slight |
| Red clover, *Trifolium pratense* | Leaves | Yosemite, summer | Rare | Good | Fair |
| Deervetch, *Lotus micranthus* | Leaves, stems | Sequoia, spring | Medium | Fair | Fair |
| Deervetch, *Lotus subpinnatus* | Leaves, stems | Yosemite, summer | Medium | Good | Fair |
| *Spanish clover, *Lotus americanus* | Leaves, stems | Yosemite, summer | Common | Excellent | Great |
| American vetch, *Vicia americana* | Leaves | Yosemite, summer | Medium | Good | Fair |
| Campo pea, *Lathyrus splendens* | Leaves, flowers | San Diego, spring | Common | Good | Fair |
| White-stem filaree, *Erodium moschatum* | Leaves, stems | Yosemite, winter | Common | Good | Fair |
| *Filaree, *Erodium botrys* | Leaves, stems | Stanislaus, winter | Common | Good | Fair |
| Red-stem filaree, *Erodium circutarium* | Leaves, stems | Sequoia, winter | Common | Fair | Fair |
| Godetia, *Godetia dudleyana* | Tips | Yosemite, summer | Common | Fair | Slight |
| *Evening primrose, *Oenothera hookeri* | Leaves, tips | Yosemite, summer | Medium | Good | Great |
| Fire-weed, *Epilobium latifolium* | Leaves, tips | Mono Lake, summer | Medium | Fair | Fair |
| Squaw-root, *Carum gairdneri* | Flowers | Sequoia, fall | Common | Fair | Fair |
| Laceweed, *Gayophytum ramosissimum* | Flowers | Yosemite, summer | Common | Low | Slight |
| Cow parsnip, *Heracleum lanatum* | Dead leaves | Yosemite, fall | Common | Low | Slight |
| Mountain hemp, *Apocynum androsaemifolium* | Leaves | Yosemite, summer | Medium | Low | Slight |
| Indian hemp, *Apocynum cannabinum* | Leaves | Yosemite, summer | Medium | Low | Slight |
| Milkweed,[1] *Asclepias cordifolia* | Dead leaves | Yosemite, fall | Medium | Fair | Fair |
| Squaw lettuce, *Hydrophyllum occidentale* | Leaves | Sequoia, summer | Rare | Low | Slight |
| Blue curls,[1] *Trichostema oblongum* | Leaves | Yosemite, summer | Rare | Low | Slight |
| Horse mint, *Agastache urticifolia* | Stem tips | Yosemite, fall | Medium | Low | Slight |
| Hedge nettle, *Stachys albens* | Tips | Yosemite, summer | Medium | Low | Slight |

| Name | Parts eaten | Locality and chief seasonal use | Availability | Palatability | Relative importance |
|---|---|---|---|---|---|
| Nightshade,[1] *Solanum villosum* | Leaves | Yosemite, summer | Rare | Low | Slight |
| Monkey-flower, *Mimulus nanus* | Stems | Yosemite, spring | Rare | Low | Slight |
| Monkey-flower, *Mimulus mephiticus* | Shoots | Yosemite, summer | Medium | Low | Slight |
| Yellow monkey-flower, *Mimulus moschatus* | Stems | Yosemite, summer | Medium | Fair | Slight |
| Common monkey-flower, *Mimulus guttatus* | Leaves | Yosemite, summer | Common | Fair | Fair |
| Indian paint brush, *Castilleia parviflora* | Leaves, flowers | Lassen, summer | Rare | Low | Slight |
| Scarlet cup, *Castilleia affinis* | Leaves, flowers | Yosemite, summer | Rare | Low | Slight |
| English plantain,[1] *Plantago lanceolata* | Leaves | Yosemite, summer | Medium | Fair | Fair |
| False dandelion, *Agoseris grandiflora* | Leaves, stalks | Yosemite, summer | Common | Good | Fair |
| Bigelow sneezeweed,[1] *Helenium bigelovii* | Leaves, tips | Yosemite, summer | Common | Low | Slight |
| Western golden rod, *Solidago occidentalis* | Leaves, tips | Yosemite, fall | Common | Fair | Fair |
| Common golden rod, *Solidago californica* | Leaves, tips | Yosemite, fall | Common | Low | Slight |
| Yarrow, *Achillea millefolium* | Green tips | Yosemite summer | Medium | Low | Slight |
| Lessingia, *Lessingia leptoclada* | Stems | Yosemite, fall | Medium | Fair | Fair |
| California mugwort,[1] *Artemisia v. heterophylla* | Leaves | Yosemite, fall | Common | Good | Fair |
| Dragon sagewort,[1] *Artemisia dracunculus* | Leaves | San Diego, fall | Medium | Low | Slight |
| Senecio, *Senecio triangularis* | Stems | Sequoia, fall | Medium | Low | Slight |
| Senecio, *Senecio lugens* | Stems, tips | Yosemite, fall | Medium | Low | Slight |
| Horseweed,[1] *Erigeron canadensis* | Stem tips | Yosemite, fall | Common | Fair | Fair |

[1] Sometimes considered as weeds in the agricultural sense.

## TABLE IV

### GRASSES AND SEDGES EATEN BY VARIOUS RACES OF MULE DEER IN CALIFORNIA

| Name | Parts eaten | Locality and chief seasonal use | Availability | Palatability | Relative importance |
|---|---|---|---|---|---|
| Red brome, *Bromus rubens* | Sprouting blades | Stanislaus, spring | Rare | Low | Slight |
| Ripgut grass, *Bromus rigidus* | Tender blades | Yosemite, winter, spring | Common | Fair | Fair |
| Soft cheat, *Bromus hordeaceus* | Tender blades | Yosemite, winter, spring | Common | Fair | Fair |
| Brome grass, *Bromus arenarius* | Tender blades | Stanislaus, spring | Rare | Low | Slight |
| Fescue, *Festuca pacifica* | Blades | Stanislaus, summer | Medium | Fair | Fair |
| Fescue, *Festuca confusa* | Blades | Stanislaus, summer | Medium | Fair | Fair |
| Fescue, *Festuca grayi* | Blades | Yosemite, summer | Rare | Fair | Slight |
| *Meadow fescue, *Festuca clatior* | Blades | Yosemite, all seasons | Common | Excellent | Great |
| *Kentucky blue grass, *Poa pratensis* | Blades | Yosemite, summer | Medium | Good | Fair |
| Slender wheat grass, *Agropyron tenerum* | Blades | Yosemite, spring | Rare | Fair | Slight |
| Western rye grass, *Elymus glaucus* | Blades | Yosemite, spring | Medium | Low | Slight |
| Squirrel-tail barley,[1] *Hordeum jubatum* | Tender blades | Yosemite, winter, spring | Common | Low | Slight |
| *Wild oat, *Avena fatua* | Tender blades | Yosemite, winter, spring | Common | Good | Fair |
| Mountain timothy, *Phleum alpinum* | Blades | Yosemite, summer | Rare | Fair | Slight |
| Velvet grass, *Notholcus lanatus* | Blades | Yosemite, summer | Medium | Fair | Fair |
| Sedge, *Hemicarpha occidentalis* | Stalks | Yosemite, fall | Rare | Low | Slight |
| Saw-grass, *Cladium mariscus* | Green stems | Yosemite, spring | Medium | Low | Slight |
| Foothill sedge, *Carex tumulicola* | Stems | Stanislaus, fall | Medium | Fair | Fair |
| Western sedge, *Carex feta* | Dead stems | Sequoia, winter | Medium | Good | Fair |
| Soft sedge, *Carex disperma* | Stems | Mono Lake, summer | Medium | Low | Slight |
| Sedge, *Carex yosemitana* | Stems | Yosemite, fall | Medium | Fair | Fair |
| Sedge, *Juncus mertensianus* | Stems | Yosemite, fall | Rare | Low | Slight |

[1] Often regarded as an agricultural weed.

TABLE V

MISCELLANEOUS FOODS EATEN BY VARIOUS RACES OF MULE DEER IN CALIFORNIA

| Name | Parts eaten | Locality and chief seasonal use | Availability | Palatability | Relative importance |
|---|---|---|---|---|---|
| Cotton fern, *Notholaena newberryi* | Fronds | San Diego, winter | Medium | Low | Slight |
| Bracken, *Pteris aquilina* | Fronds, young tips | Yosemite, summer | Common | Fair | Fair |
| Coffee fern, *Pellaea andromedaefolia* | Frond tips | San Diego, winter | Medium | Low | Slight |
| Grasshopper | Whole insect | Yosemite, summer | Medium | Fair | Slight |
| Mistletoe, *Phoradendron* (sp?) | Branches | Yosemite, winter | Medium | Fair | Fair |
| Fungi, Scaly lentinus, *Lentinus lepidens* | Crown and stalk | Yosemite, summer | Medium | Good | Fair |
| Fungi, *Clavaria formosa* | Crown | Lassen, summer | Rare | Good | Slight |

# FOURTH ANNUAL BLACK BRANT CENSUS IN CALIFORNIA

*By* James Moffitt

The fourth annual census of black brant, *Branta bernicla nigricans,* was made in California February 10 to 12, inclusive, 1934. Results of the three previous censuses have been reported upon by the writer in California Fish and Game as follows: vol. 17, 1931, pp. 396–401; vol. 18, 1932, pp. 298–310; vol. 19, 1933, pp. 255–263.

The 1934 census was, in many respects, the most satisfactory one made to date. The cooperators felt that the counts that they made in California this year were the most accurate ones secured during this work. This year, for the first time since this work was undertaken, other states interested themselves in it and censuses were made in Oregon and Washington coincident with ours. The results of these counts are recorded in this paper and serve to provide a much more intelligible idea of the entire Pacific Coast brant population than could California censuses alone portray.

The census of black brant on Mission and San Diego bays was made by Game Warden E. H. Glidden, assisted by Clinton G. Abbott, Director of the San Diego Natural History Museum, and A. Muelheisen of that city on February 10, 1934. Most of the day was devoted to taking the census, the greater part being spent on Mission Bay. Tides for the day in San Diego Bay were as follows: high tide, 5.56 a.m., 6.1 feet; low tide, 1.30 p.m., –1.0 feet. The tides on Mission Bay were one and one-half hours later. This party recorded 154 brant on Mission Bay and seven birds were seen on San Diego Bay on the mud flat on the east side northwest of the old cotton seed plant. The total number of brant observed in this region therefore was 161 birds.

The writer took the census on Morro Bay the same day where he was assisted by Game Warden F. W. Hecker and Dr. A. P. Marshall, of San Luis Obispo. The count was commenced at 7.40 a.m. and completed at 10.10 a.m. and was made from an outboard motorboat. The day was clear and calm and the excellent weather materially assisted in permitting us to secure what we all agreed was a very accurate record of the number of brant present on Morro Bay that day, a total of 3895 individuals. The tides on Morro Bay February 10, 1934, were as follows: high tide, 7.24 a.m., 6.0 feet; low tide, 2.59 p.m., –1.3 feet. During the course of census taking, a close watch was kept for brant flying between the Bay and the ocean but as no bird was seen to do so we concluded that all the brant of the immediate vicinity were in the Bay as inspection of the calm ocean from the sand dunes on the beach failed to reveal a brant on its glassy surface. However, there may have been some brant on the coast that day a few miles to the northward as Game Warden Hecker and fishermen told of numbers that they had seen feeding in the kelp on the ocean off Cayucos a few days previous. According to fishermen and local residents, it is an annual custom for the brant to feed in the ocean in this vicinity, a few miles northward from

Morro Bay, at this season, but they do not resort to this coast before early February so whatever feed it is that draws them there is probably not available or suitable before that time. We regretted very much our inability, on account of lack of time, to visit this part of the coast that day to count the birds. This should be done in taking future brant censuses in the region when it would be highly desirable to ascertain what factor is responsible for the birds' presence there.

Censuses were made in 1934 at the same time on Drakes, Tomales and Bodega bays in order to eliminate the possibility of birds shifting from one to another of these neighboring bodies of water which fact suggested itself in 1933 when the census on Tomales Bay was taken two days later than were the counts on Drakes and Bodega bays.

T. T. McCabe, Berkeley, California, again took the census on Drakes Bay, this being the third year in which he has counted the brant there on February 11. This year he was assisted by J. E. Cushing, Jr., San Francisco. The tides on Drakes Estero (for map see CALIFORNIA FISH AND GAME, vol. 18, 1932, p. 302) were approximately the same as those listed in the following paragraph for Tomales Bay. The census was taken from 9 a.m. to 1.45 p.m. during which period a strong southwest wind was blowing causing whitecaps to form on the Estero and the birds to be restless. This condition rendered making an exact count impossible, but the cooperators felt that they secured a reasonably accurate census notwithstanding. No count was attempted on Estero de Limantour and the results obtained apply solely to Drakes Estero where a total of 2189 brant was noted by the census takers.

The writer's attempt to count the brant on Tomales Bay the morning of February 11, 1934, from an outboard motorboat was frustrated by a balky motor so an estimate of the birds' numbers was made from shore from seven to ten o'clock. This count netted 5238 brant, but was feared to be low because the wind that hindered McCabe's and Cushing's work on Drakes Bay was also blowing on Tomales Bay where it made accurate counting difficult and working from shore by necessity made it hard to count brant on the opposite (westerly) shore, where, fortunately however, no birds were seen with the glasses. About 2 p.m the southwest wind that had been blowing strongly all morning, suddenly ceased and the brant all congregated in large flocks in smooth water between Hamlet and Toms Point on the eastern shore of the Bay where they were easy to count accurately from shore (see map, CALIFORNIA FISH AND GAME, vol. 18, 1932, p. 301). Here 5565 individuals were recorded between 2.45 and 4 p.m., which number was thought to represent more accurately the total number of brant present on Tomales Bay that day than did the morning's count and is therefore accepted as the figure for the 1934 census. The tides on Tomales Bay on February 11, 1934, were as follows: high tide, 8.36 a.m., 6.4 feet; low tide, 3.51 p.m., −1.2 feet. The day was clear with wind and calm as above noted.

Dr. Jean Linsdale, assisted by W. H. Behle, Berkeley, took the 1934 census on Bodega Bay on February 11 (Linsdale took the 1932 and 1933 censuses at the same point on the same date). In commenting upon the 1934 census Linsdale stated: "In spite of the strong wind, we made a fairly satisfactory count, beginning at 8.45 a.m. The locations of the birds and the point from which they were counted were much the same as for last year. * * * By noon, the brant had con-

gregated in bunches, much as last year, but there were more people on the Bay in boats this time and the birds moved about too much to satisfactorily map their locations." (For map of Bodega Bay showing location of black brant on February 11, 1933, see CALIFORNIA FISH AND GAME, vol. 19, 1933, p. 256.) Linsdale and Behle counted a total of 1298 brant on Bodega Bay this year. The tides here were similar to those listed above for Tomales Bay.

Captain of Game Wardens W. J. Harp and the writer counted the brant on Humboldt Bay on February 12, 1934. The weather was clear and calm that day with the following tides: high tide, 10.01 a.m., 7.2 feet; low tide, 5.15 p.m., –1.2 feet. We devoted the morning, commencing at 9.30 a.m. to census taking on South Bay, where, working from outboard motorboat we secured a very satisfactory count totalling 10,860 brant. In the afternoon we circled North Bay by automobile, stopping and scanning its placid waters with glasses from every vantage point and concluded that 6000 brant fairly represented the number of birds present there that afternoon. Thus the total census for Humboldt Bay was 16,860 brant.

J. B. Phillips, Bureau of Commercial Fisheries, who is located at the Hopkins Marine Station, Pacific Grove, kindly advised that he noted approximately 400 black brant on the Pacific Ocean off the Station on February 11, 1934. This is an unusual number of birds for this locality, where the species is usually noted only in migration and these brant seen by Phillips were doubtless moving along the coast between two of our larger bays favored with growths of eel grass and frequented by this species.

Recapitulation of the 1931, 1932, 1933 and 1934 Black Brant Censuses

| *Locality* | *1931* | *1932* | *1933* | *1934* |
|---|---|---|---|---|
| Humboldt Bay | Unsatisfactory | 29,415 | 5,000 | 16,860 |
| Bodega Bay | None made | 3,200 | 977 | 1,298 |
| Tomales Bay | 9,445 | 6,285 | 7,409 | 5,565 |
| Drakes Bay | None made | 2,108 | 318 | 2,189 |
| Morro Bay | 4,493 | 2,938 | None made | 3,895 |
| Mission Bay | 71 | No birds | 115 | 154 |
| San Diego Bay | No birds | No birds | No birds | 7 |

## 1933 FALL BRANT MIGRATION IN CALIFORNIA

The fall migration of black brant in California in 1933 seems to have been the earliest one on record since observations have been especially sought by me during the past ten years, or perhaps the interest in this matter that my queries have instilled into various persons has resulted in a more careful watch being kept for these birds, resulting in earlier records. At any rate, numbers of brant were seen on Tomales Bay and in the ocean off Tomales Point during the last two weeks of October, 1933. H. J. Jensen who resides at Hamlet on Tomales Bay told me on November first last that several hundred brant stopped in the bay for a day or two on or about October 25 and that a few individuals were noted there on October 19 and every day following. Mr. H. C. Conrad, San Francisco, told me that he went fishing in the Pacific Ocean off Tomales Bay on October 14 where he saw flocks of brant averaging 50 birds each that totaled 300 individuals. I was gunning for ducks on Tomales Bay on November 1, 1933, when I saw a flock consisting of 16 brant fly into the bay from the ocean about midday. I was unable to revisit Tomales Bay last fall until

December 16 by which date brant were very numerous there. At that time, Jensen and others told me that the birds had become sufficiently abundant by mid-November to afford fair sport, whereas they usually do not appear in such numbers on this bay until Thanksgiving or later.

Captain of Game Wardens W. J. Harp, Arcata, wrote me on January 6, 1934, stating that brant shooting during the 1933 waterfowl hunting season had been very successful. The birds put in their appearance on Humboldt Bay far earlier in 1933 than in the previous year. Harp stated that small flocks commenced to arrive about December 1, 1933, and that the species was sufficiently common after December 15 to afford good sport to hunters for the remainder of the season (until December 31). Harp estimated that there were 10,000 brant present on Humboldt Bay during that period. The previous season (1932) brant were so late in reaching Humboldt Bay that few were shot before the season closed on December 31 and the birds had not arrived there in numbers by February 12, 1933 (see CALIFORNIA FISH AND GAME, Vol. 19, 1933, pp. 258–259).

At the time of my visit to Morro Bay, February 10, 1934, Game Warden Hecker and A. C. Silva stated that brant became common on its waters exceptionally early in the preceding fall and that good shooting was had from mid-November until the close of the gunning season.

An unusually late date for brant to tarry in our waters in the spring was provided by S. H. Dado of this Division who noted a flock of 12 or 13 individuals in the ocean off New Years Island, San Mateo County, on May 29, 1934.

### BRANT CENSUS IN OREGON, WASHINGTON AND BRITISH COLUMBIA

Through the kind offices of Dr. I. N. Gabrielson, Bureau of Biological Survey, U. S. Department of Agriculture, I was successful in interesting the Oregon State Game Commission into cooperating with our brant census work to the extent of directing its game wardens stationed along the Oregon coast to count the brant present there February 10–12, 1934. Results of these observations were kindly provided by State Game Supervisor F. B. Wire in letter dated February 26, 1934, as follows:

> We have received copies of officers' reports concerning black or sea brant observed in Lincoln and Tillamook counties as follows:
>
> John H. Price, State Police, Newport:
>
> "On February 12th, observed about 100 black or sea brant in this vicinity as follows: Yaquina Bay about 80, Siletz Bay 20. There have been large flocks of sea brant on Yaquina Bay for some time."
>
> Earl C. Williams, State Police, Tillamook:
>
> "With reference to letter from Mr. Wire rel. observing number of black brant or sea brant between the dates Feb. 10th and 12th, did not get a chance to personally observe for the two days mentioned, but on inquiry, there seemed to be more in Netarts Bay than anywhere else. I observed some two or three thousand in bay and am told that a large number migrated on north from the bay about two or three days ago."

