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## Nesting studies of ducks and coots in Honey Lake Valley

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### INTRODUCTION

During the spring of 1951 and 1953 studies were made to determine the status of nesting ducks and coots in Honey Lake Valley, Lassen County, California.

The main objectives of the studies were to obtain information on nesting populations, nesting density, preferred nesting habitat, nesting success, and the production derived from successful nesting. The 1951 study was the first survey made on nesting ducks and coots in the valley.

The 1953 study determined what changes had occurred in nesting activities and also supplied data additional to those obtained in 1951.

Sample areas were established and utilized during each study, and nest histories were completed on all nests found in these areas.

The results obtained in both years were similar in most cases. The most apparent difference was a shift in the bulk of nesting from dry upland areas in 1951 to marshy areas in 1953. The average nesting success for both years was approximately 50 percent for ducks and 96 percent for coots.

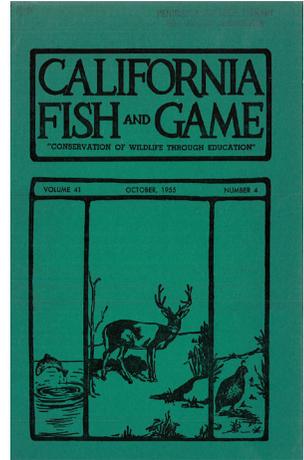
Brood data showed a slight reduction in the brood size of ducks and an extensive reduction in the brood size of coots during the first week of life.

### ACKNOWLEDGEMENTS

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### LOCALE OF THE STUDIES

The study areas were located in Honey Lake Valley in southeastern Lassen County (Figure 1). Most of the preferred waterfowl nesting habitat in this valley was in an area along the lower reaches of the Susan River, from the mouth of Willow Creek to the river's entrance into Honey Lake. During the wet cycles, when Honey Lake is filled to capacity or near capacity, suitable nesting habitat is available from the mouth of the Susan River west along the lakeshore for approximately five miles. A further description of waterfowl