My inquiries to the Washington State Department of Game in the fall of 1933 relative to the numbers of black brant frequenting the waters of that State met with hearty and cordial response from Director

of Game Lou Ovenden. As a result this gentleman delegated Arthur S. Einarsen, then of the Department, to gather all possible information on the subject during the season and to transmit same to me. During the fall hunting season, Einarsen devoted much time to this detail and prepared a masterly report on the subject under date of December 18, 1933, which he forwarded to the writer with permission to use in whole or in part in connection with the present paper. We are therefore greatly pleased and highly obligated to the Washington Department of Game to quote from Einarsen's report as follows:

Black brant (*Branta bernicla nigricans*) are found in varying abundance within the territorial limits of the State of Washington during the different seasons of the year.

With the opening of the shooting season, on October 16, 1933, very few reports were made of black brant being seen on the opening day, although many snow geese (*Chen hyperboreus*), a few Canadian honkers (*Branta canadensis*), and also a scattering of whistling swan (*Cygnus columbianus*), were seen on the opening day. On the Skagit Flats three geese were shot—one a snow goose, and the other two Canadian geese. Following through the season there were no reports of an abundance of brant until about November 1st, when visitors to the ocean coast, between Grays Harbor and the Columbia River, reported them in considerable numbers, feeding along the coast line. As excellent hunting can be enjoyed in both Grays and Willapa harbors as soon as the black brant enter these areas to feed, their actions were closely watched, and very few entered the bays until about Thanksgiving time when the majority of the birds still favored the open ocean along the coast. It was not possible for me to make personal observation of their numbers and actions but through the word of hunters there seems to be little doubt that such conditions existed.

In the northern portion of the State brant can be expected to congregate, chiefly in the following areas: The Gulf of Georgia, near Point Roberts and Blaine, Bellingham Bay, Samish Bay, Padilla Bay, Bellingham Channel, Rosario Straits, the Straits of Juan de Fuca, Livingston Bay and Hood Canal.

A continual contact maintained with the shooting fraternity, gave little encouragement until about November 15th, when a few birds were reported from the Livingston Bay area, and with scattered reports of increasing numbers in Bellingham Bay, where about November 23d, a few birds were taken. On December 2d and 3d a hasty trip along Hood Canal and the Straits of Juan de Fuca, in the Dungeness and Protection Island districts revealed very few birds. Normally these areas are highly favored, but on these dates the annual winter residents had not arrived to a noticeable degree. Communicating with boatmen employed on regular runs through the districts where brant might be expected to appear, it was generally reported that no great numbers were apparent until about December 1st, and up to date have been increasing with rapid strides.

Going into the field in the northern district on Puget Sound, on December 12th, the Blaine area on the Gulf of Georgia produced fair numbers of birds. As there is considerable high ground to the south of Blaine, overlooking the Gulf of Georgia, by means of field glasses, approximately 30 small flocks, ranging in numbers from 10 to 100, could be seen feeding on the Gulf. These waters are not hunted to any degree, and as there are a few sand spits on the Lummi Indian Reservation, which are not open to shooting by the general public, they are favorite resting areas for the brant.

On December 13th Padilla Bay and Samish Bay claimed my attention, and these areas were found to be occupied by brant in such numbers that plans were made to follow them closely on the following day. In glancing at the attached sketch [see map, Fig. 136] maybe it will be noticed that there is an abundance of open water and that eel grass flats abound in the district, and later investigation of the crops of five brant dissected revealed the presence of nothing but eel-grass in their diet. The more limited area lies to the south in the Padilla Bay district, and it was found that there is a definite daily migration, beginning at daylight in the morning, from the northern areas when hundreds of flocks fly into Padilla Bay, almost touching

land, as far south as the entrance to Swinomish Slough. This definite daily migration continues until about noon. As this was the approximate time of high water, it leaves a little doubt in my mind as to whether the tide stage influenced their actions or whether this was a normal daily occurrence. I had not the opportunity to establish this point, but the fact remains that the southerly migration on both the 13th and 14th terminated about that time. There was little activity until evening, with the first of the flight northward beginning about 4 p.m., and until long after dark, the flight continued. It was my assumption that the northerly flight is for the purpose of reaching more open and unrestricted waters where the brant may drift and rest at night without being cast upon the shore as there are heavy currents in these

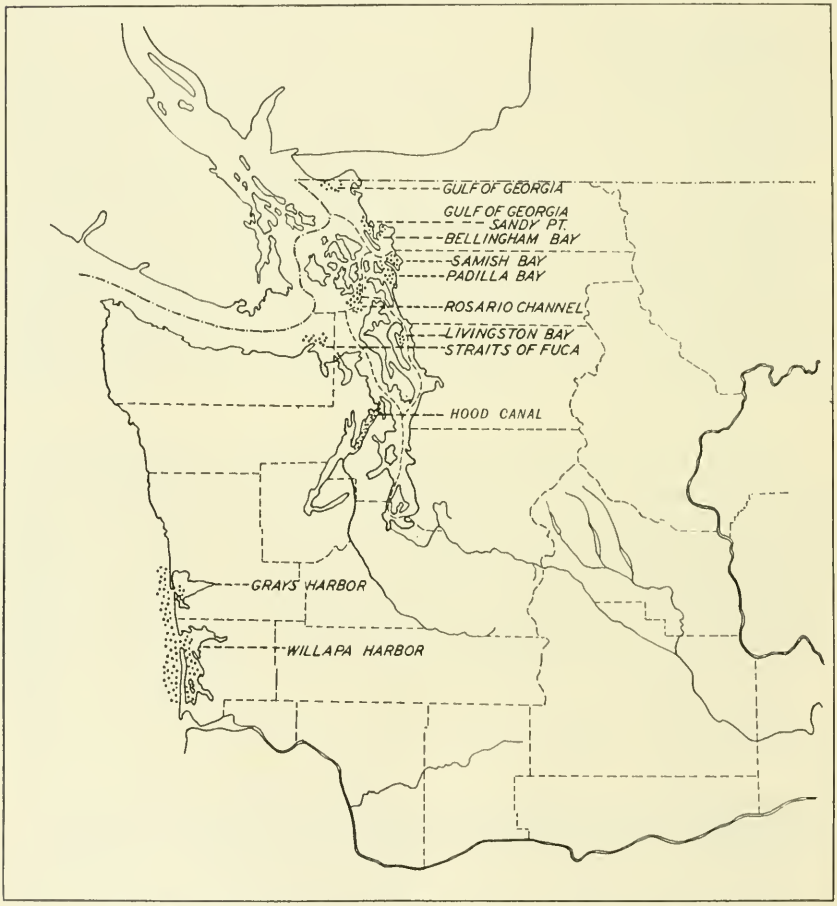


FIG. 136. Map showing brant concentration areas, State of Washington.

bays, which in conjunction with the storms that were persisting, could be expected to drift them onto the beaches in a short while. Even in Samish Bay they must be continually alert to keep off shore as with the heavy winds they drift quite rapidly.

Observing birds at close range on December 14th, it was found that they could breast a fifty-mile gale with ease, both in the air and on the water. At one spot, with a four-knot tide running, with seas approximately 12 feet high, a small group of about twenty birds remained practically stationary for an hour's time, but, of course, were continually alert to retain their position.

Outside of the gony (albatross) there is no bird to my knowledge that pays as little attention to the storm tossed waters as the black brant. On the 14th of December the sea was comparatively calm, with thousands of brants winging their way to the south and coming to rest in Padilla Bay, near Hat and Saddle-Bag Islands. The wind gradually increased so that at noon it had reached a velocity of approximately 50 miles, but this terrific wind did not cause them any inconvenience or develop a flight of birds, and all brant that were seen in the air were still approaching from a northerly direction, boring southward at a terrific rate, and coming to rest in apparent satisfaction among the flocks already feeding in Padilla Bay. At the same time a flock of approximately 50 snow geese were seen upon the horizon to the north, a distance of approximately six miles, but these birds were in sight for twenty minutes, weaving back and forth against the wind, and continually changing their elevation, depending upon the gusts of wind, and finally disappearing to the south, skimming the waves. Brant in a similar situation flew as straight as an arrow with a uniform speed that would take them out of sight in about five minutes. A rough count of the birds seen on the 14th, passing Point Williams on Samish Island, places the figure at 7900. Only the southward bound birds were counted and there could be little possibility of duplication, since during that period less than fifty birds passed Point Williams, drifting northward.

Hunters who periodically visited these grounds during the past season, report that the migration reached the area only about the fifth of December, and very few birds were taken until December 10th, when the daily kill in the district would sometimes amount to fifty birds. They are not generally sought after, except by a few limited hunters, who were properly equipped. On December 13th, several bags were investigated, an aggregate of fourteen birds scrutinized. They were all of the species of *Branta bernicla nigricans*,* and with few exceptions were in prime condition.

Generally speaking, it is the consensus of opinion amongst the gunners who seek brant, that the present season is much too early to give them good brant hunting, as the migration reaches this State on its sheltered waters only a short period before the season closes [December 15]. The thought arises that if this season is maintained generally through the west coast, it may contribute a great deal to the maintenance of the abundance of black brant since they can not then be overshot and they are not poached upon in this State during the closed season, since any hunter preying upon them would be far more conspicuous than a poacher on ducks that enter the fields and other obscure places to meet their doom at the hands of a skulking poacher.

Plans are going forward to collaborate with the State of California, whose work is under the direction of James Moffitt, to take a general census on February 10th to 12th, and there is little doubt that a quite accurate count can be taken by the use of our field force at certain strategic spots. Fortunately the interest in brant is being developed before their value as a game bird is generally appreciated and remedial measures to perpetuate them, if inaugurated in the near future, will be easily enforced as very limited resentment of any type will need be combatted. * * * Field observations above recorded were made to ascertain to what extent the brant are being hunted, and it was found that the entire kill of brant this year throughout the State of Washington, probably was less than one thousand birds. The Puget Sound area alone shows records of about 470 birds killed, and, of course, there will be some not generally reported or known of. The southern portion of the State, along the coast, including Grays and Willapa harbors, have produced some birds, but their number is unknown, and I believe the above figures would be extremely liberal. It is doubtful if the returns requested of license holders will be even as accurate, as many of the brant hunters take out parties of gunners on the favorite grounds, and do not report their kill, as they feel the numbers which they should record to be extremely high and derogatory to their continued

* Dr. Joseph Grinnell, Director, University of California Museum of Vertebrate Zoology, advised me on June 15, 1934, that E. J. Booth, Bellingham, Washington, sent a brant to him to be identified which he shot on the Samish Flats, Skagit County, Washington, on December 10, 1933. Dr. Grinnell stated that this bird is possibly somewhat of an intergrade between *Branta bernicla nigricans* and *Branta hernicla hrota*, but that it is so far nearer the latter as properly to bear the name *hrota*, the Atlantic or light-bellied brant.—*James Moffitt.*

existence, as action to curtail this shooting might be attempted in the light of such information.

Due to the necessary expense, a complete coverage of the brant areas could not be made, but information will be assembled as far as possible to render a reasonable appraisal of existing conditions in all districts for the winter of 1933–34.

(Signed) ARTHUR S. EINARSEN.

Upon receipt of this report, I wrote Einarsen drawing his attention to the statement in the second paragraph of his report to the effect that brant were noted along the Washington ocean coast after November 1, but few entered the bays until the last of that month. I commented to him upon similar habits that I have noted in the past in this species along the California coast where we apparently have an early fall flight of brant, some of which appear off our shores in mid-October, but the birds do not enter our bays in numbers until after mid-November. One theory that I have in this regard is that these early south-bound birds are migrating to Lower California and they apparently do not stop except for brief rests along our coast. Another theory that I suggested to Einarsen might account for the habits of the Washington coast brant as well is that the spawning of our herring may be a factor in governing the time at which brant enter our bays. In preceding years I have noticed that the arrival of these birds on Tomales Bay has closely coincided with the first spawning of our herring (*Clupea pallasii*), further that the early spawning schools of herring deposit their eggs on isolated patches of eel grass in different parts of the bay, which are very noticeably the patches of eel grass first utilized by brant for food. The fact that the first appearance of numbers of brant on Tomales Bay in several different seasons has closely coincided with the commencement of herring spawning and the fact that the birds feed mainly where these fish have spawned, are responsible for my opinion in this regard.

In response to this suggestion, Einarsen kindly replied as follows, which seems to settle the question in this regard:

I can see that there, perhaps, are some points of difference in the habits of black brant in regard to their custom, in California, in foraging on eel-grass covered with herring spawn. From years of experience on the bays and inlets of Puget Sound, I have become acquainted with all of the herring spawning grounds, the majority of which are in shallow water where eel-grass abounds, although there are a few deep water spawning areas also. Peculiarly brant are not found on any of the spawning grounds, which is entirely at variance with the California situation. Our local herring (*Clupea pallasii*) begin spawning during the month of January and continue until about the middle of May. Many of these favored spots, to which they return to spawn year after year, are in the center of the brant waters, notably Hales Pass, a portion of Bellingham Bay, the Duckabush Flats, near Brinnon in the Hood Canal district, and Birch Bay, a short distance from the exceptionally heavy concentration of brant, near Sandy Point, Gulf of Georgia. As I have spent a great deal of time at all of these spawning grounds, I feel justified in making the statement that in Puget Sound I have never seen a solitary brant taking advantage of this abundant food, although I have fine pictorial records of thousands of other birds that congregate annually, during the herring spawning season, to solve their food problem. I shall devote more time during the present season to substantiate these statements.

At Director of Game Ovenden's request, Einarsen and other members of the Department conducted a brant census in Washington on

February 14, 1934. Einarsen wrote that this survey was quite successful although he imagined that certain districts which were missed would have swelled the total count, but that roughly there was an abundance of brant on that date and they were still particularly numerous in the Straits of Juan de Fuca near Dungeness. Due to the fact that Einarsen severed his connection with the Department the day following the census taking, no detailed and itemized report was prepared, but in his letter to me dated July 17, 1934, he wrote that there was considerable enlightenment in this survey for certain districts which had been considered as highly favored by brant produced very small numbers. This can be accounted for by the fact that the shooting season had closed and it was not necessary for them to be isolated into these districts but they could migrate into areas that during the open season would have been disastrous for them to occupy. The result of this census provided a total of approximately 30,000 birds for the State of Washington for that day, which it is interesting to compare with the grand totals for Oregon and California, respectively 3000 approximately and 29,986. It seems strange that the numbers for the State of Washington approximately equal our count for California for the former state is so favored with inlets and bays supporting growths of eel grass that seem to afford ideal feeding places for this species that I should think its waters could support far larger numbers than can our few suitable California bays.

I regret very much that pressure of other work preceding the 1934 brant census taking time prevented my contacting the British Columbia Game Department and friends residing along the coast of that Province relative to cooperating with our work to the extent of counting the brant in their respective localities on the dates designated. I did address Kenneth Racey, West Vancouver, British Columbia, in this regard and he was so kind as to take a census of the brant in this vicinity on February 10 and 11. On the first day, Mr. Racey visited Sea and Lulu islands where no brant were noted although a small flock had been reported there in November. The next day he noted a flock of from 50 to 60 birds in the Sound about a mile northwest of Crescent Beach. Stewart Loutit, an experienced hunter and a reliable observer, at Mr. Racey's request, kindly made observations on the brant present near Point Roberts on February 11, 1934, where he noted but 150 birds lying in flocks of from 30 to 40 each about a half mile off shore. Mr. Loutit stated that there had been about 1500 brant in this locality at the beginning of the hunting season and that most of these birds moved down towards Birch Bay on the American side of the international boundary and that only between four and five hundred individuals wintered about Point Roberts, Boundary and Mud bays. Racey wrote that there has been a great reduction in the number of brant in this locality during the past two years which he attributes principally to damage to their principal food, eel grass, by excessively high tides and the silting in of channels.

## CONCLUSION

In conclusion I wish especially to acknowledge with sincere appreciation the assistance of those who cooperated with the 1934 census taking and without whose help this work would have been impossible.

I feel especially grateful to those who helped in outside states and provinces, for this brant census began as a California project of my conception and it is certainly not my intention to attempt to make it an annual affair all along the Pacific Coast. Last winter I had hopes of securing a rather accurate record of the total number of brant on the Pacific Coast north of the Mexican boundary at census taking time. That we were successful in this as far as the United States is concerned, seems assured, and I feel that had I been able to make more requests to Canadians for assistance, we should also have secured a fairly complete census for British Columbia as well.

I feel assured that a fifth annual brant census will be taken in California in February, 1935, for the cooperators all seem to be in sympathy with continuing this work. The dates will probably be the same as were originally selected, for even though February 10 to 12 now seems to be too early to secure maximum brant concentration in California (two or three weeks later would be better for this purpose) this factor, to me, is overweighed by the desirability of continuing our counts on the same dates, now that we have the records for four seasons.

I fully appreciate the importance and desirability of periodically, say every five years, taking stock as it were of all our Pacific Coast black brant by taking coincident censuses wherever the species is known to occur. In this way we could very definitely ascertain the trend of this species. However, it seems useless to consider such an undertaking and to again burden our indulgent northern neighbors with the request for another census until means are devised for counting the black brant wintering in Lower California where large numbers are known to resort. This problem presents real difficulties, for transportation by road is almost impossible along the central part of the peninsula where the birds are known to winter in large aggregations. To attempt to take the census by boat, would, I fear, be more expensive than the results would justify, so sea-plane, if the birds could be counted from one, appears to be the only practical solution. If it develops that it is practical to so count brant, I shall try to organize a party to do so and hereby solicit help from anyone interested in this enterprise. If this could be arranged, I would then advocate that a very careful count be also made at the same time all along the Pacific Coast to the northward as far as brant are known to winter and the accumulated results should provide a fair estimate of the total number of birds wintering on this side of the Pacific. Such information might become invaluable in the event, for instance, of an eel grass shortage on the Pacific Coast such as the one which has recently so seriously reduced the numbers of Atlantic brant.—*August 27, 1934.*

# AN EXPERIMENT IN QUAIL IMPORTATION

*By* Gordon H. True, Jr.

When the Division of Fish and Game inaugurated its quail replenishment program in southern California early in 1932, the valley quail that were used for restocking were solely the product of the Los Serranos State Game Farm, at Chino. During the following season, the increase in the total acreage of available refuge lands warranted the purchase of birds from private breeders to supplement the production of the game farm. Over nine thousand quail were liberated during this 2-year period. It was then that the Commission conceived the idea of importing valley quail from the west coast of Lower California since, by so doing, the volume of birds available for restocking purposes might be immeasurably increased and the cost of the program to the sportsmen materially reduced. The author wishes to take this opportunity to present to the sportsmen an account of our operations in this direction, an experiment that will most certainly react in their favor.

Negotiations were officially set in motion during the month of September, 1933. Since the Division did not number among its personnel a man with a thorough understanding of the Mexican, his language and methods, the first step was to enlist the aid of such a personage. In San Ysidro, California, we found H. S. Weir, a man who possessed all the desired qualifications and who willingly consented to act in the capacity of official intermediary between the Division and the Mexican government. Preliminary negotiations consumed much of the fall of 1933 and it was not until the month of December that they had been completed and we were able to proceed. Time was then short, with the rainy season rapidly approaching, but the Division was none the less elated for it held in its hands written permission to import from Mexico a total of one hundred thousand quail. The Mexican government graciously consented to waive the export tariffs in the case of all birds destined for southern California refuges. On December 23, 1933, the first truck load of birds passed over the border.

The quail were secured by Mexican trappers, and brought to the border by truck where they were delivered to representatives of the Division at San Ysidro. According to a regulation of the Mexican Department of Agriculture, trapping activities were confined to territory south of the village of San Telmo, Lower California, situated at a distance of some two hundred miles below the border. Each shipment was inspected by a Mexican official resident at San Telmo, was sealed by him and taken to San Ysidro without further formality. It had been hoped that the Lower California birds could be liberated immediately upon their arrival on southern California soil, but, it was later deemed advisable to alter the original plan. The long, rough, dusty journey from San Telmo to the border resulted in a number being dead or in a dying condition upon arrival. Consequently, each shipment was taken to Chino and held at the game farm until the birds had recuperated from the effects of the rough handling they had received. After a

sufficient period of time had elapsed, the quail were sorted, banded with aluminum leg bands and liberated at various points throughout southern California.

It was to be expected that a certain percentage of loss would be incurred in handling a large number of birds, and anticipating the situation, it was stipulated that the trappers rather than the Division should assume responsibility for most of the loss. Consequently, proper deductions were made on payment. It was hoped that this arrangement would result in more careful handling of the birds on the part of the trappers and that a lower percentage of loss would follow.

We paid a visit to a quail trapper's camp in Lower California. It was late in the evening when we arrived at their bivouac. The darkness

FIG. 137. Typical Lower California quail cover near San Quintin. Photo by G. H. True, Jr.

allowed us to see but little of our immediate surroundings, but to the eastward we could make out the rugged peaks of the San Pedro Martir, against the sky outlined by a full moon. The trappers, or cordoniceros as they call themselves, were squatted about their fires preparing supper. On each fire was a blackened pot of coffee and an equally blackened pot of frijoles. At one fire, a young Mexican was busily engaged in transforming unhealthy looking lumps of dough into deliciously crisp tortillas. So interested were we in that particular phase of Mexican cookery that it was with a feeling of reluctance that we withdrew to a discreet distance, pitched our own camp and hastened to care, American fashion, for the needs of the inner man. As we attacked a rapidly vanishing mountain of ham and eggs, one Domingo produced a battered guitar and a hastily organized trio of young cordonieeros proceeded to fill the moonlit night with Spanish melody. Tired out, we soon sought our blankets while still forms about slowly dying fires told us that our Mexican hosts were likewise consigning themselves to the forgetfulness of repose.

We were up and about at dawn and hurriedly gulped down a hastily prepared breakfast, anxious to see all that was being done. Senor Jose Felix, the chief trapper, informed us, however, that we hurried needlessly, for the trappers wanted at least an hour's start ere we appeared upon the scene. They left camp as he spoke, in two battered, topless touring cars loaded down with rolls of wire and other quail trapper's accoutrements, and soon vanished to the eastward in a cloud of dust. While waiting for our hour of departure we had time to look about us and noted that we were in a wide valley that narrowed rapidly to the eastward as the low, rolling foothills of the San Pedro Martir encroached upon it. We were in a barren land, treeless and drab, but none the less magnificent because of those very qualities. Low shrubs of various species, few over 12 inches in height, comprised most of the vegetation. Here and there were interspersed clumps of cholla and, less frequently, the pithaya or organ pipe cactus. We were camped in a group of larger shrubs, similar in appearance to the creosote bush, and these, together with the ever-present mescal, or maguay, completed the picture that was spread before us.

As we sat there drinking in the scenery the time passed quickly and soon we were trudging eastward in the wake of Senor Felix, a tall, powerful man with an ornate buckskin overcoat and, best of all, a fair speaking acquaintance with the English language. As we journeyed up the valley we met with several coveys of quail, for it was still early and the birds were busy feeding. The several hundred birds that comprised each covey evidenced little alarm at our approach, merely moving out of our path and continuing their search for food. We also observed at various points large V's of piled brush and were told that these were the remains of quail traps that had been in use prior to our visit. This prompted Senor Jose to embark on a detailed account of quail trapping methods, but in the midst of his discourse he stopped short and raised his hand for silence. We ceased our chattering and in the dead silence that followed we heard a faint but incessant clicking noise coming from a point not far distant.

Quickening our pace we soon arrived at the source of the strange sound and saw before us five of the trappers advancing slowly across the floor of the valley in a semicircular skirmish line. Each of the boys held a stick or stone in either hand and by striking them rapidly together produced the clicking noise that had piqued our curiosity. As we drew still nearer we could see that the line of trappers partially surrounded a large covey of quail that was being slowly driven toward the mouth of a brush V, similar to those we had observed on our walk from the encampment. As the covey approached the trap, the pace of the drivers became perceptibly slower though still accompanied by that incessant clicking. The birds gradually entered the V, milled about for a few moments and then flushed, flying over and beyond the trap. This galvanized the trappers into instant action and we, likewise, rushed forward, unwilling to miss a single step in the procedure we had come to witness. We found the apex of the V was open and led into a long tunnel of wire mesh, in which a number of birds were fluttering madly. This tunnel, the functional part of the trap, had been constructed by unrolling the wire and securing the edges to the ground with wooden pegs. Enough slack remained to allow the wire

to be propped up, tent-like, by means of slender sticks about two feet long and notched at one end. One end of the tunnel was blind and the other, of course, communicated with the opening in the apex of the V. As a final touch, the tunnel had been lightly covered with brush. While we were making the above observations, the trappers were engaged in removing the props from the tunnel, and the wire fell upon the two dozen birds that had been captured, pinning them to the ground without apparent injury. Stones were placed here and there on the wire to hold the birds more securely and the captives were then carefully removed and placed in containers. The trap was reset and the trapping crew was again ready to proceed.

Another trap was located not far from the one just described and the covey was rounded up and driven toward it. When this second trap had taken its toll of birds the covey was driven back to the first one. This process was repeated again and again, the birds being driven

FIG. 138. San Telmo Valley, Lower California. Note line of quail drivers. Photo by G. H. True, Jr., January 31, 1934.

in a rough circle and into each trap, in turn, until they had become so wary that none would enter the tunnels. Senor Felix explained that the trappers would now locate another covey, set their traps in a similar fashion and repeat the process just as we had seen it. Another trapping crew was working some distance westward and were employing essentially the same method with the additional factor of a line of brush fires set by the trappers as they moved along. This it was explained, was to prevent the quail from doubling back and is used wherever the cover is exceptionally heavy.

We were next conducted to the "holding pen," a large expanse of wire mesh pegged to the ground and covered with brush. Beneath the wire a number of birds were imprisoned and their lot was certainly not an enviable one. Although an attempt had been made to prop the wire up by means of short sticks, the birds had little room for movement and were forced to content themselves with remaining in one position. Food and water had been provided but it is doubtful if the

birds either fed or drank while in such confined quarters. There they were to remain, however, until a sufficient number had been collected to warrant a trip to the border. In some instances, we were told, old adobe houses had been utilized as holding pens but the above-described method was, unfortunately, the one most commonly employed.

There is little to criticize in the quail trapping method just described. It is an ingenious method and one admirably suited to Lower Californian conditions, though it would be of little use in a region only sparsely populated with quail made wild by continual shooting. The "driving method" as depicted here is distinctly advantageous in that only a relatively small percentage of birds is taken from each covey insuring a permanent breeding stock and a consequent large annual crop of young birds. The methods employed in holding and handling the birds are in contrast to the trapping procedure open to considerable criticism. When one considers that the birds were held for at least several days, and often as long as a week, in close confinement with virtually no food or water, and were then subjected to an arduous two hundred mile journey in poorly ventilated trucks, it appears strange that the losses were no greater. The fact that so many birds survived that sort of treatment is a tribute to the hardiness of the species. The trip to San Telmo was made in order that a thorough investigation of Mexican methods might be conducted and to so alter the plan of operations that losses might be reduced to the minimum.

The quail imported from Lower California are not identical to the birds that we know as natives of southern California. The San Telmo quail is referred to in scientific journals as *Lophortyx californica plumbea,* a subspecies of the California quail that inhabits the coastal regions of the State. It differs but little, however, from the valley quail, *Lophortyx californica vallicola,* in either habits or coloration and is adapting itself admirably to a new environment. Even in such a poor quail year as 1934 has proven itself to be, we have found the Lower Californian birds mating freely with not only their own kind, but with native birds as well, and the pround father of many a family of young quail produced this year on California refuges displays the slightly reddish head that proclaims his alien origin.

In all, 8297 live birds completed the journey from San Telmo to Chino of which 7517 were released after a short stay at the game farm. Seven hundred and eighty quail remained at the game farm as breeding stock, to be released at the close of the hatching season. The imported quail cost the sportsmen of California exactly $1,918. This sum represents not only the actual cost of the birds but includes as well the cost of trapping permits and the salary of the Mexican inspector stationed at San Telmo. The cost per bird planted was a fraction more than twenty-three cents.

As the above figures indicate, we have imported less than 10 per cent of our quota of one hundred thousand quail. This was due to the fact that trapping activities commenced after the optimum trapping season was over and were limited by inclement weather and the rapidly approaching mating season. In addition, the difficulties involved in the transportation of the birds to the border tended to limit the number of shipments.

The plan to be followed this year will, it is hoped, result in the completion of the quota. Briefly, it involves the establishment of a base of operations at San Quintin, a Lower California seaport. There the birds will be held, sorted, banded, and then shipped to California by boat in lots of at least ten thousand. The birds will be taken to San Quintin at the close of each day's trapping activities and need not be held as they were at San Telmo. The quarters available at the seaport are spacious and will allow the birds to be held with a minimum of injury. The altered method of procedure should finally result in better quail shooting in southern California.

# QUAIL BANDING RETURNS FOR 1932 AND 1933

*By* Gordon H. True, Jr.

In July, 1932, the Division of Fish and Game inaugurated the practice of banding the quail liberated on sanctuaries in southern California, with the conviction that, through banding, important data relative to the quail refuge program would be obtained. Already we have learned much concerning the spread of birds from various points of liberation and the data gathered relative to the survival of game farm reared quail have enabled us to answer the critics who condemn the practice of liberating pen-raised birds and question their successful reproduction under natural conditions. In addition to possessing a certain scientific value, the bands serve to remind the hunter of the efforts that are being made on his behalf.

Fig. 139. Catching quail prior to banding at Los Serranos State Game Farm, Chino. Photo by G. H. True, Jr.

A band encircling the leg of a quail may provide us with information in two ways. The actual return of a band after the bird has been shot constitutes one of these. The second way is through the provision of an easy means of field identification since banded birds may be easily picked out from the others by the use of field glasses or the unaided eye. This paper deals primarily with the first-named method of securing data, but before proceeding directly to a discussion of band returns, a general treatment of the banding program is advisable.

Over a period of time beginning in the month of July, 1932, and ending August, 1934, 16,728 valley quail have been banded and released south of the Tehachapi. In addition, 839 Gambel quail have been banded and liberated. Of the valley quail, 7517 were wild birds imported from the west coast of Lower California and the balance were reared on the State game farm at Chino.

A number four aluminum poultry band has proved to be the most satisfactory for quail banding purposes. The bands are serially num-

bered and bear the printed request that they be returned to the Division of Fish and Game. The first bands used were inscribed with the number and "Notify Game Comm." on the outside and the address to which the bands are to be sent, "San Francisco, California," was to be found on the inside of the aluminum circlet. It was learned, however, that the hunter seldom opens a band and, in consequence, any inscription on the inside may be overlooked. On the bands now in use, therefore, the entire legend, "Return to F. & G. Com. S. F." may be read on the outside. The above may appear to be of minor importance to the reader, but so anxious are we that bands taken by sportsmen be returned that we wish to leave no stone unturned—even in the case of such a relatively simple matter as a band inscription.

FIG. 140. Banding Lower California quail prior to release, Antelope Valley. Photo by G. H. True, Jr.

A careful record is kept of all band numbers, each one being entered on an especially prepared record sheet. With the number is listed the age of the bird, the sex, the point at which it was released and the date thereof. In addition, a column is reserved for such data relative to the recovery of the band as the date, locality and the agent. The latter may be, and most frequently is the hunter. A predatory mammal or bird, or even accidental death may, however, be responsible for the recovery of a band. Upon the receipt of a band, a card is mailed to the person making the return thanking him for his cooperation and setting forth, for his information, data relative to the release of the bird that wore the band. To this card is attached a return postal card on which the sportsman is requested to set down specific information concerning the point at which the band was taken by reference to some well known landmark. Up to the present time this system has met with a very satisfactory response on the part of the quail hunter. Individuals have failed to return cards, as requested, in only a few instances.

In reviewing the band returns for the 1932 and 1933 seasons the author does not attempt to make a lengthy analysis of the results.

The banding system has not been in vogue long enough to allow many definite conclusions to be drawn. At the end of the year 1932 only 10 bands had been returned. Of the 10 birds, six had been shot and four taken by other means. This small return may be accounted for by the fact that up to and including the 1932 open quail season only a relatively few birds had been released and, further, the sportsmen had not yet become acquainted with our work. It is presumed, however, that the ten bands represent only a fraction of the total number taken. By the close of the 1933 season a total of 59 bands had been recovered, the increase over the previous year being the result of a vast increase in the number of birds released and a considerable extension of the area over which the liberations were made. Again, as in the case of the 1932 returns, it is believed that the number of bands received was far less than the actual number of banded birds killed during the season.

The reports of 1933 show that of the 59 returns, 10 were made anonymously and 25 separate individuals were responsible for the recovery of the remaining 49. The largest number returned by one individual was nine while two hunters recovered six and five bands respectively. Five men averaged three birds, the same number took two and 13 recovered one band each. The average number of banded birds taken per hunter was slightly less than two, since only 49 were actually killed by shotguns. Ten birds died by other means, one being killed by an owl, another taken from the stomach of a Cooper hawk, and so on.

In the case of 35 of the birds killed we were able to learn the exact date on which the shooting took place. An average period of 113.6 days had elapsed between the date on which each of the above 35 quail was liberated and that on which it was taken. The maximum period of liberty was, in the case of two birds, 480 days and one had been at liberty but 16 days before being killed—this last being the minimum. These data show conclusively that game farm reared birds are able to survive under natural conditions.

Of the 59 bands taken, 26 were from Riverside and San Bernardino counties, 20 from the Antelope Valley region of Los Angeles County, and one from San Diego County. It should be explained that the above mentioned areas correspond with the three groups of quail sanctuaries that have been established in southern California and, further, that in the case of the San Diego County group but one liberation had been made prior to the 1933 quail season. In addition to the birds from the vicinities of these southern California refuges, two were taken in the northern part of the State, near Morgan Hill, and were products of the State Game Farm at Yountville, which institution is likewise carrying on the banding program. The two birds taken in the north complete the total of 59, which includes representatives from 15 distinct liberations.

Only 25 of the returns included really accurate information concerning the exact point at which the birds were killed. From these data, however, we have been able to calculate the distance of the point of recovery from the point of liberation, the maximum being 10.5 miles and the minimum, one mile. The average distance was 4.86 miles.

These distances, measured on a straight line, are the shortest routes over which it was possible for the quail to travel.

As a brief summary of the bird banding activities, it may be stated that as a result we may determine among other things where refuges may be most advantageously located and how far they should be spaced to insure the maximum amount of shooting in the intervening territory; what amount of successful shooting results from the refuge program; to what extent farm reared birds will mate and produce young under natural conditions; and the fate of wild birds that have been introduced from the outside.

In order that full advantage may be taken of our quail banding efforts, it is necessary to have the complete and willing cooperation of all interested sportsmen. It is hoped that this exposition of what has been already planned and accomplished may be an aid to that end.

# THE FRESHWATER COMMERCIAL FISHERIES OF CALIFORNIA*

*By* Richard S. Croker

There was a time when the river fisheries of California surpassed those of the ocean, but that was many years ago. Saltwater fishing methods have been improved so as to take greater toll of the schools of ocean fish, canneries have been established and enlarged, and the rapid growth of coastal cities has opened up larger markets, so that now the ocean catch far exceeds the take of the freshwater. Of the hundreds of millions of pounds of fish caught every year in California, less than five million are taken from inland waters. Nevertheless, many fishermen derive their livelihood from the rivers and lakes of the central part of the State.

The most important fishes taken in the rivers of California are anadromous species, that is, fish that spend the greater part of their lives in saltwater but enter the rivers for spawning purposes and occasionally to feed. These are the king and silver salmon, the striped bass and the shad. The extensive gill net fishery for these species is well known and as it has been covered in previous publications of the California Division of Fish and Game, it will not be taken up in the present article. Two other anadromous fishes, the sturgeon and the steelhead, were formerly taken commercially. The capture of the former was prohibited in 1917 to preserve it from extinction, and the latter, due to depletion, has been removed from the commercial list.

It is with the true freshwater fishes that we are concerned at present. There are eight species of these that are caught commercially in California. All of them descend at times into the brackish waters of bays and estuaries, but they are essentially freshwater species. Five of them are native to central California waters. These are the split-tail (*Pogonichthys macrolepidotus*), the Sacramento pike (*Ptychocheilus grandis*), and two species known as hardheads (*Orthodon microlepidotus* and *Mylopharodon conocephalus*), and the western sucker (*Catostomus occidentalis*). The other three species were introduced into our waters by the California Fish Commission during the latter part of the last century. The carp (*Cyprinus carpio*) came from Asia by way of Europe and the eastern United States. The square-tail catfish (*Ameirus nebulosus*) and the fork-tail catfish (*A. catus*) came from the Mississippi Basin. The carp, split-tail, hardheads, and Sacramento pike are all members of the carp or minnow family, Cyprinidae.†

In 1933, the recorded commercial catch of the eight freshwater species totaled about 580,000 pounds. The value of these fish to the fishermen was approximately $28,000. The catfish, principally the fork-

*Contribution No. 139 from the California State Fisheries Laboratory, May, 1934.

† The fork-tail catfish is sometimes called "blue catfish," and the square-tail is sometimes referred to as "yellow catfish." The Sacramento pike is occasionally called "squawfish," and the hardhead is sometimes known as "blackfish," especially in Clear Lake. The names used in the text are those authorizd by the California Division of Fish and Game.

tail species, is by far the most important freshwater species, both in amounts caught and in value. (See Figs. 141 and 144.) The supremacy of the catfish is usually more marked than it was in 1933. All other freshwater fishes, with the exception of game species, such as black bass and trout, are grouped together by the fishermen and called "rough fish," "coarse fish" or "Chinee fish." The latter term originated from the fact that the Chinese are particularly fond of these species.

Within the boundaries of our State there are thousands of miles of rivers and streams and hundreds of lakes. In years gone by, commercial fishing was carried on in every bit of accessible water that contained fish. All the coastal streams contributed trout, salmon and sturgeon to the markets at San Francisco. Lake Tahoe and the Truckee River were once important trout producers. The Sacramento River supplied the fish for the Pacific coast's first salmon cannery over seventy years ago, and has remained an important fishing region ever since. Clear Lake in Lake County annually produces a con-

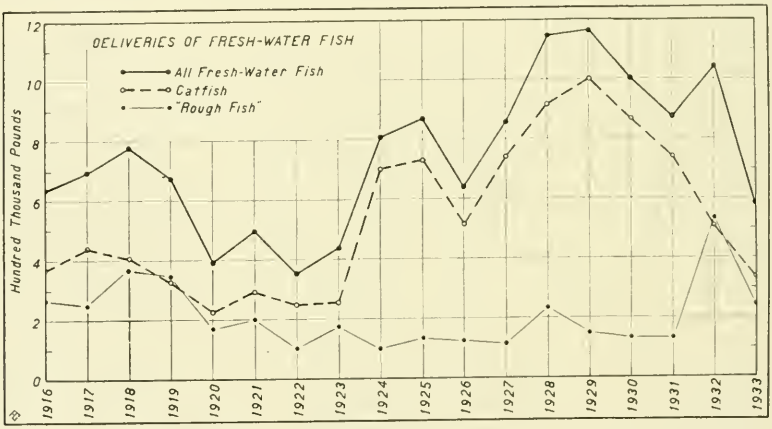


FIG. 141. The deliveries of the eight species of freshwater fish in the State of California, by years, 1916-1933. Note that the catfish landings generally dominate the fishery. Amounts given in round weight.

siderable harvest of fish. Buena Vista Lake, now shrunken to a swamp, and Tulare Lake, now dry, furnished quantities of fish not so many years ago, before reclamation projects encroached on their borders and irrigation districts diverted their water sources. Nigger Slough in Los Angeles County furnished carp in abundance before it was drained about fifteen years ago. Salton Sea, a great saltwater lake in the Imperial Valley, has long been the scene of operations of commercial fishermen. Scattered ponds, lakes and streams throughout the State have also contributed at times to the commercial fish catch.

Today, restrictive legislation, passed to preserve the natural resources of the State, confines commercial fishing in inland waters to but a few localities. The most important of these is the Sacramento-San Joaquin River system, which furnishes the bulk of the catch.

In the extensive area of the Central Valley, there are many hundreds of miles of water open to commercial fishing. These include the main channel of the Sacramento River from Vina in Tehama

County down to the mouth, the San Joaquin River below Stockton; Steamboat Slough, Sutter Slough, most of the connecting water courses in San Joaquin and Contra Costa counties, and Suisun Bay. Practically no commercial fishing is carried on above Sacramento or for freshwater fish in Suisun Bay, but all the intervening legally open waters are thoroughly exploited.

The total catch of freshwater fish (exclusive of anadromous species) in this district in 1933 amounted to 374,000 pounds. In former years the catch was very much greater, but since the World War it has only once (1929) exceeded the million-pound mark. (See Fig. 142.) Several factors contributed to the diminution of the fishery during the years just before the war. Reclamation projects deprived the fish of spawning and feeding grounds; irrigation districts diverted water; unscreened irrigation ditches caused destruction of many young fish; and fishermen formerly harassed and caught

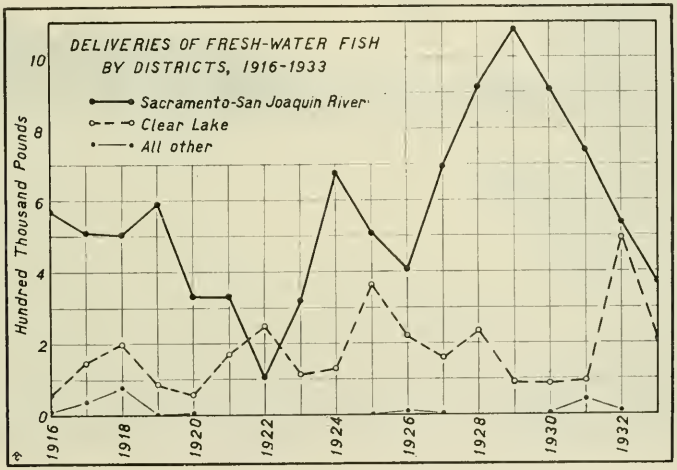


FIG. 142. Yearly landings of all species of freshwater fish by districts, 1916-1933. Note that the Sacramento-San Joaquin River district leads, followed by Clear Lake. The other districts include the catch in southern California lakes and reservoirs principally. Amounts given in round weight.

spawning fish. The main river and connecting sloughs above the city of Sacramento remained productive, although on a diminished scale, as late as 1918, but since that year there has been practically no commercial fishing above Sacramento. Washington Lake, across the river from Sacramento, at one time was very productive as was Sacramento Slough near the mouth of the Feather River, but both are now dry. Reclamation projects disturbed the rough fish most. These have become so scarce that their former good market has vanished because of the resulting absence of a steady supply. Formerly carp and catfish were shipped in carload lots to Eastern markets but when the supply failed in large measure, the Eastern dealers turned to other sources of supply. At present the bulk of the production of California freshwater fish is consumed locally.

During the war, the increased demand for fish maintained the catch at a fairly high level, but the post-war depression affected the river fisheries and the catch decreased markedly. From 1922 to 1929 the total catch of freshwater fish in the valley-delta area increased considerably. (See Fig. 142.) The larger catches were probably not the result of greater availability of the fish but of the increased demand and correspondingly greater effort on the part of the fishermen. The number of fishermen has not increased in proportion to the rise of the catch, but each fisherman now uses many more nets than he did ten years ago. The recent depression has resulted in a curtailment of fishing effort since 1930 and the catch has slumped to a marked extent.

FIG. 143. The Sacramento River near Courtland, typical catfish water. Photograph by R. S. Croker, April, 1931.

The greater part of the catch of freshwater fish in the river district is composed of catfish. The delicate flavor of this fish is known and appreciated, resulting in a relatively good sale. The towns of the Sacramento-San Joaquin Valley and the San Francisco region are the best markets, but quantities are shipped to Los Angeles. Occasional shipments are still made to the Rocky Mountain States, especially to the cities of Denver, Butte and Salt Lake. Californians prefer the white meat of the fork-tail, whereas the people of the Mountain States prefer the reddish flesh of the square-tail species. The Chinese like the large fish, those over 12 inches long, and prefer to get them alive. The smaller ones, 9 to 12 inches long (7 to 10 inches, dressed) find favor with other consumers who usually buy in small amounts yet wanting several individual fish.

The fishermen deliver catfish to the markets dressed, that is, with the heads, skins and viscera removed.

They receive 8 to 18 cents a pound for dressed fish and 4 to 8 cents a pound for the relatively small amounts of live fish sold to Chinese dealers. In cleaning, the catfish loses 50 per cent of its weight. The catch figures collected by the Division of Fish and Game and shown in their various publications are of the deliveries of fish as made by the fishermen, which in the case of catfish, is just half of the round weight. As the deliveries of other freshwater fish are given in round weight, it has seemed advisable to double the recorded weight of catfish to facilitate comparison with the other species. This has been done throughout this article, unless otherwise noted, but has not been previously done in other California State publications.

In the river district, the carp is second to the catfish in order of pounds landed, but the prices paid for it are so low that it ranks but third in value. Consumers of carp prefer to buy their fish alive, and as they will live in a small tank indefinitely they are often retailed while still wriggling.

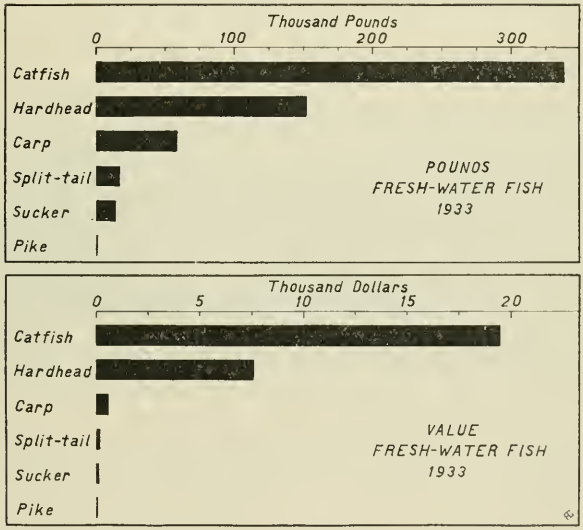


FIG. 144. Deliveries and values of each of the species of freshwater fish taken commercially in California in 1933. Amounts given in round weight.

Because of the poor demand for carp, the fishermen receive nothing for small lots mixed with other fish, and seldom receive more than 2 cents a pound for larger loads. The average price in 1933 was 1 cent per pound.

In the river fishery, the hardhead is third in poundage and second in value. It is the favorite of the Chinese as it will remain alive in captivity and has a sweet flavor, although it is rather bony. The price paid to the fishermen for live hardhead is sometimes as high as 20 cents a pound, averaging about 10 cents in 1933. Those brought to market dead bring 2 to 4 cents a pound. The price, as with other "Chinee fish," is highest in the spring when they are scarce and lowest in the fall when they are most easily caught. The market will

not absorb any large quantities of hardhead, so the price can be maintained only by holding the catch to a low level.

### TABLE 1—PRICES PAID TO FISHERMEN

The average price paid to California fishermen for the several species of freshwater fish. The low price paid for hardhead in 1933 was due to large scale operations of seiners in Clear Lake and to the fact that much of the hardhead was marketed dead rather than alive as usual (see text).

| Species | Average price per lb. 1926–29 | Average price per lb. 1930 | Average price per lb. 1933 |
|---|---|---|---|
| Catfish* | $0.14 | $0.135 | $0.115 |
| Hardhead | .11 | .13 | .05 |
| Pike | .04 | .06 | .05 |
| Sucker | .03 | .05 | .01 |
| Split-tail | .05 | .03 | .01 |
| Carp | .02 | .02 | .01 |

*Price given for catfish only is the price paid for dressed fish; to obtain a value comparable to other species, divide above price by two.

The split-tail, Sacramento pike and sucker are unimportant, although good prices are occasionally paid for small quantities of them when alive. The Chinese of the valley and bay regions are the principal consumers of these fish.

Besides the recorded catch of these fish delivered to wholesale dealers, there are tons of freshwater fish caught and sold direct to the consumer. The ranchers and others who live near the fishing grounds buy quantities of dressed catfish from the fishermen. The managers and cooks of the Chinese and Filipino ranch gangs, working in the neighborhood of the river, buy their fish direct from the fishermen. They purchase both dressed and live catfish and live rough fish. The amounts thus sold are considerable, and the money realized by their sale is an important item.

Only the adult rough fish are used for food. The young of the hardhead, Sacramento pike, split-tail, and of another minnow or chub, *Lavinia exilicauda,* are used as live bait by striped bass and black bass sport fishermen in the river region. Many commercial fishermen make some additional money by catching and selling small minnows for bait. They catch them in baited traps and keep them alive until sold. During the summer when the commercial catfish season is closed the sale of minnows is almost a necessity for some of the fishermen.

The universally used type of gear in the river district is a baited trap known as the fyke net. This net is used for the capture of all the species of freshwater fish. Some carp are caught in the shad, bass and salmon gill nets in the lower river, but there is no regular gill net fishery for freshwater fish. In the old days, beach seines were employed in Washington Lake and enormous catches were sometimes made at one haul. At present beach seines are illegal in the river region.

The fishermen who take catfish are located along the Sacramento River from Courtland to the mouth, and on the rivers and sloughs between Stockton and the Sacramento River. Each has his own territory, including several miles of river and slough, which is conceded to him by the unwritten consent of the other fishermen. Most of the

fishermen locate as near as possible to the legally closed waters out of which the catfish sometimes venture. The fyke nets in the lower reaches of the river near Pittsburg are operated by gill netters as a side line.

Most of the fishermen live in houseboats moored to the bank. Usually the base camp consists of the dwelling boat, a cleaning barge, live cars, and a net tarring tank which is on the shore. The live cars, in which the fish are kept until marketed, are large boxes set in the water. They have holes or slits through which the water can circulate but which are small enough to prevent the escape of the fish. The boats from which the fishermen tend their nets are 16- to 20-foot skiffs powered with outboard motors.

Each fisherman uses 50 to 100 fyke nets. Some of the fishermen work in pairs, in which cases as many as 150 or more nets are employed. These nets are no more than stationary baited traps. (See Fig. 145.) The net consists of tarred webbing of $2\frac{1}{2}$-inch mesh stretched over 5 iron hoops to form a sort of modified cone. The largest hoop is at the open end. A mesh sack containing bait is at the closed end. To get at the bait, the fish must enter at the open end of the trap. Mesh funnels on the second and third hoops direct the fish toward the bait but

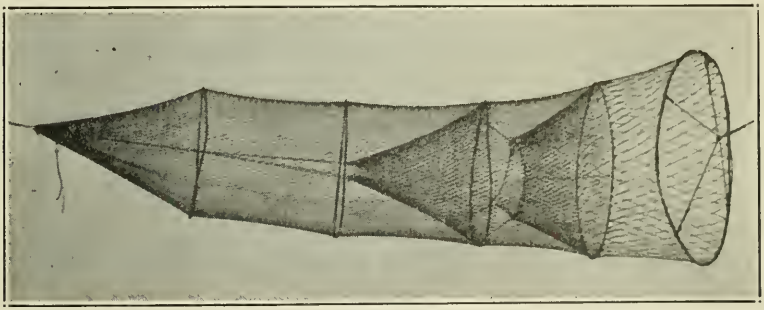

FIG. 145. A typical Sacramento River fyke net. The open end is at the right; the bait is kept in a bag at the small end of the net. To get to the bait, the fish must pass through the mesh funnels, which then prevent their escape. Photograph by D. H. Fry, Jr., Pittsburg, October, 1932.

hinder their escape. The nets are usually about 14 feet in length. In some nets the hoops taper from $4\frac{1}{2}$ feet down to $2\frac{1}{2}$ feet in diameter. Others have a 6-foot hoop at the open end and one of $1\frac{1}{2}$ feet as the smallest. The cost of the average fyke net is about $20. The webbing must be dipped in coal tar every 30 days to prevent deterioration, resulting from contact with catfish slime. A number of years ago it was the general practice to place mesh wings on either side of the opening to lead the fish toward the trap, but the wings were held to be destructive and were outlawed. The fishermen now use an increased number of the wingless nets.

The fisherman places his nets in deep water close to the bank of the river or slough. The net is lowered to the bottom and a rope or wire from each end is made fast to an overhanging tree or stake on the bank. The ropes are made taut enough to keep the hoops upright. The lines are not marked, but rather are concealed from the prying eyes of net thieves. The nets are often stolen and more often robbed

of fish and thrown back in the water tangled beyond all hope of fishing success. During periods of unusually heavy depredations the fishermen fasten the ropes to underwater snags. In the spring when the catfish move upstream, the net is placed so that the open end faces downstream to intercept the fish. At other times it is immaterial which way the opening faces.

The best bait is fresh sardines. The fishermen obtain the sardines from the dealer to whom they deliver their catch. Most of the sardines are caught at Monterey and San Francisco. During the sardine canning season the Pittsburg fishermen obtain their bait from the canneries at that point. As each fisherman uses 500 to 1000 pounds or more of sardines every week, the fyke net fishery is of some importance to the sardine fishery. When fresh sardines are available, the fishermen buy more than they need and salt the surplus for times of scarcity. Salted sardines are nearly as good as fresh ones.

The fisherman leaves his nets in the water for 24 hours or more. The nets which are placed in the best locations are lifted every day, others are left 2 days, and those in the poorest places sometimes are left for 3 or 4 days. The fish do not suffer from the confinement as there is plenty of room to swim around inside the trap.

In making his rounds the fisherman runs his boat directly over the net and hauls on the line fastened to the open end, pulling the whole net into the boat. The swarms of small bait-stealing fish make their escape through the coarse mesh as the net is lifted. The fisherman raises the closed end and shakes the net so that the entrapped fish fall through the open month into the bottom of the boat. Then he replenishes the bait and lowers the net. On the way to the next net he returns the illegal and undesirable fish to the water. In spite of the 2½-inch mesh, some undersized fish are taken. The minimum size limit for catfish is 9 inches total length or 7 inches exclusive of any part of the head. The catfish are very hardy and stay alive until the base is reached. Here they are thrown into the live cars until the fisherman is ready to dress them. The few remaining undersized fish escape through the cracks or are sorted out during cleaning.

The method of cleaning catfish is ingenious. The cleaner makes a shallow cut between the top of the head and the dorsal fin, impales the head on a hook which is fastened to the wall, seizes the skin at the cut with a pair of pliers, and pulls the skin off in one piece. Then he grasps the body and pulls it away from the head. The viscera stay with the head and the flesh is free from everything except the bones.

Some of the fishermen have their own trucks and deliver to the markets at Sacramento, Stockton or Pittsburg. The fish companies send out trucks to pick up the catch of the others and to take bait to them.

The open season for catfish and other species taken in fyke nets in the river district is from September 1 to April 30. Spring is generally the best time for catching catfish. In midwinter they do not come to the bait. At this time the fishermen often put 8-foot hoops in front of the regular fyke nets and set them at the surface to catch "Chinee fish" which they sell direct to the neighboring Chinese. During the somewhat muddy water of early spring, the catfish start moving upstream out of the deep holes where they are alleged to have spent the

winter. They are hungry and enter the traps freely. In years when the river is low and clear in the spring, the catfish do not seem to move much. The poor spring fishing of some seasons has been attributed to low water by the fishermen.

Second only to the Sacramento-San Joaquin River district in the production of freshwater fish is Clear Lake. This beautifully situated body of fresh water is technically part of the Sacramento River drainage system in that its surplus waters flow into that stream. However, during the present series of dry winters there has been practically no run-off to the river. Clear Lake contains the same native species of commercial and game fishes found in the Sacramento. The square-tail and fork-tail catfishes, the carp and various game fishes have been introduced into the lake with success.

The catch in Clear Lake varies greatly from year to year due to fishing conditions and economic factors. The trend was upward from 1916 to 1925, in which year 360,000 pounds were taken. (See Fig. 142.)

FIG. 146. Seining for "rough fish" in Clear Lake. Preparing to lay out the 1200-foot seine from the apron of the barge. Photograph by H. B. Nidever, January 7, 1932.

During the years from 1926 to 1931, the catch decreased considerably. Until 1931 the greater part of the catch consisted of catfish, principally the square-tail species. From time to time quantities of rough fish, mostly carp, were caught in the lake but the take of these fish never approached that of the catfish. In 1931 the State Legislature passed a law prohibiting the shipment of catfish out of the district in which Clear Lake is located, and as a result it has ceased to be an important factor in the lake fishery. On the other hand, in 1932 the Division of Fish and Game issued a permit to a group of fishermen allowing them to seine coarse fish from the lake. It is due to the operations of these men that the Clear Lake catch showed a large increase in 1932. (See Fig. 142.) Practically all of the 1932 and 1933 catch in the lake consisted of rough fish, mostly hardhead.

The best fishing in Clear Lake has always been in the winter and early spring with few fish of any kind being taken during the summer and fall. The lake is at present open to fishing throughout the year.

The standard type of gear for taking catfish was formerly the trot line. This is a set line bearing many hooks. The best bait for catfish is sardine. Since 1931 hand lines or rod and line have been the only legal types of gear for catfish. The fishermen formerly shipped their catfish to Sacramento or San Francisco for marketing.

Seines are used for catching rough fish in the lake. The fishermen operate under a permit which requires them to return all catfish and other game fish to the water alive. Commercial fishing licenses are required also. It is hoped that the seining will reduce the numbers of coarse fish which are so numerous in the lake that they are considered pests. A barge which can be moved to different parts of the lake is the base of fishing operations. The large seine is set out from the barge by a motor boat, and is hauled in with power winches. (See Fig. 146.) Trucks are used for shipping the fish to market in San Francisco and Sacramento. The trucks are equipped with tanks so that live fish can be transported. The fish not sold are donated to charity or used for fertilizer.

Commercial fishing in other inland bodies of water in California is now on a permit basis. From time to time it seems advantageous to remove excess carp from reservoirs and natural lakes where they have become too numerous. The fishermen use beach seines and sell their catch if they can although the sale is of secondary importance. The catch records show only amounts sold to dealers. Guadalupe Lake in Santa Barbara County, Lake Elsinore in Riverside County, and the Los Angeles City reservoirs have all been seined at times for carp.

Nigger Slough, between Los Angeles and Wilmington, was once the habitat of numerous carp. Fish dealers in Los Angeles occasionally sent fishermen, equipped with beach seines, to the Slough to catch carp. The Slough was partially drained about 1918, and the fish perished.

Salton Sea was once an important fishing area for carp, humpback suckers (*Xyrauchen cypho*) and mullet (*Mugil cephalus*). The fishermen made their catches with seines and trammel nets, and shipped their fish to Los Angeles by train and truck. As the lake gradually receded and became more salty, the carp and suckers perished but the mullet fishery survived until 1931. Since then the Salton Sea fishery has been on a permit basis. The statistics on the catch from this body of water have never been adequate and are not included in the graphs accompanying this report.

The inland fisheries of California will not again surpass the ocean fisheries, but they may supply our markets with considerable quantities of excellent fish for many years to come.

# CALIFORNIA FISH AND GAME

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## DIXON'S MULE DEER STUDY

The concluding installment of Joseph S. Dixon's article, "A Study of the Life History and Food Habits of Mule Deer in California," is the leading article of this issue. The first installment on "Life History" appeared in the July, 1934, number of this magazine.

Reprints of each of these articles have been ordered and will be available under one cover at a nominal fee.

## GEORGE NEALE RETIRES FROM DIVISION

George Neale, for over 25 years a member of the Division of Fish and Game, and since 1928 chief of the Bureau of Fish Rescue, retired on pension on August 1, 1934.

Neale entered the employ of the Division in 1903. Prior to that time he had been a game warden in Sacramento County. Shortly after entering the service of the Fish and Game Commission, he was placed in charge of all deputies in 23 northern counties. He held this important position until 1922. In March, 1922, he was appointed executive officer, from which position he resigned in 1925.

So well versed in fish and game subjects, and especially fish, he was put in charge of the newly formed Bureau of Fish Rescue in 1928, which position he held until his retirement.

Neale developed the saving of game fish into one of the most important activities of the Division. At a cost of never more than $6,000 per year, he saved, annually, 4,000,000 of various species of sport fish. Fish that would have been swept to destruction by receding waters, improperly screened diversion points and the flooding of large areas of farm lands have been rescued and placed in waters that insured them being saved for the sportsmen's creels.

Few men in the Division had a wider knowledge of game and fish than George Neale, and he applied this knowledge to the benefit of the Division and the sportsmen.

The work of the Bureau of Fish Rescue has been incorporated with that of the Bureau of Fish Culture. Foreman Merrill Brown, who has had charge of the Friant black bass experimental ponds, will assume responsibility for the details of fish rescue and distribution so ably administered in the past by George Neale.—*O. L. Warner, August 24, 1934.*

## FEDERAL MIGRATORY WATERFOWL REGULATIONS, 1934

The new regulations affecting migratory waterfowl provide that each State may take not more than 30 days for an open season on wild ducks and geese. A State may take 30 consecutive days, or it may take two, three, four, five, or six consecutive days, for as many consecutive weeks as will total 30 days. Such days as a State decides on must be the shooting days for each week until the end of that State's season. It is not possible under the new regulations to have a Wednesday and a Saturday shooting, but such days as are selected must be consecutive. A State may take less than the 30 days open season if the commissioners of that State believes the supply of ducks will not warrant a month's shooting.

California has the distinction of taking the shortest open duck season of any State in the Union, with 22 days, shooting on Saturdays and Sundays, from October 20 to December 30.

California's week end consecutive days was decided upon after Fish and Game Commissioners J. Dale Gentry, I. Zellerbach and Earl B. Gilmore had made a carfeul study of the waterfowl situation in California, and after conferences with sportsmen, originized and unorganized. They decided two days a week for eleven weeks would give the hunter plenty of time to get limits and at the same time conserve the supply of birds that light in this State. They reduced the total days each State might take by over 25 per cent, and though there was some protest at first, all true sportsmen are seeing the justice of the position of the commissioners.

Seasons selected by other western States are as follows: Oregon and Washington will take three days, Friday, Saturday and Sunday, for 10 weeks, starting October 18 and closing December 23; Montana will take the same three days, opening October 5 and closing December 9; Utah, Saturday, Sunday and Monday, opening October 12 and closing December 16; Colorado and Nevada, Saturday and Sunday, opening October 1, closing January 6; Nebraska and West Virginia are the only two States taking 30 consecutive days.

The bag limit for ducks in California will be 12 with a possession limit of 24. Only 5 or an aggregate of 5 of any of the following "imperiled species" may be included in a daily bag, with possession of 10; Eider, canvasback, redhead, greater and lesser scaup, ringneck, blue wing, green wing, cinnamon teal, shoveller and gadwall.

The limit on geese is 4 with possession 8; coot bag and possession 25; jacksnipe bag and possession 20.

It will be unlawful to kill Ross geese, wood, ruddy and bufflehead ducks, or swans.

Baiting of waterfowl regulations were also changed. To be able to legally bait waters and lands, application must be made to the

chief of the Bureau of Biological Survey. To receive a permit, after a thorough check has been made as to the advisability for such feeding, the applicant must agree to keep an accurate record of the persons shooting on the baited property; the total number of waterfowl killed; the various species bagged; number of blinds and number of occupants of each blind each day, and daily kill of birds by gunners in each blind; kind of feed to be used, intervals of baiting and that there be no shooting after 3 p.m. on open days. This record is to be sent to the Bureau within 30 days after the close of the season in the applicant's State.—*O. L. Warner, August 29, 1934.*

## WESTERN ASSOCIATION OF FISH AND GAME COMMISSIONERS' MEETING, 1934

The fourteenth annual convention of the Western Association of State Fish and Game Commissioners, was held at Portland, Oregon, June 14th to 16th. This Association consists of the fish and game officials of the eleven Western States. It was organized in 1921 and the original meeting was called for the purpose, primarily, of forestalling further extension of Federal jurisdiction over fish and game. It can be truthfully stated that the Association ran true to the concepts for which it was originally organized. Nine of the eleven States which comprise the Association were represented at the Portland meeting. California was represented by J. Dale Gentry, president of the California Fish and Game Commission. Most of the States sent two or more representatives, which indicated unusual interest in the matters which were up for consideration.

The U. S. bureaus represented were the Forest Service, National Park Service, Bureau of Fisheries and Biological Survey. The different activities of these bureaus were represented by the western supervisors of such activities. British Columbia, which has many problems in common with those of our western States, was as usual well represented.

The meeting was presided over by M. L. Corrigan, president of the Oregon Game Commission. Mr. Corrigan has been an ardent sportsman throughout his life and has been a member of the Oregon Commission for many years. Both he and the personnel of the Oregon Commission are to be congratulated for the manner in which the meeting was conducted and the entertainment provided. Portland's famous "Rose Carnival" was under way and the delegates were made complimentary guests, a consideration greatly appreciated.

Commissioner Frank T. Bell of the U. S. Bureau of Fisheries appeared before the Association for the first time and discussed problems of common interest with the States, and expressed a desire to cooperate in further improving sport fishing.

W. C. Henderson of the Bureau of Biological Survey, discussed the migratory bird situation and emphasized the effects of drought and reclamation on the abundance of water-fowl in general. His was not a cheerful report and there was probably not a person present who did not personally feel that there should be no open season on migratory birds during the current year. Mr. Henderson explained what the Duck Stamp Bill will permit the Bureau to accomplish but regretted

the delay in getting clearance for Federal funds allotted for the acquisition of marginal lands.

Papers were presented by the different delegates covering the major problems which are continously before those engaged in solving conservation problems. Fish culture, planting, and upland game bird raising and distribution, received the usual attention and progress was reported, in most instances.

Everyone was on the "qui vive" to hear C. E. Rachford's discussion and explanation of U. S. Forestry Regulation G-20-A, which regulation contemplates taking over from the States jurisdiction of fish and game on national forest areas, whenever, in the judgment of the Secretary of Agriculture, the States are not cooperating with the Forest Service to the satisfaction of the latter. That the promulgation of this order, coming without consultation with the States, would meet with strenuous opposition, was indicated by the questions submitted to Mr. Rachford, and to requests for further enlightenment on the Forest Service's ultimate aims. After a day's discussion of Regulation G-20-A, the subject was referred to a resolutions committee. This committee submitted the resolution which appears herein, together with Regulation G-20-A, and the resolution received unanimous approval of the Western Association:

"Reg. G-20-A. When the secretary shall determine upon consideration of data and recommendations of the forester, that the regulation or the prohibition for a specified period of hunting and fishing upon any National Forest or portion thereof is necessary for the accomplishment of the purposes above set forth, he shall designate such National Forest or portion thereof, established hunting and fishing seasons therefor, fix bag and creel limits, specify the sex of animals to be killed, fix the fees to be paid for permits, designate the authorized official to whom application for permit shall be made, and describe the terms and conditions under which hunting and fishing shall be conducted with a view of carrying out the purpose of this regulation. Public notice of such designation shall be given by such means as the forester shall deem adequate for the purpose. Carcasses of animals or fish taken under permit shall be marked or tagged for identification as directed by the forester.

Reg. T-8½. Upon National Forest lands designated under Reg. G-20-A, the following acts are prohibited: Hunting, trapping, catching, disturbing, or killing any kind of game or nongame animal, or game or nongame bird, or taking the eggs of any such bird, except during hunting and fishing seasons established by the secretary, and in accordance with the terms and conditions of a permit issued by a duly authorized officer which is valid and subsisting at the time."

The resolution reads as follows:

"Your committee, appointed to study and report upon section G-20-A, of the order of the Department of Agriculture, has met and considered the said section and has heard arguments thereupon, and the committee unanimously reports as follows:

Since the days of early England it has been the unquestioned right of the sovereign to control the taking of fish and game. Prior to the Magna Charta, the title to fish and game was fixed in the crown, and since that time, and particularly since the adoption of the system of English common law by the sovereign States of the United States, it uniformly has been held that the title to the fish and game within the boundaries of a State is vested in that State, in trust, however, for the people thereof.

This theory has been upheld uniformly by the decisions of courts of last resort in every State where the matter has had judicial cognizance; and by the Supreme Court of the United States where it has been on appeal many times. It is submitted that, inasmuch as the question presented by Regulation G-20-A here in question already has had the judicial interpretation of our courts, the States affected should take a determined stand, that these judicial decisions shall not be reversed by usurpation by any ambitious governmental department or bureau.

We feel that the threatened enforcement of regulation G-20-A is an unlawful appropriation of the property of the people of a sovereign State which the officers of that State, and particularly the fish and game commissioners thereof, are sworn to defend. Any attempt on the part of a Federal bureau or agency to transgress upon this duty and right is in direct violation of all the principles of the organic acts and constitutions of the States involved, as well as of the Federal Constitution itself. It also is in direct violation of the spirit of all statutes and acts promulgated by the Congress of the United States, the legislatures of the several States, and of the judicial interpretations rendered thereupon.

We believe the States involved should, if necessary, curb this threat before same is accepted, in any part, by the public, for while the initial steps toward the enforcement of this section of the order may seem mild and only inconsequential in result, still it may be the initial step in complete usurpation of State rights amounting to confiscation of property without due process of law. We feel that the principle is entirely unsound, unjust and uncalled for.

Therefore, we respectfully recommend that all States involved unite in most strenuously resisting any attempt of the Federal bureaus in affecting the menacing threats contained in said order.

We have been and still are appreciative of any cooperative work done by the Federal bureaus in cooperation with the fish and game commissions of the several States in furtherance of propagation and protection of wild life, and we shall continue to welcome such cooperation so long as same does not ripen into usurpation of State powers; and to the end that the State rights be safeguarded and that any attempted usurpation might be checked at its inception, it respectfully is recommended that this association appoint an interim committee to consist of three members and to be appointed from the States constituting this association. Such committee to be appointed by the president and to devise ways and means to bring about an early determination of the question herein involved. Such committee to be subject to the call of the chairman of the committee."

Before adoption of the resolution, Mr. Rachford warned the association that the Forest Service might determine it advisable to exercise complete control over the National Forests, which would mean that the States would have no jurisdiction nor any rights thereon.

The 1935 meeting of the association will be held at Santa Fe, New Mexico. Present at the Portland meeting were D. H. Madsen, now with the National Park Service; R. G. Parvin, game commissioner of Colorado, and A. E. Burghduff, assistant executive officer of the California Fish and Game Commission, who assisted in organizing the association at Salt Lake in 1921.

The Resolutions Committee was composed of Federal Judge Colin Neblett of New Mexico, Dr. Irving Vining of Oregon and Newell Cook of Utah.—*A. E. Burghduff, July, 1934.*

## PLANT SILVER SALMON IN EAGLE LAKE

Warden C. O. Fisher in cooperation with local sportsmen has planted 266,000 silver salmon in Eagle Lake, Lassen County. This is part of a state-wide experiment, utilizing to a greater extent this easily propagated species as a sport fish. Individuals grow rapidly and mature in three years. It is not expected that they will reach a size comparable to ocean grown fish, but it has been found that second year examples are much larger than rainbow trout of the same age. It is intended to follow this introduction with others annually until something definite is learned as to their success in the lake.

According to Fisher's observations, food in the form of young minnows (these of the genera Leucidius and Siphateles) locally known

as whitefish is abundant, and the introduced salmon began to feed upon them almost immediately.

The fish were transported in a truck in the usual manner, the cans unloaded on a raft, which was towed about the lake by a power boat. The fish were thus widely scattered, insuring a good distribution in areas well supplied with food. The plantings were made at intervals from July 14 to 28, 1934, with almost no loss.

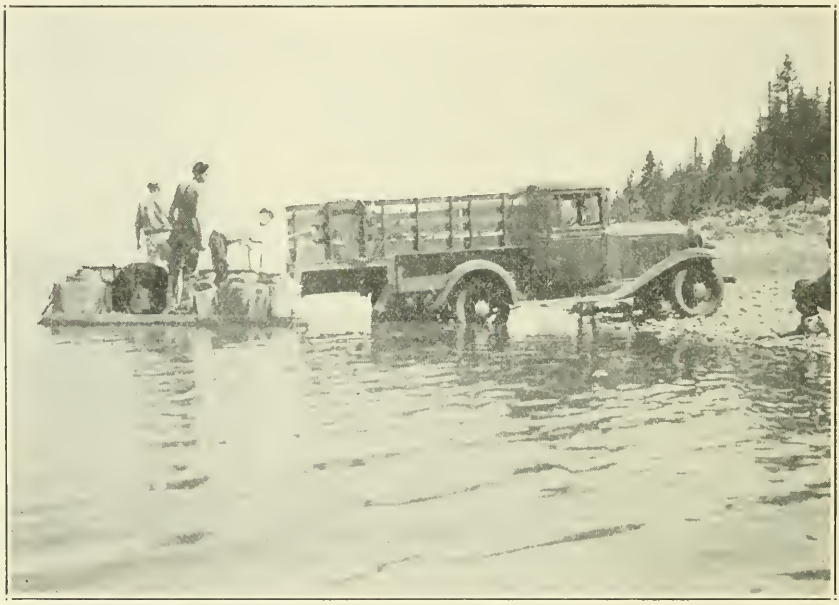

FIG. 147. Transfer of silver salmon from truck to raft for distribution in Eagle Lake.

It may be remarked here that these were healthy and active fingerlings averaging over 3 inches in length, 14 to the ounce, samples of the exceptionally fine fish that have been grown this year at the new Lake Almanor Hatchery under the able supervision of Foreman William Berrian.—*J. O. Snyder, August 9, 1934.*

## WATER STORAGE IN SANTA CLARA COUNTY

In the near future, six large dams will be constructed in the Santa Clara Valley Water Conservation District. The Coyote Creek dam will be 100 feet high with a reservoir capacity of 30,000 acre-feet. The others on Almaden, Calero, Guadalupe, Los Gatos and Stevens creeks are said to range from 21 to 115 feet in height and have a combined reservoir capacity of about 19,660 acre-feet.

It is stated that the reservoirs are for storage purposes, the waters to be used through percolation in the replenishment of well water in Santa Clara Valley.

It is presumed that fishing conditions in the region will not be greatly altered. Although the reservoirs do not give promise to addi-

tional fishing water because of their necessarily great variation in surface level the matter of an adaptable stocking policy is under consideration. Of late years, the winter migration of steelheads that formerly stocked these streams has become all but extinct, and the lower courses of most of the creeks seldom carry water to the bay. The proposed dams will not better this condition and it is altogether likely that the little natural spawning of trout that now occurs will entirely cease.—*J. O. Snyder, August, 1934.*

## ADDITION TO LIST OF TOTALLY EXCLUDED BIRDS, STATE IMPORTATION LAW

In accordance with the provisions of section 9 of Chapter 76, Statutes of 1933, the Fish and Game Commission and the State Department of Agriculture have added the Hawaii rice bird (*Munia nisoria* Temminck), belonging to the Ploceidae or weaver finches. It is a native of Malaysia. This bird is therefore added to the list of totally excluded species listed under regulation 1, pages 3 and 4 of the "Rules and Regulations Governing the Importation of Wild Birds and Animals into the State of California and Conditions under which Same May Be Kept in Confinement."

The birds are dull colored, have no song that is worthy of the name and are rather unsatisfactory cage birds. Their food is primarily seeds of weeds and grasses. In rice growing districts, the principal food in seasons when available is the green or unripe rice grain. As the birds are extremely gregarious, the damage they do to rice is very considerable. In seasons when the rice is not heading, or when the grains are too hard, the birds feed on seeds of grasses and weeds.

## COMMERCIAL FISHERY NOTES

### SUMMER OCEANOGRAPHIC WORK

The oceanographic program of the State Fisheries Laboratory for the summer of 1934 consisted of seven trips on the patrol boat *Bluefin* in the waters of southern California. The patrol boat *Albacore* stationed at Monterey conducted experimental hauls with an otterboard trawl in order to demonstrate the effectiveness of larger meshed savings gear in taking flatfishes. This was done in addition to keeping up her regular schedule of observations as a part of the hydrobiological survey of Monterey Bay which is being conducted jointly by Stanford University and the Division of Fish and Game.

The first research trip of the *Bluefin* this season was the exploration of the waters off San Diego on March 5–10, to seine for the small "quarter-oil" sizes of sardines in an effort to estimate their abundance as compared with former years. This work, by H. C. Godsil and R. S. Croker of the laboratory staff, was for the purpose of determining in advance the relative number of the small sardines which would make up the entering size class appearing for the first time in the commercial catch at San Pedro in the fall of 1934. It was found that the "quarter-oil" sizes, resulting from the spring spawning, were scarce and as a result, the San Pedro cannery catch in the autumn would contain few very small fish as compared with the fall of 1933 when the smallest size class was unusually abundant.

A second trip in March was made by H. C. Godsil (March 12–16) to observe the abundance of large winter sardines farther offshore than the localities visited by the boats fishing for the canneries. During the winter of 1933–34 the fishing had been confined largely to areas close to shore so that we had insufficient knowledge of the presence of large adult fish off shore. Many large schools of "winter fish" were observed by Godsil south of Point Conception in the neighborhood of the channel islands, indicating that fishing had concentrated inshore taking advantage of available fish near by rather than because of a scarcity of sardines elsewhere in the San Pedro area.

During April two seining trips on the *Bluefin* were made to fishing areas off San Diego. The first trip, on April 1–4, was made by H. C. Godsil and R. S. Croker and the second trip was by R. S. Croker and D. H. Fry, Jr., on April 23–27. These trips confirmed earlier observations as to the scarcity of small sized sardines to be expected in the San Pedro commercial catch of the following autumn.

On May 14-18, a 600-mile trip on the *Bluefin* was made by R. S. Croker in southern California waters and on the high seas off Lower California as far south as Cape San Quentin, including Tanner, Cortes and other fishing banks. This trip was to locate albacore, if possible, as well as other tunas and to make observations on the occurrence of sardines in these areas. Albacore were not sighted and sardine schools were not located. The rough seas encountered on this trip might explain the failure to see sardines. Yellowtail and bonito were found in

abundance and ripe spawning bonito, both male and female, were found over a wide area, suggesting a rather extensive spawning range for the latter species. As a preliminary trial of the method of attaching tags to tuna, three bonito were tagged by R. S. Croker during the trip. The mechanics of tagging proved satisfactory so that we are now in readiness for an extensive tagging program in an attempt to dissolve some of the mystery as to the movements of tuna schools in the waters off Mexico and southern California.

A four-week trip (June 7-July 6) was made by H. C. Godsil down the coast of Lower California and into the gulf as far as La Paz. The purposes of the trip were to locate tuna schools and fishing banks, to initiate tuna tagging, to extend our knowledge of mackerel spawning time, density, and localities, and to continue our observations on the occurrence and spawning of sardines to the south of the State line. The mackerel and sardine observations made on the trip were very successful. Plankton net hauls were made for mackerel eggs and larvae at frequent intervals down the coast. Sardines were observed and samples taken from what appears to be a local population in the Gulf of California near La Paz. Tuna scouting was unavoidably curtailed and difficulty was encountered in keeping bait alive in the tank which had an insufficient circulation of sea water.

August 9 to 18 a trip was made by H. C. Godsil and R. S. Croker among the channel islands off southern California in an attempt to locate and tag albacore and other tunas. No fish were taken but the staff members are consoled by the fact that commercial fishermen also were unable to make catches in the same localities during the 9-day interval.

Other research trips planned for the *Bluefin* during the autumn will be postponed because of a change in schedule by which the patrol boat will be engaged in transporting wild quail from Lower California for planting in suitable locations in this State.—*W. L. S., August 21, 1934.*

### UNCOMMON FISH TAKEN AT SAN PEDRO

A few unusual fish have been taken in the commercial fish catch of the San Pedro region within the past few months.

On March 15, 1934, a tongue sole, *Symphurus atricaudus*, was caught by the boat *President*. This is the only true sole occurring along the California coast and is taken only occasionally in the commercial catch.

Two specimens of *Macrourus stelgidolepis* have been brought into the San Pedro fish markets, one on March 9, 1934, and one on July 2, 1934. This is a relatively rare fish and has no common name. It belongs to the family Macrouridae. A related species, taken on the Atlantic coast, is called a rat-tail. Fish of this family are taken in comparatively deep waters. They are characterized by a deep body, narrowing abruptly to a long, slender tail. Our specimens were about 15 inches in length.

A sunfish, *Mola mola*, was seen at the San Pedro markets on September 28, 1933, and another on July 2, 1934.

The Japanese herring, *Etrumeus microps*, appears occasionally in the fish catches of these waters. On May 22, May 24, and June 11, 1934,

one of these fish was found with the mackerel catch. These three individuals were all females with ripening eggs and with a size range of 275 to 295 mm.—*Frances N. Clark, California State Fisheries Laboratory, August, 1934.*

### ALBACORE

During the month of August, 1934, the fishermen of the Los Angeles district were taking albacore in commercial quantities for the first time in many years. The last run of any importance in this district occurred in 1930 and up to this year, with the exception of an occasional stray, no albacore have been taken in these waters.

Throughout the month of July, several single fish were taken in the roundhaul nets incidental to other fishing activities. During the first week of August, several of the cruising swordfish boats started locating albacore while trolling. In a few days a great many of the small gig boats were out prospecting for fish and catches of a few fish up to a ton were being landed both at the fresh fish markets and at the canneries.

Approximately fifty tons of the fish were delivered to the canneries during the first two weeks of August while the markets received about two tons during the same period. The price being paid to the fishermen was eight cents per pound at the markets and one hundred fifty-five dollars per ton at the canneries.

At the present writing (August 15) the run has fallen off and some of the old timers are rather skeptical as to whether or not the fish are going to appear in quantities large enough to be of any general value.

It is interesting to note that the fish were first observed and taken in the Los Angeles area and that no fish were taken at San Diego during the first appearance of the fish in local waters. During the second week in August, a few fish were taken at San Diego.—*L. G. Van Vorhis, Terminal Island, August 22, 1934.*

### BLUEFIN TUNA

Bluefin tuna have returned to southern California waters and are being taken by the purse seine boats in good quantities.

The first catch was made in April and the local run started the early part of May. This is very unusual since the fish do not ordinarily appear before the first or the fifteenth of June. The catches have been very spotted and have varied a great deal in quantity. During the early part of the season, the landings were comparatively light, running from three to fifteen tons per boat. It was not until the first part of August that an unusually heavy run was experienced.

The 1934 catch, up to the middle of August, has been approximately ten million pounds. This is well above the ordinary catch although it amounts to only about half of the record take of twenty million pounds made in 1930—*L. G. Van Vorhis, Terminal Island, August 21, 1934.*

## STATEMENT OF INCOME

**For the Period July 1, 1933, to June 30, 1934, of the Eighty-fifth Fiscal Year**

| | | |
|---|---|---|
| Departmental Income, Current Year— | | |
| License sales: | | |
| Angling licenses, 1932 | $5,475 00 | |
| Angling licenses, 1933 | 300,170 00 | |
| Angling licenses, 1934 | 83,719 00 | |
| Commercial hunting club licenses, 1933-34 | 1,750 00 | |
| Commercial hunting club operators' licenses, 1933-34 | 395 00 | |
| Deer tags, 1932 | 1,143 25 | |
| Deer tags, 1933 | 95,776 00 | |
| Deer tags, 1934 | 4 00 | |
| Fish breeders' licenses, 1933 | 20 00 | |
| Fish breeders' licenses, 1934 | 365 00 | |
| Fish importers' licenses, 1933 | 5 00 | |
| Fish importers' licenses, 1934 | 60 00 | |
| Game breeders' licenses, 1933 | 130 00 | |
| Game breeders' licenses, 1934 | 970 00 | |
| Hunting licenses, 1931 | 261 30 | |
| Hunting licenses, 1932-33 | 8,387 18 | |
| Hunting licenses, 1933-34 | 330,779 00 | |
| Hunting licenses, 1934-35 | 79 00 | |
| Kelp licenses, 1934 | 50 00 | |
| Market fishermen's licenses, 1933-34 | 25,040 00 | |
| Market fishermen's licenses, 1934-35 | 24,440 00 | |
| Trapping licenses, 1933-34 | 1,413 00 | |
| Wholesale fish packers' and shell fish dealers' licenses, 1933-34 | 990 00 | |
| Total license sales | | $881,421 73 |
| Other income: | | |
| Contributions from importers | $324 15 | |
| Court fines | 27,107 56 | |
| Fish packers' tax | 192,637 06 | |
| Fish tag sales | 1,576 10 | |
| Game tag sales | 106 32 | |
| Interest on bank balances | 5,332 57 | |
| Income from Department of Agriculture Fund—Chap. 825-33 | 45,131 65 | |
| Kelp tax | 116 76 | |
| Lease of kelp beds | 1,309 20 | |
| Miscellaneous sales | 1,248 07 | |
| Publication sales | 553 30 | |
| Dividends California National Bank (50%) | 18,545 08 | |
| Dividends Trinity County Bank at Weaverville | 178 50 | |
| Total other income | | 294,166 32 |
| Total departmental income, current year | | $1,175,588 05 |

## STATEMENT OF EXPENDITURES

**For the Period July 1, 1933, to June 30, 1934, of the Eighty-fifth Fiscal Year**

| Function | Salaries and wages | Materials and supplies | Service and expense | Property and equipment | Total |
|---|---|---|---|---|---|
| Administration: | | | | | |
| Executive | $8,360 00 | | | | $8,360 00 |
| Clerical and office | 5,520 00 | $1,090 37 | $230 01 | | 6,840 38 |
| Printing, Fish and Game Magazine | | 2,175 52 | | | 2,175 52 |
| Printing, general | | 3,469 94 | | | 3,469 94 |
| Automobile | | 635 26 | 389 57 | | 1,024 83 |
| Traveling | | | 3,232 79 | | 3,232 79 |
| Postage | | | 4,392 22 | | 4,392 22 |
| Telephone and telegraph | | | 3,966 12 | | 3,966 12 |
| Freight, cartage and express | | | 631 95 | | 631 95 |
| Rent | | | 13,354 66 | | 13,354 66 |
| Accident and death claims | | | 4,491 92 | | 4,491 92 |
| Accounting pro rata | 4,500 00 | | | | 4,500 00 |
| Legal | 493 56 | | 3,582 05 | $81 32 | 4,156 93 |
| Premiums on bonds | | | 42 50 | | 42 50 |
| Publicity | | | 438 25 | | 438 25 |
| Pro rata General Fund expense, Chap. 923-33 | | | 2,670 68 | | 2,670 68 |
| Total Administration | $18,873 56 | $7,371 09 | $37,422 72 | $81 32 | $63,748 69 |
| Bureau Education and Research: | | | | | |
| Chief | $1,079 85 | | | | $1,079 85 |
| Clerical and office | 1,920 00 | $35 91 | $65 06 | $3 07 | 2,024 04 |
| Automobiles | | 491 83 | 258 63 | | 750 46 |
| Traveling | | | 2,348 17 | | 2,348 17 |
| Postage | | | 14 80 | | 14 80 |
| Telephone and telegraph | | | 2 42 | | 2 42 |
| Photography | | 8 30 | 104 37 | 45 10 | 157 77 |
| Freight, cartage and express | | | 3 47 | | 3 47 |
| Library | 1,080 00 | 27 86 | 73 17 | 197 87 | 1,378 90 |
| Research | 5,140 00 | 136 80 | 53 10 | 10 50 | 5,340 40 |
| Publicity | 2,450 00 | 41 50 | 34 29 | | 2,525 79 |
| Total Bureau Education and Research | $11,669 85 | $742 20 | $2,957 48 | $256 54 | $15,626 07 |
| Bureau Patrol and Law Enforcement: | | | | | |
| Chief and assistants | $11,100 00 | | | | $11,100 00 |
| Clerical and office | 3,180 00 | $53 50 | $12 70 | $56 86 | 3,303 06 |
| Automobiles | | 27,780 04 | 10,858 88 | 9,699 29 | 48,338 21 |
| Traveling | | | 45,916 23 | | 45,916 23 |
| Postage | | | 603 83 | | 603 83 |
| Telephone and telegraph | | | 1,620 05 | | 1,620 05 |
| Freight, cartage and express | | | 27 40 | | 27 40 |
| Rent | | | 618 78 | | 618 78 |
| Captains and wardens | 176,146 67 | 1,506 07 | 1,105 12 | 76 54 | 178,834 40 |
| Launches | | 2,366 17 | 1,551 12 | 14 06 | 3,931 35 |
| Fish planting | 4,620 00 | 629 58 | 1,257 75 | 49 59 | 6,556 92 |
| Volunteer deputies | | 102 50 | | | 102 50 |
| Premiums on bonds | | | 229 50 | | 229 50 |
| Temporary help | 2,237 77 | | | | 2,237 77 |
| Cooks | 1,500 00 | | | | 1,500 00 |
| Game refuge guard | 720 00 | | | | 720 00 |
| Commercial fisheries patrol: | | | | | |
| Chief and assistants | 2,760 00 | | | | 2,760 00 |
| Captains and wardens | 14,355 50 | 13 83 | 17 66 | | 14,386 99 |
| Launches | 11,291 29 | 5,373 21 | 2,766 31 | 293 95 | 19,724 76 |
| Fish cannery inspectors, seasonal | 9,333 18 | | | | 9,333 18 |
| Traveling | | | 5,256 02 | | 5,256 02 |
| Rent | | | 841 50 | | 841 50 |
| Automobiles | | 678 61 | 359 07 | | 1,037 68 |
| Temporary help | 350 64 | | | | 350 64 |
| Total Bureau Patrol and Law Enforcement | $237,595 05 | $38,503 51 | $73,041 92 | $10,190 29 | $359,330 77 |
| Bureau Commercial Fisheries: | | | | | |
| Chief and assistants | $13,620 00 | | | | $13,620 00 |
| Clerical and office | 9,596 34 | $84 94 | $23 96 | | 9,705 24 |
| Automobiles | | 347 29 | 254 51 | $976 12 | 1,577 92 |
| Traveling | | | 5,694 22 | | 5,694 22 |
| Postage | | | 60 | | 60 |
| Telephone and telegraph | | | 585 77 | | 585 77 |
| Freight, cartage and express | | | 129 73 | | 129 73 |
| Rent | | | 146 92 | | 146 92 |
| Heat, light, water and power | | | 361 37 | | 361 37 |
| Research | 2,280 00 | 33 24 | | 100 92 | 2,414 16 |
| Laboratory | 22,687 58 | 1,154 57 | 907 24 | 500 18 | 25,249 57 |
| Fish tags | | 580 00 | | | 580 00 |
| Statistics | | 855 45 | 2,016 00 | 143 30 | 3,014 75 |
| Temporary help | 88 39 | | | | 88 39 |
| Total Bureau Commercial Fisheries | $48,272 31 | $3,055 49 | $10,120 32 | $1,720 52 | $63,168 64 |

## STATEMENT OF EXPENDITURES

**For the Period July 1, 1933, to June 30, 1934, of the Eighty-fifth Fiscal Year**—Continued

| Function | Salaries and wages | Materials and supplies | Service and expense | Property and equipment | Total |
|---|---|---|---|---|---|
| Bureau Fish Culture: | | | | | |
| Chief and assistants | $7,185 00 | $13 20 | $160 50 | | $7,358 70 |
| Clerical and office | 4,080 00 | 23 94 | 12 75 | $165 28 | 4,281 97 |
| Automobiles | | 6,953 11 | 3,091 37 | 2,913 68 | 12,958 16 |
| Traveling | | | 7,867 58 | | 7,867 58 |
| Postage | | | 219 53 | | 219 53 |
| Telephone and telegraph | | | 1,198 29 | | 1,198 29 |
| Freight, cartage and express | | | 896 25 | | 896 25 |
| Rent | | | 2,774 04 | | 2,774 04 |
| Heat, light and power | | | 1,640 01 | | 1,640 01 |
| Hatcheries | 108,536 67 | 62,139 24 | 1,076 80 | 1,068 65 | 172,821 36 |
| Fish cars | 3,540 00 | 415 47 | 725 63 | | 4,681 10 |
| Blue printing | | 1 62 | 16 46 | | 18 08 |
| Cooperative research | 3,110 71 | 637 58 | 1,762 81 | 22 67 | 5,533 77 |
| Temporary help | 1,520 35 | | | | 1,520 35 |
| Fish hatchery assistant, seasonal | 21,646 04 | | | | 21,646 04 |
| Hydraulic engineering | 2,400 00 | 50 26 | 957 72 | 225 28 | 3,633 26 |
| Special field | 7,340 00 | 99 76 | 5 50 | 94 79 | 7,540 05 |
| Total Bureau Fish Culture | $159,358 77 | $70,334 18 | $22,405 24 | $4,490 35 | $256,588 54 |
| Bureau Game Propagation: | | | | | |
| Chief and assistants | $5,460 00 | | | | $5,460 00 |
| Automobiles | | $630 88 | $270 04 | | 900 92 |
| Traveling | | | 2,250 61 | | 2,250 61 |
| Postage | | | 72 79 | | 72 79 |
| Telephone and telegraph | | | 174 10 | | 174 10 |
| Freight, cartage and express | | | 40 59 | | 40 59 |
| Heat, light and power | | | 1,300 07 | | 1,300 07 |
| Maintenance | 13,005 71 | 10,039 86 | 448 63 | $64 70 | 23,558 90 |
| Temporary help | 744 95 | | | | 744 95 |
| Quail trapping and expansion of quail program | 4,726 07 | 1,641 77 | 2,493 59 | 492 18 | 9,353 61 |
| Purchase of quail and pheasants | | 2,135 67 | | | 2,135 67 |
| Total Bureau Game Propagation | $23,936 73 | $14,448 18 | $7,050 42 | $556 88 | $45,992 21 |
| Bureau Fish Rescue: | | | | | |
| Chief and assistants | $4,800 00 | $4 27 | $42 24 | | $4,846 51 |
| Traveling | | | 107 56 | | 107 56 |
| Rent | | | 109 00 | | 109 00 |
| Temporary help | 117 00 | | | | 117 00 |
| Heavy truck service | | | 1,187 20 | | 1,187 20 |
| Total Bureau Fish Rescue | $4,917 00 | $4 27 | $1,446 00 | | $6,367 27 |
| Bureau Game Refuges: | | | | | |
| Chief and assistants | $8,500 00 | | | | $8,500 00 |
| Clerical and office | 1,920 00 | $11 16 | $12 50 | | 1,943 66 |
| Automobiles | | 557 97 | 182 96 | | 740 93 |
| Traveling | | | 4,752 46 | | 4,752 46 |
| Telephone and telegraph | | | 95 | | 95 |
| Lion hunters | 5,479 00 | | | | 5,479 00 |
| Refuge posting | 450 00 | | | | 450 00 |
| Predatory animal control | | | 5,530 00 | | 5,530 00 |
| Refuge maintenance | 8,145 50 | 3,282 35 | 2,199 81 | $328 20 | 13,955 86 |
| Predatory animal hunters and trappers, seasonal | 5,600 00 | | | | 5,600 00 |
| Temporary help, seasonal | 3,982 00 | | | | 3,982 00 |
| Total Bureau Game Refuges | $34,076 50 | $3,851 48 | $12,678 68 | $328 20 | $50,934 86 |
| Bureau Licenses: | | | | | |
| Clerical and office | $13,140 00 | $111 77 | $22 04 | | $13,273 81 |
| Printing, licenses and applications | | 15,776 06 | | | 15,776 06 |
| Traveling | | | 340 62 | | 340 62 |
| Postage | | | 1,838 14 | | 1,838 14 |
| Freight, cartage and express | | | 1,071 29 | | 1,071 29 |
| Premiums on bonds | | | 1,177 50 | | 1,177 50 |
| Total Bureau Licenses | $13,140 00 | $15,887 83 | $4,449 59 | | $33,477 42 |
| Total eighty-fifth fiscal year expense paid from support appropriations | $551,839 77 | $154,198 23 | $171,572 37 | $17,624 10 | $895,234 47 |

## STATEMENT OF EXPENDITURES

**For the Period July 1, 1933, to June 30, 1934, of the Eighty-fifth Fiscal Year**—Continued

| Function | Salaries and wages | Materials and supplies | Service and expense | Property and equipment | Total |
|---|---|---|---|---|---|
| Special items: | | | | | |
| Claim of Chief Accounting Officer of Department of Finance—Chapter 991-33 | | | | $2,259 11 | |
| Construction of Russian River Jetties—Chapter 989-33 | | | | 7,325 76 | |
| Deer-tight fences—Chapter 872-31: | | | | | |
| From January 1, 1934, to June 30, 1934 | | | $73 80 | | |
| From July 1, 1933, to December 31, 1933 | | | 1,498 05 | | |
| Total deer-tight fences—Chapter 872-31 | | | | $1,571 85 | |
| Electro Metals Company's Claim—Chapter 599-31 | | | | 18,750 00 | |
| License commissions | | | | 38,313 71 | |
| State Fair and other exhibits | | | | 538 32 | |
| Total special items | | | | | $68,758 75 |
| Permanent improvements: | | | | | |
| Construction, improvements and equipment | | | | | $67,496 43 |
| Prior year expense: | | | | | |
| 83d fiscal year | | | | $82 35 | |
| 84th fiscal year | | | | 26,043 69 | |
| Total prior year expense | | | | | $26,126 04 |
| Bureau Commercial Fisheries— Chapter 825-33 | | | | | |
| Fresh fish marketing: | | | | | |
| Chief and assistants | $4,490 47 | | | | $4,490 47 |
| Clerical and office | 1,139 03 | $123 40 | $11 55 | | 1,273 98 |
| Automobiles | | 6 50 | 19 42 | | 25 92 |
| Traveling | | | 1,155 63 | | 1,155 63 |
| Postage | | | 260 00 | | 260 00 |
| Telephone and telegraph | | | 2 61 | | 2 61 |
| Freight, cartage and express | | | 180 68 | | 180 68 |
| Rent | | | 40 57 | | 40 57 |
| Exhibits | | 205 47 | 3,545 95 | | 3,751 42 |
| Temporary help | 351 00 | | | | 351 00 |
| Printing | | 1,852 02 | | | 1,852 02 |
| Pro rata administration | | | 696 21 | $103 79 | 800 00 |
| Total Bureau Commercial Fisheries—Chapter 825-33—Fresh fish marketing | $5,980 50 | $2,187 39 | $5,912 62 | $103 79 | $14,184 30 |
| Grand total proprietary group | | | | | $1,071,799 99 |

In addition to the above expenditures the following amount was transferred from the Fish and Game Preservation Fund into the State Employees' Retirement Fund $17,000 67

## ANGLING LICENSE SALES, 1914-1933

| Year | Number sold | Value | Year | Number sold | Value |
|---|---|---|---|---|---|
| 1914 | 81,965 | $84,417 | 1924 | 202,690 | $210,988 |
| 1915 | 87,262 | 89,620 | 1925 | 222,983 | 232,501 |
| 1916 | 111,994 | 115,518 | 1926 | 246,167 | 256,629 |
| 1917 | No record | 125,572 | 1927 | 262,886 | 273,202 |
| 1918 | No record | 123,080 | 1928* | 217,788 | 445,764 |
| 1919 | No record | 146,724 | 1929 | 225,774 | 471,826 |
| 1920 | No record | 163,183 | 1930 | 248,319 | 508,875 |
| 1921 | 176,873 | 183,319 | 1931 | 242,857 | 497,317 |
| 1922 | 183,116 | 189,738 | 1932 | 212,662 | 436,373 |
| 1923 | 225,171 | 232,995 | 1933 | 175,936 | 358,568 |

*Resident license fee increased from $1.00 to $2.00 each.

## SEIZURES OF FISH AND GAME

### April, May, June, 1934

| | |
|---|---|
| Fish: | |
| Abalones, pounds | 278 |
| Barracuda, pounds | 60 |
| Bass— | |
| Black | 38 |
| Striped | 105 |
| Striped, pounds | 29 |
| Clams | 2,622 |
| Crappie, perch, sunfish | 141 |
| Cockles | 610 |
| Halibut, pounds | 14 |
| Lobsters, pounds | 814 |
| Scallops, pounds | 34 |
| Salt Water Perch, pounds | 75 |
| Salmon, pounds | 1,370 |
| Trout, all kinds, pounds | 872 |
| Yellowfin, pounds | 1,992 |
| Yellowtail, pounds | 17 |
| Nets | 1 |
| Fish traps | 13 |
| Game: | |
| Deer | 11 |
| Deer meat, pounds | 205 |
| Doves | 5 |
| Ducks | 109 |
| Pheasants | 7 |
| Pigeons | 8 |
| Quail | 7 |
| Rabbits | 9 |
| Non-game birds | 11 |
| Tree squirrel | 1 |
| Guns | 2 |
| Bird traps | 1 |

## FISH CASES

April, May, June, 1934

| Offense | Number arrests | Fines imposed | Jail sentences (days) |
|---|---|---|---|
| Abalones; small; overlimit | 41 | $870 00 | 12½ |
| Angling, no license | 48 | 490 00 | |
| Bass— | | | |
| Black; small | 10 | 265 00 | |
| Striped; small; overlimit | 14 | 205 00 | |
| Barracuda; small | 3 | | |
| Clams; small; overlimit | 46 | 560 00 | 30 |
| Cockles; overlimit | 2 | 50 00 | |
| Commercial fishing license act; violations of | 22 | 96 00 | |
| Crappie, sunfish, perch; closed season; overlimit | 17 | 255 00 | |
| Halibut | 1 | | |
| Nets, illegal | 9 | 200 00 | 50 |
| Trout; closed season; overlimit | 50 | 1,200 00 | 47½ |
| Lobsters; closed season | 3 | 25 00 | |
| Salmon; small | 1 | | |
| Fish traps, illegal | 3 | 135 00 | |
| Fishing in closed waters | 21 | 375 00 | |
| Illegal fishing gear | 2 | 5 00 | |
| Miscellaneous fish cases | 4 | 5 00 | 3 |
| Totals | 297 | $4,736 00 | 143 |

## GAME CASES

April, May, June, 1934

| Offense | Number arrests | Fines imposed | Jail sentences (days) |
|---|---|---|---|
| Deer; closed season; killing does, fawns; spike buck | 38 | $775 00 | 495 |
| Ducks; closed season | 2 | 40 00 | |
| Doves; closed season | 2 | 75 00 | 75 |
| Grouse; closed season | 1 | | |
| Pheasants; closed season | 6 | 75 00 | 450 |
| Pigeons; closed season | 3 | | |
| Quail; closed season | 2 | 65 00 | |
| Rabbits; closed season | 4 | 25 00 | |
| Tree squirrels | 1 | | |
| Firearms in game refuge | 8 | 80 00 | |
| Hunting license act; violations of | 11 | 108 00 | |
| Non-game birds; killing of | 1 | | |
| Spotlight hunting | 4 | 165 00 | 120 |
| Shooting from automobile | 1 | | |
| Totals | 84 | $1,408 00 | 1,140 |

## FRESH FISH IMPORTATIONS* FROM FOREIGN COUNTRIES FOR APRIL, MAY AND JUNE, 1934

**Compiled by the Division of Fish and Game, Bureau of Commercial Fisheries**

| Species | Landed in Region 70, Los Angeles | Landed in Region 80, San Diego | Total pounds |
|---|---|---|---|
| Barracuda | 9,685 | 21,495 | 31,180 |
| Cabrilla | 104,389 | 113,900 | 218,289 |
| Corbina, Mexican | 17,295 | | 17,295 |
| Grouper | 25,467 | 15,440 | 40,907 |
| Halibut, California | 23,613 | 48,767 | 72,380 |
| Mackerel, Pacific | 20 | 90,846 | 90,866 |
| Mackerel, Spanish | 1,331 | 253 | 1,584 |
| Perch | | 278 | 278 |
| Rock Bass | 10,428 | 37,497 | 47,925 |
| Rockfish | 12,429 | 39,499 | 51,928 |
| Sardine | | 613 | 613 |
| Sea-bass, Black | 108,925 | 60,876 | 169,801 |
| Sea-bass, White | 4,002 | 43 | 4,045 |
| Shark | | 604 | 604 |
| Sheepshead | | 171 | 171 |
| Sole | | 40 | 40 |
| Totuava | 96,217 | | 96,217 |
| Tuna, Albacore | 916,470 | | 916,470 |
| Tuna, Bonito | 1,144 | 71,868 | 73,012 |
| Tuna, Skipjack | 258,909 | 751,258 | 1,010,167 |
| Tuna, Yellowfin | 7,718,528 | 11,628,596 | 19,347,124 |
| Whitefish | 3,536 | 2,272 | 5,808 |
| Yellowtail | 118,612 | 387,836 | 506,448 |
| Miscellaneous Fish | 360 | | 360 |
| Crustacean: | | | |
| Lobster, Spiny | 10,066 | 28,131 | 38,197 |
| Mollusk: | | | |
| Clam, Cockle | 7,800 | | 7,800 |
| Reptile: | | | |
| Turtle | | 2,601 | 2,601 |
| Total pounds | 9,449,226 | 13,302,884 | 22,752,110 |

*Included in tables of landings for Region 70, Los Angeles, and Region 80, San Diego.

## CALIFORNIA FRESH FISH LANDINGS* FOR APRIL, MAY AND JUNE, 1934

Compiled by the Division of Fish and Game, Bureau of Commercial Fisheries

| Species | Region 10, Del Norte | Region 20, Eureka | Region 30, Sacramento | Region 40, San Francisco | Region 50, Monterey | Region 60, Santa Barbara | Region 70, Los Angeles | Region 80, San Diego | Total pounds |
|---|---|---|---|---|---|---|---|---|---|
| Anchovy | | | | 35,080 | 96,770 | | 27,236 | | 159,086 |
| Barracuda | | | | | 52 | 1,861 | 540,250 | 142,829 | 684,992 |
| Cabezone | | | | 190 | 2,837 | 81 | | | 3,108 |
| Cabrilla | | | | | | | 104,389 | 113,900 | 218,289 |
| Carp | | | 34,816 | | | | 788 | | 35,604 |
| Catfish | | | 24,402 | | | | | | 24,402 |
| Corbina, Mexican | | | | | | | 17,295 | | 17,295 |
| Cultus, Pacific | 3,717 | 22,564 | | 119,457 | 16,689 | | 1,002 | | 163,429 |
| Eel | | | | 23 | | | | | 23 |
| Flounder, Starry | | | 205 | 145,069 | 3,843 | | | | 149,117 |
| Flying Fish | | | | | | | 15,200 | | 15,200 |
| Grouper | | | | | | | 25,467 | 15,440 | 40,907 |
| Hake | | 392 | | 21,663 | 850 | | | | 22,905 |
| Halibut, California | | | | 14,883 | 7,984 | 52,783 | 137,412 | 73,207 | 286,269 |
| Halibut, Northern | 437 | 402,275 | | 74,021 | | | | | 476,733 |
| Hardhead | | | 30,840 | | | | | | 30,840 |
| Herring, Pacific | | | | | 100 | | | | 100 |
| Kingfish | | | | 5,013 | 35,157 | | 98,465 | 6 | 138,641 |
| Mackerel, Horse | | | | | 5,888 | | 80,374 | | 86,262 |
| Mackerel, Pacific | | | | | 171,709 | 471 | 11,468,692 | 4,690,379 | 16,331,251 |
| Mackerel, Spanish | | | | | | | 1,331 | 253 | 1,584 |
| Mullet | | | | | | | 1,073 | 4,464 | 5,537 |
| Perch | 29 | 1,327 | | 18,304 | 13,204 | 4,278 | 9,149 | 463 | 46,754 |
| Pike | | | 128 | | | | | | 128 |
| Pompano, California | | | | | 42 | | 2,445 | | 2,487 |
| Rock Bass | | | | 130 | 4 | 1,422 | 92,798 | 59,182 | 153,536 |
| Rockfish | 1,849 | 18,163 | | 203,101 | 518,343 | 99,158 | 358,873 | 117,018 | 1,316,505 |
| Sablefish | | 166,738 | | 116,544 | 23,189 | 8,677 | 212,364 | 452 | 527,964 |
| Salmon | 43,936 | 952,340 | 135,076 | 101,541 | 169,345 | | | | 1,402,238 |
| Sand Dab | | | | 229,092 | 5,087 | | 3,246 | | 237,425 |
| Sardine | | | | 10,710 | 499,795 | | 27,107 | 3,513 | 541,125 |
| Sculpin | | | | | | | 13,807 | 633 | 14,440 |
| Sea-bass, Black | | | | | | 1,249 | 112,834 | 68,373 | 182,456 |
| Sea-bass, Shortfin | | | | | | | | 358 | 358 |
| Sea-bass, White | | | | | 495 | 2,644 | 228,402 | 19,033 | 250,574 |
| Shad | | | 825,277 | | 3 | | | | 825,280 |
| Shark | | | | 2,998 | 400 | 5,203 | 152,925 | 2,246 | 163,772 |
| Sheepshead | | | | | | 834 | 12,560 | 171 | 13,565 |
| Skate | | | | 51,676 | 5,148 | | 3,180 | 440 | 60,444 |
| Smelt | 339 | 7,055 | | 82,384 | 36,136 | 10,944 | 40,988 | 5,814 | 183,660 |
| Sole | | | | 1,933,022 | 65,780 | 147,190 | 9,683 | 188 | 2,155,863 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Split-tail | | | 11,759 | | | | | | 11,759 |
| Striped Bass | | | 418,270 | 9,896 | 40 | | | | 428,206 |
| Sucker | | | 6,575 | | | | | | 6,575 |
| Swordfish, Broadbill | | | | | | | 11,464 | 4,465 | 15,929 |
| Swordfish, Marlin | | | | | | | 343 | | 343 |
| Tomcod | | | | 243 | | | | | 243 |
| Totuava | | | | | | | 96,217 | | 96,217 |
| Tuna, Albacore | | | | | | | 916,470 | | 916,470 |
| Tuna, Bluefin | | | | | | | 3,089,512 | 5,555 | 3,095,067 |
| Tuna, Bonito | | | | | | | 1,904,593 | 784,388 | 2,688,981 |
| Tuna, Skipjack | | | | | | | 258,909 | 751,508 | 1,010,417 |
| Tuna, Yellowfin | | | | | | | 7,718,528 | 11,628,596 | 19,347,124 |
| Turbot | | | | 32,515 | 416 | | | | 32,931 |
| Whitebait | 11,267 | 30,440 | | 5,697 | 16,823 | | | | 64,227 |
| Whitefish | | | | | | | 7,479 | 6,291 | 13,770 |
| Yellowtail | | | | | | | 190,165 | 426,608 | 616,773 |
| Miscellaneous Fish | 75 | 1,531 | 1,485 | 73,822 | 5 | 58 | 2,522 | | 79,498 |
| Crustacean: | | | | | | | | | |
| Crab | 2,621 | 36,444 | | 1,097,950 | 59,014 | | | | 1,196,029 |
| Crab, Rock | | | | | | | 8,475 | | 8,475 |
| Lobster, Spiny | | | | | | | 10,066 | 28,131 | 38,197 |
| Prawn | | | | | | | 12 | | 12 |
| Shrimp | | | | 587,704 | | | | | 587,704 |
| Mollusk: | | | | | | | | | |
| Abalone | | | | | 740,550 | 125,950 | | | 866,500 |
| Clam, Cockle | | | | 21,542 | | | 11,884 | | 33,426 |
| Clam, Great Washington | | 600 | | 440 | | | | | 1,040 |
| Clam, Pismo | | | | | 441 | 29,708 | | | 30,149 |
| Clam, Soft-shell | | 210 | | 67,086 | | | | | 67,296 |
| Clam, Washington | | 4,756 | | 344 | | | | | 5,100 |
| Octopus | | 124 | | 3,072 | 6,521 | | 89 | | 9,806 |
| Oyster, Eastern | | | | 60,916 | | | | | 60,916 |
| Oyster, Native | | | | 25,999 | | | | | 25,999 |
| Squid | | | | | 429,556 | | 4,465 | | 434,021 |
| Amphibian and Reptile: | | | | | | | | | |
| Frog | | | 60 | | | | | | 60 |
| Turtle | | | | | | | | 2,601 | 2,601 |
| Total pounds | 64,270 | 1,644,959 | 1,488,893 | 5,152,127 | 2,932,216 | 492,511 | 28,030,528 | 18,956,505 | 58,762,009 |

*Fresh fish importations from foreign countries included. See importation tables.

## FRESH FISH IMPORTATIONS BY POINT OF ORIGIN, APRIL, MAY AND JUNE, 1934

Compiled by the Division of Fish and Game, Bureau of Commercial Fisheries

| Species | Gulf of California | West coast Mexico and international waters south of boundary | From Cape Corrientas to Gulf of Fonseca | Costa Rica | Panama | Galapagos Islands | Japan | Total pounds |
|---|---|---|---|---|---|---|---|---|
| Barracuda | | 31,180 | | | | | | 31,180 |
| Cabrilla | 26,629 | 191,660 | | | | | | 218,289 |
| Corbina, Mexican | 16,903 | 392 | | | | | | 17,295 |
| Grouper | | 40,907 | | | | | | 40,907 |
| Halibut, California | | 72,380 | | | | | | 72,380 |
| Mackerel, Pacific | | 90,866 | | | | | | 90,866 |
| Mackerel, Spanish | | 1,584 | | | | | | 1,584 |
| Perch | | 278 | | | | | | 278 |
| Rock Bass | | 47,925 | | | | | | 47,925 |
| Rockfish | | 51,928 | | | | | | 51,928 |
| Sardine | | 613 | | | | | | 613 |
| Sea-bass, Black | 460 | 169,341 | | | | | | 169,801 |
| Sea-bass, White | | 4,045 | | | | | | 4,045 |
| Shark | | 604 | | | | | | 604 |
| Sheepshead | | 171 | | | | | | 171 |
| Sole | | 40 | | | | | | 40 |
| Totuava | 96,217 | | | | | | 916,470 | 96,217 |
| Tuna, Albacore | | | | | | | | 916,470 |
| Tuna, Bonito | | 73,012 | | | | | | 73,012 |
| Tuna, Skipjack | | 868,584 | | 16,088 | 125,495 | | | 1,010,167 |
| Tuna, Yellowfin | | 14,165,169 | 281,265 | 1,424,638 | 2,566,552 | 754,058 | 155,442 | 19,347,124 |
| Whitefish | | 5,808 | | | | | | 5,808 |
| Yellowtail | | 506,448 | | | | | | 506,448 |
| Miscellaneous Fish | | 360 | | | | | | 360 |
| Crustacean: | | | | | | | | |
| Lobster, Spiny | 136 | 38,061 | | | | | | 38,197 |
| Mollusk: | | | | | | | | |
| Clam, Cockle | 7,800 | | | | | | | 7,800 |
| Reptile: | | | | | | | | |
| Turtle | | 2,601 | | | | | | 2,601 |
| Total pounds | 148,145 | 16,363,957 | 281,265 | 1,440,726 | 2,692,047 | 754,058 | 1,071,912 | 22,752,110 |

# INDEX TO VOLUME 20

All numbers in italics refer to pages where definite information pertaining to subject is given.

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# 1933–ABSTRACT CALIFORNIA SPORTING FISH & GAME LAWS–1935

THIS ABSTRACT WILL BE VALID UNTIL 90 DAYS AFTER ADJOURNMENT OF THE 1935 LEGISLATIVE SESSION

## OPEN AND CLOSED SEASONS

WHITE SQUARES INDICATE OPEN SEASON. NUMBERS IN SQUARES ARE OPEN DATES

| GAME | DISTRICTS | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC | BAG AND POSSESSION LIMITS, ETC. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEER | 1½ | | | | | | | | | | 15 | | | No Does, Fawns or Spike Bucks<br>No Forked Horned Deer in Dist. 1¾<br>No sale of Venison or Deer Skins<br>Two Bucks per Season<br>except in 1¾ where limit is one<br>See Notes 6-9-10-12 |
| | 2-2½-3 | | | | | | | | | 14 | | | | |
| | 2¾-4-4¼ | | | | | | | | 16 | 15 | | | | |
| | 1-1¾-4½-23-25 | | | | | | | | | 16 | 15 | | | |
| Rabbits—Cottontail and Brush | ALL EXCEPT 4, 4¾, 19, 21 | | | | | | | | | | | 15 | 15 | 15 per day. 30 per week. Season always open in 4, 4¾, 19, 21 |
| Bear, Fur Animals | ALL | | | | | | | | | | | | 16 | See Note 7 |
| Ducks, Geese, Jack Snipe, Mud Hens | ALL — FEDERAL LAW | See Note → | | | | | | | | | | | | Federal regulations will be enforced in California and will be published as soon as announced by Federal authorities. |
| | STATE LAW | 15 | | | | | | | | | | | | 15 Ducks daily, 30 weekly, possession limit, 25 Snipe daily, possessed limit. Goose & Mud hen limit see note 4. See notes 9 to 13, incl |
| Quail—Valley, Desert and Mountain | ALL EXCEPT 1½ | | | | | | | | | | | | 15 | Valley - Desert - Mountain<br>Each Variety<br>10 per day. 10 in possession.<br>20 per week |
| | 1½ | | | | | | | | | | | | | |
| Dove | ALL EXCEPT 4-4½-4¾ | | | | | | | | | | | | | 15 Per Day 15 in possession<br>30 Per Week |
| | 4-4½-4¾ | | | | | | | | | | | | | |
| Pheasant | | | | | | | | | | | | 15 | 15 | 2 Male birds per day<br>2 in possession |
| Pigeon | | | | | | | | | | | | 20 | | 10 per day 10 in possession<br>20 per week |

There is no open season on Elk, Antelope, Mountain Sheep, Sea Otter, Beaver, Tree Squirrel, Sierra Hare, Rail, Wood Duck, Swan, Shore Birds (except Jack Snipe), Grouse, Sage Hen, Imported Quail, Partridge, or Wild Turkey

| FISH | DISTRICTS | JAN. | FEB. | MAR. | APR. | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC | BAG AND POSSESSION LIMITS, ETC. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Steelhead and all Trout (except Golden) Whitefish<br>Unlawful to take trout in waters closed by Governor's proclamation | 1-1½-1¾-2-2¾-3-4-4½-4¾ 15 Klamath River, Lake Almanor | | | | | | | | | | | | | Bag limit for taking and possession, 25 trout or 10 pounds and one trout. No Sale<br>No Spearing<br>For other restrictions See Notes 12-15-16-20 21-22-27-28 30-32 On this Card |
| | 2½ | | 28 | | | 30 | | | | | | | | |
| | 23-25 | | | | | 30 | | | | | | | | |
| | Truckee River | | | | | 15 | | | | | | | | |
| | See Note 22 | | | | | | | | | | | | | |
| | 1½-5 and Winter Klamath River | | 28 | | | | | | | | | | | 5 Trout regardless of weight |
| | Russian, Napa, Navarro, Tet in 2, 2½, 12a, Tidewater 2, 2-15 | | 28 | | | | | | | | | | | 3 Trout regardless of weight |
| | Sacramento River between Vina Ferry and Middle Creek, Shasta County | | | | | | | | | | | | | 3 Trout regardless of weight |
| Golden Trout | ALL EXCEPT 1-4½ | | | | | | | | | | | | | 20 per day. None under 5 inches<br>Not more than 10 lbs. and one<br>See Note 22 |
| | 1-4½, Except Col Tributaries Lake group | | | | | | | | | | | | | |
| BLACK BASS | ALL EXCEPT 4¾ | | | | | 29 | | | | | | | | 15 per day<br>No Black Bass under 9 in.<br>No sale<br>Hook and line only |
| | CLEAR LAKE | | | | | | | | | | | | | Clear Lake<br>10 per day<br>25 per day |
| Sunfish | ALL | | | | | 29 | | | | | | | | |
| Sacramento Perch and Crappie | ALL EXCEPT CLEAR LAKE | | | | | 29 | | | | | | | | 25 per day<br>Hook and line only<br>No sale<br>10 per day |
| | CLEAR LAKE | | | | | | | | | | | | | |
| Striped Bass | ALL | | | | | | | | | | | | | Feather River from mouth to Oroville, closed January 1st to April 10th<br>None under 12 inches, 5 per day 5 in possession None to be taken from Suisun Bay. See Notes 18 and 28. |
| Crabs | ALL EXCEPT 1½-6-7-8-9 | | | | | | | 30 | | | | | 15 | Season Districts 1½-6-7-8-9 December 15 to August 30<br>See Note 23, None under 7 inches, No Female |
| Abalones | | 14 | | | 16 | | | | | | | | | Only for Food. Must be brought to shore alive in shell<br>Angling license Required. See Note 26 |
| Pismo Clams | 17 | | | | | | | | | | | | | None under 5 inches. No shipment. 15 per day<br>Angling license Required District 18a Closed |
| Spiny Lobster | ALL | | | | | | | | | | | | | No Sale of Meat. None under 10½ or over 16 inches<br>See Note 23 |
| GRUNION | ALL | | | | | | | | | | | | | |

**SALMON, See Note A.** **STURGEON, No Open Season (possession prohibited).**

## NOTES

### IT IS ALWAYS UNLAWFUL

1. To hunt, kill, possess wild birds or mammals, to possess firearms, except under written permit from the Commission, in Dists. 1a, 1b, 1c, 1d, 1e, 1f, 1g, 1h, 1i, 1j, 1k, 1m, 1n, 1o, 1p, 1q, 1r, 1s, 1t, 2a, 2b, 3a, 3b, 3c, 3d, 3e, 3f, 3g, 3h, 4a, 4b, 4c, 4d, 4e, 4f, 4g, or General Grant Refuge, or Mt. Tamalpais Game Refuge, including Richardson Bay, or San Francisco Refuge, or Silver Lake Refuge (water fowl may be killed in 4a and 4e), or to hunt quail in Bolinas Quail Refuge, or to hunt or discharge firearms in Huntington Lake Refuge, San Leandro Bay Refuge, or Monterey Peninsula Refuge.

2. To hunt birds or mammals excepting predators without a hunting license. To hunt in areas closed by proclamation.

3. To possess any bird net or to net, trap or to hold protected game or birds of any kind, their nests or eggs except under written permit from the Commission.

4. To take more than 4 geese per day, 8 per week of all varieties, and 12 Canada geese and black sea brant. To take more than 25 mud hens per day, 50 per week. To have more than 1 daily bag limit of geese and mud hens in possession by 1 person in 1 day.

5. To take or kill nongame birds, except blue jay, butcher bird, English sparrow, sharp-shinned, Cooper or duck hawk, great horned owl, linnat, crow, black-billed magpie, white pelican, shag, and in Dists. 1, 2, 3, 4 and 4½, blackbirds.

6. To hunt deer without deer tag license. To fail to attach to horns of deer immediately on killing, properly filled out deer tag or at same time to send duplicate tag to Division. To carry deer into closed district without having deer tag counterasigned, or to have untagged deer in possession. To fail to retain in possession during open season and for 10 days after, skin and portion of head bearing horns of deer killed and to produce upon demand. To use more than 1 dog to hunter in hunting deer or to allow dogs to run deer in closed season, or to possess doe or fawn skins, or deer skins not bearing evidence of sex.

7. To trap for profit without first procuring a trapping license bear, ring-tailed cat, coon, pine marten, skunk, fisher, wolverine, mink, river otter, fox or muskrat, or to kill same during closed season, except when destroying property. To interfere with traps of licensed trappers. To use saw tooth or spike-jawed traps for taking fur bearers.

8. To use any animal other than dog to stalk wild birds.

9. To shoot game from power boat, sailboat, auto, airplane, or to hunt waterfowl from scull boat in Dists. 8, 9, except on Wed. and Sun., or at any time in Dist. 12 or Napa River south of Edgerly Island, and in Mare Island Straits from the Napa River to Carquinez Strait, or to use shotgun larger than 10 gauge, or to possess an extension automatic or cane gun. To have in possession any device capable of or to be used in silencing the report of any firearm.

10. To shoot resident game between ½ hour after sunset and ½ hour before sunrise, or migratory game between sunset and ½ hour before sunrise. To use a spotlight in hunting game.

11. To drive game birds by means of auto, airplane, or power boat over shooters.

12. To hold game or fish longer than 5 days after close of season; venison 15 days.

13. To sell wild game, except cottontail and brush rabbits.

14. To make a false statement in applying for license. To fail to show license upon demand to any officer.

15. To take game or fish from one district to another when season is not open in both. (Special law for deer, trout and black bass.) Trout legally taken may be transported from open district into closed district by the consignor making an affidavit in duplicate setting forth his name, address, number of angling license and name and address of consignee. Original must be attached to shipment; copy left on file with officer before whom sworn. Trout may be shipped into closed district when accompanied by written statement to effect that trout were legal, signed by shipper, countersigned by person to whom offered for shipment. Black bass legally taken may be transported from open district into closed district.

16. To ship wild birds, mammals, or fish except smoked or dried fish other than trout by parcels post, or in concealed packages or without a tag bearing name and address of consignee and consignor and contents, or to ship game out of State.

17. To operate a commercial hunting club without license.

18. To place obstructions in streams in Dists. 1, 1½, 2, 2½, 2¾, 3, 4, 4½, 23 and 25 that will stop or impede fish.

19. To sell striped bass taken with hook and line; to transport or carry striped bass out of State. To ship striped bass less than 20 in. in length or more than 10 lbs. in weight. To possess more than 5 shad per day between June 1 and Feb. 14

20. To take trout other than with rod and line held in hand or with lure with more than 2 attractor blades or more than 3 hooks. To take trout except by angling in such manner as to cause trout to voluntarily take hook in its mouth.

21. To have in possession any fish spear or gaff (except landing gaff) within 300 feet of any lake or stream when unlawful to spear salmon.

22. To take trout in any lake within 200 feet of mouth of any stream from Oct. 31 to Aug. 1, or in that portion of any stream flowing into any lake in Dist. 23 within 2 miles from its mouth, upstream, from Oct. 31 to Aug. 1. To take golden trout in Cottonwood Lakes group, including South Fork Cottonwood Lakes group and ½ mile of stream below the lower lake in each of said groups, except from July 1 to Oct. 31.

23. To bring to shore crabs or lobsters in such condition that size can not be taken; or to ship or carry crabs out of Dists. 1½, 2½, 5, 6, 7, 8 or 9. To sell any crabs taken in Eel River or tributaries or to possess more than 10 crabs taken there or to take any between ½ hour after sunset and ½ hour before sunrise.

24. To take or possess in Dist. 3 salt water eels of less than 12 in. or more than 16 per day.

25. To take or possess cockles less than 1½ in. in diameter, or to take or possess more than 15 (Dists. 2 and 10) Washington clams or more than 10 horse clams or more than 30 razor or jackknife clams per day, or in Dists. 18, 19, 21 more than 15 lbs. of mussels per day. To take or possess any Pismo clams in Dist. 18 between ½ hour after sunset and ½ hour before sunrise, or to possess any clam digging implement in that district. To possess any clam digging implement in any clam preserve.

26. To take red abalones less than 7 in., in greatest diameter; green, 6½; pink, 6; black, 5; to dry abalones; to dive for abalones in Dists. 7, 15, 16, 17, 19, 20 and 20a; to take more than 10 per day or 20 per week in Dists. 7, 15, 16, 17, 19, 20 and 20a. To take more than 10 per day from shore in Dists. 7, 10 and 18; to take more than 10 black abalones per day in Dists. 15, 16, 17, 18, 19, 20, 20a, 21. To possess more than 10 per day in Dist. 2.

27. To fish for game fish without having an angling license.

28. To take game fish between 1 hour after sunset and 1 hour before sunrise in Dists. 1, 1½, 1¾, 2, 2½, 2¾, 3, 4, 4½, 4¾, 23, 25. To take striped bass by hook and line between sunset and sunrise.

29. To fish with nets except in commercial districts or to injure any legal net.

30. To fish through ice for any fish or to take fish in Dist. 14.

31. To place, cause to be placed, or discharge into any waters substances deleterious to fish or plant life.

32. To fish within 250 ft. of fishway or 150 ft. of upper side of fish screen, or lower side of dam, or to take fish except salmon within ½ mile of either side of spawning station, or any lake within ½ mile of spawning station when station is in operation.

33. To kill, injure or capture Cal. sea lions in Dists. 19, 20, 20a.

34. To take invertebrates or marine plants in Hopkins Marine Refuge (Monterey Co.) or in that area between the west line of the property of the Scripps Institute and a line 1,000 feet west of low tide line (San Diego Co.).

35. To take more than 5 white sea bass from May 1 to June 30, or to take at any one time more than 5 under 28 in.

36. To take more than 30 lbs of halibut under 4 lbs. each, or to take more than 5 barracuda less than 3 lbs. each.

37. To take frogs less than 4 in. in length measured from tip of nose to posterior end of body between hind legs, or to take or possess more than 24 frogs per day or 48 frogs per week.

NOTE A.—SALMON. Salmon can not be taken on spawning beds, or within 10 miles of spawn-taking station, or 3 miles north and south of mouth of Klamath River. All salmon boats must have landing net, and no chinook less than 27, or silver less than 24 in. can be taken in ocean and Humboldt Bay Dists. Undersized salmon can not be gaffed or clubbed, or brought ashore in such condition that size can not be determined. Salmon may be taken with hook and line in any district when trout season for said district is open.

In Dist. 1, salmon may be taken with hook and line or spear between May 28 and Oct. 31, except (a) in Feather River from its mouth to mouth of the Yuba; (b) in American River from its mouth to Fair Oaks bridge. In Dist. 3, (c) in Ruslian, Napa and Navarro rivers; (d) in Eel River and (e) in tidewater in Dists. 2, 2½ and 15, with hook and line from May 1 to last day of Feb., bag limit 2 per day. In Feather River between mouth of Yuba and Thermalito bridge, with hook and line between May 1 and Dec. 31, bag limit 2 per day. In San Joaquin River, from mouth to Mendota weir, with hook and line from April 1 to Dec. 31. In Dist. 1¼, with hook and line from May 29 to Dec. 31; with spear from Aug. 1 to Oct. 31, bag limit 2 per day. In Dists. 2, 2½, with hook and line from May 1 to Feb. last; with spear from Nov. 1 to Feb. last, bag limit 2 per day. In Dist. 2, with hook and line from May 1 to Oct. 31, bag limit 2 per day. In Klamath River Dist. above tidewater, with hook and line from May 29 to Dec. 31; with spear, from Aug. 1 to Oct. 31, bag limit 2 per day. In Klamath River Dist. in tidewater, with hook and line from May 29 to Dec. 31. Bag limit 1½ per day from May 29 to Sept. 5, and 2 per day from Sept. 6 to Dec. 31, not more than 1 daily bag limit in possession. In Dists. 6, 7, 8, 9 with hook and line from April 1 to Sept. 15, no bag limit. In Dists. 10, 11, with hook and line from May 1 to Aug. 30, no bag limit. In Dists. 12, 12B, 12C, 13, with hook and line at any time, no bag limit. In Dist. 12A, with hook and line from May 1 to Feb. last, bag limit 2 per day. In Dists. 15, 16, 17, 18, with hook and line from Mar. 1 to July 15.


## LICENSES MUST BE SHOWN UPON DEMAND

Districts 1a, 1b, 1c, 1d, 1e, 1f, 1g, 1h, 1i, 1j, 1k, 1m, 1n, 1o, 1p, 1q, 1r, 1s, 1t, 2a, 2b, 3a, 3b, 3c, 3d, 3e, 3f, 3g, 3h, 4a, 4b, 4c, 4d, 4e, 4f, 4g, are Game Refuges. Hunting prohibited. Angling in accordance with law relating to main districts in which refuge is located.

Districts 5, 6, 7, 8, 9, 10, 11, 12, 12a, 12b, 12c, 13, 16, 17, 18, 19, 19a, 20, 20a, 21, 22, are Commercial Districts. Hunting and angling in accordance with law relating to main district in which small district is located.

District 14 is a Fish Reservation. All fishing prohibited.

District 2½ includes those townships in Mendocino County bordering on the Pacific Ocean (except 15 and 16 W., 11 N.) and townships 13, 14, 15, 16, 17 and 18 N., R. 16 W.

District 2¾. Those parts of Mendocino, Lake and Colusa counties lying east of the Redwood Highway and north of the Lake Tahoe-Ukiah Highway, and all of Glenn County.

District 23. The water shed of Lake Tahoe and Truckee River, Rubicon and Little Rubicon above confluence. Water shed of American River and Silver Creek above confluence. Includes waters in water shed of Cosumnes above mother lode highway bridge, waters of South Fork American River between Chili Bar Dam and mouth of Silver Creek, the waters of the Carson, West Carson and all tributaries, Twin Lakes, Silver, Twin, Blue, Meadow, Wood, Winnemucca, Scott, Burnside Lake and all tributary streams and the drainage area of Webber Creek above mother lode highway bridge.

*Sporting fishing licenses are required for the taking of the following fish and mollusks only, trout, yellow tail, marlin, broad bill swordfish, pink or black sea bass, albacore, barracuda, bonita, sea bass, California whiting (also known as corbina and surf fish), yellowfin, croakers, sturgeon (under), steelhead salmon, rainbow trout, chars, whitefish, striped bass, black bass, perch, crappie, catfish bass, Pismo clams, abalones, and all varieties of mollusks.*

## LICENSE PROVISIONS

### HUNTING

License year July 1 to June 30

| | |
|---|---|
| Residents under 18 | $1.00 |
| Resident citizens | 2.00 |
| Nonresident citizens | 10.00 |
| Declarant aliens | 10.00 |
| Other aliens | 25.00 |

### ANGLING

License year January 1 to December 31

| | |
|---|---|
| Resident citizens | $2.00 |
| Nonresident citizens | 3.00 |
| Aliens | 5.00 |
| Under 18 no license required | |

### TRAPPING

License year July 1 to June 30

| | |
|---|---|
| Citizens | $1.00 |
| Aliens | 2.00 |
| Under 18 no license required | |

### DEER TAG

License year January 1 to December 31

| | |
|---|---|
| Everyone (2 tags) | $1.00 |

### COMMERCIAL HUNTING CLUBS

License year July 1 to June 30

| | |
|---|---|
| Citizens | $25.00 |
| Aliens | 100.00 |
| Operators, citizens | 5.00 |
| Operators, aliens | 25.00 |

*For Laws in Full See Fish and Game Code*

*For Commercial Fish Laws See Commercial Abstract*

*For Information Regarding Fish or Game Write to the Division of Fish and Game*

# CALIFORNIA FISH AND GAME

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Volume 20 San Francisco, January, 1934 Number 1

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## DEPARTMENT OF NATURAL RESOURCES

## DIVISION OF FISH AND GAME

San Francisco, California

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Erol Greenleaf—Launch "Albacore," Monterey
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W. J. Black—Launch "Hunter," Vallejo
Wm. Hoppe—Launch "Rainbow," Walnut Grove
Geo. Smalley—Launch "Walter R. Welch," Pittsburg
T. F. Miller—Launch "Silverside," Klamath

Captains indicated in capitals.

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San Francisco, California

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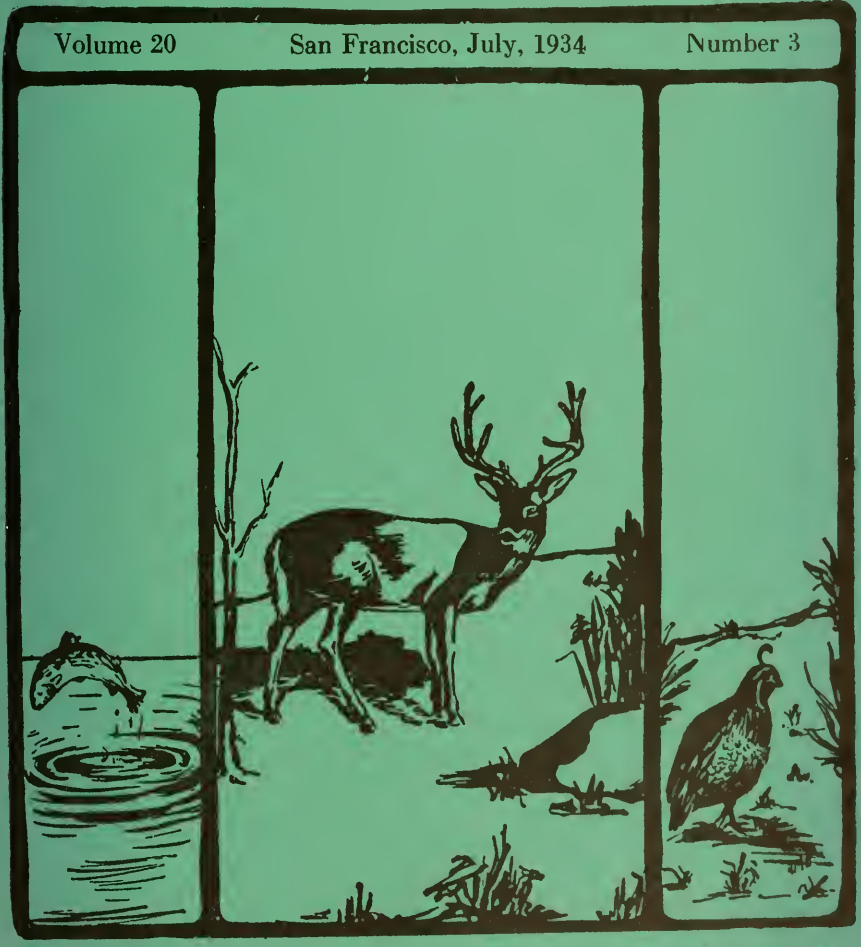

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