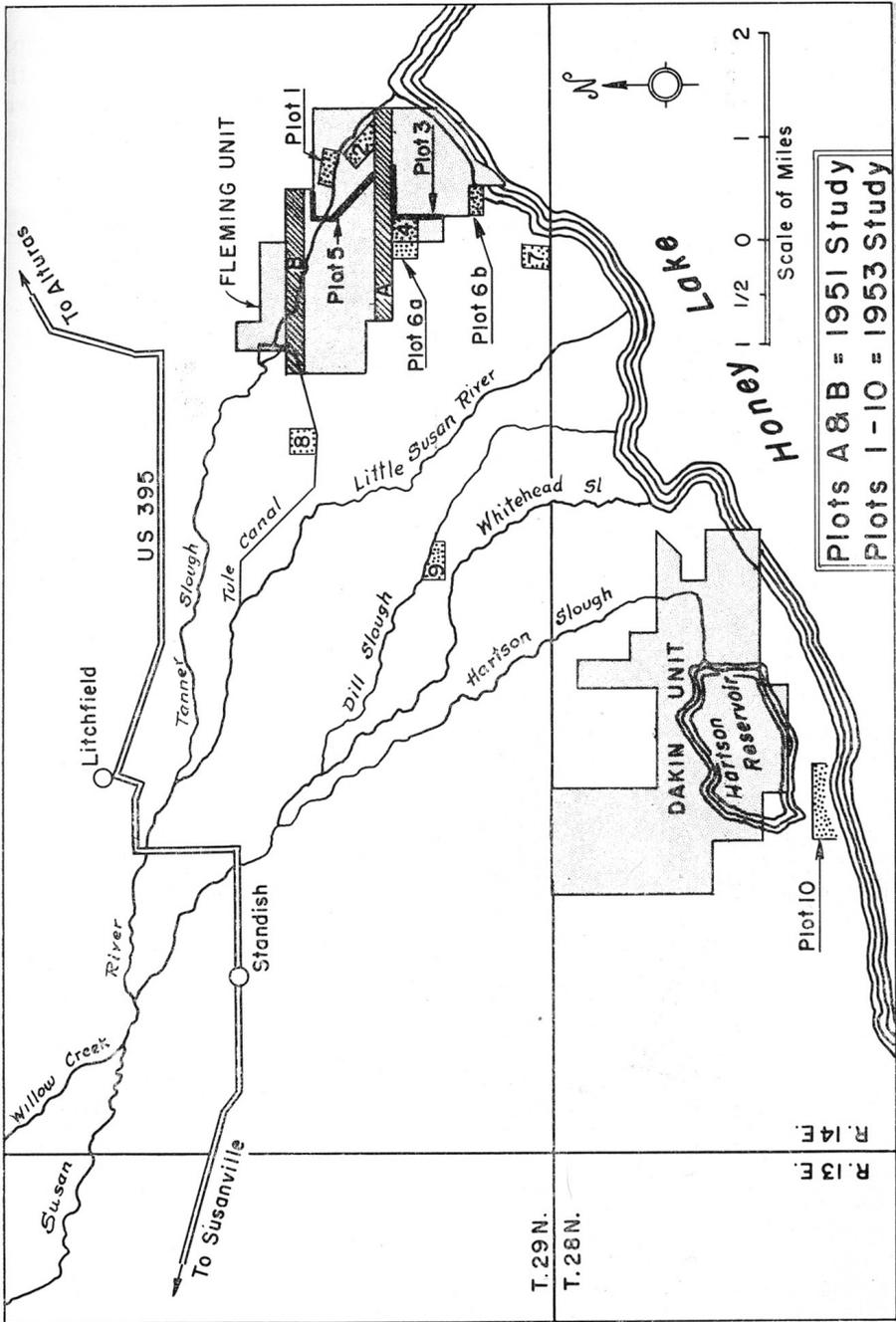


FIGURE 1.—Map of study areas in Honey Lake Valley.

nesting area in the valley has been published previously (Naylor, 1953; Naylor and Hunt, 1954).

Approximately 80 percent of the nesting population of ducks and coots in the Honey Lake Valley was found along the Susan River and its diversions from Litchfield to Honey Lake. It was in this area that the studies were located.

The 1951 study was conducted by Naylor on the Fleming unit of the state-owned Honey Lake Waterfowl Management area. The second study was conducted by Hunt in 1953 on the Fleming unit and on privately owned land.

## HISTORY

The water level of Honey Lake throughout the years has been characterized by fluctuation, determined mainly by wet and dry climate cycles. The lake has contained water several years after filling, but at times reverts to a dry alkaline lakebed. When full the lake covers approximately 100 square miles and has an average depth of 18 inches.

The main source of water for Honey Lake is the Susan River drainage. The water in this drainage is either stored for domestic use and irrigation or allowed to flow into the lake. The amount of water that eventually enters the lake is determined by the amount of spring runoff and the demand on the water supply. Only during the years of extremely large spring runoff does an appreciable amount of water enter Honey Lake. Some water enters the lake from Long Valley Creek and several other small streams, but the volume is small and is not considered an important source for Honey Lake.

Honey Lake filled during 1937 and then gradually receded until it became dry in the late 1940s. Above-normal winter rains and snowfall combined to fill the lake partially during the winter of 1950-51. Water was abundant in the vicinity of the lake until spring (May, 1951), at which time the water level of the lake receded rapidly until fall, when little or no water remained. The abundant spring water supply enabled dormant emergent vegetation to attain some growth before the water level dropped in the fall. However, with the continuation of heavy winter precipitation during the winters of 1951-52 and 1952-53, the emergent vegetation became abundant. In 1953 growth was considered to have reached a maximum. Vegetative growth along the lakeshore, excluding the large area at the mouth of the Susan River, was not appreciably increased during 1952 and 1953, when water was abundant. In general, dryer conditions prevailed during the nesting season of 1951 than was the case in 1953. In 1953 the vegetation had become rank and ideal for nesting in the area at the mouth of the Susan River.

Land use practices in Honey Lake Valley have remained relatively stable during the last few years. The chief agricultural activities are concerned with pasturing livestock and raising cereal crops.

## METHODS

Because of the large size of the study area, plots were used to sample the nesting activities. The methods used in locating and marking the nests differed slightly in the two studies. None of the differences was of great significance, and methods utilized in both studies obtained satisfactory results.

Each plot was visited at least every 10 days. A rope was dragged several times on plots to flush the nesting birds when the nature of the vegetation made this practice possible. As each nest was found it was assigned a number and marked by placing a willow marker several feet from the nest to facilitate location on return visits. The marker was aligned with the nest and a fixed object, a mountain peak easily seen from any spot on all study plots. The distance between the marker and nest varied from three feet in very dense cover to 15 feet in sparse cover. The markers were placed away from the nest to reduce the chance of predators being attracted to the nest. The top of each willow marker was cut on an angle, and the number assigned to the nest was written on the cut surface. In the 1953 study a white specimen tag was tied to the top of each willow marker that was placed in dense cover and to some markers that were placed in sparse cover. The flashing of this white tag facilitated the finding of nests in all types and colors of vegetation. It was found that little or no increase in the amount of predation occurred in areas where the white tags were used.

At each visit to a nest all necessary information was recorded on a nest card. A nest card was assigned to each nest, and all data gathered during subsequent visits to the nest were recorded on the same card (Figure 2).

Table 1 gives the species composition of the nests found during both studies.

An attempt was made to find as many of the nests as possible, but on the densely vegetated plots all could not be found. In 1951 it was estimated that the percentage of nests found in relation to the actual number on each plot ranged from approximately 60 percent in the densely covered plots to 100 percent in some of the sparsely vegetated plots. In 1953 an estimated 75 percent of the nests in the densely covered plots were found and 100 percent of those in some of the sparsely vegetated plots.

The scientific names of all birds, mammals, and plants referred to in this study are given in Appendix A.

#### SELECTION OF STUDY PLOTS

Because most of the nesting in Honey Lake Valley in 1951 was confined to the Fleming Unit of the Honey Lake Waterfowl Management Area, the 1951 study was made on this unit. In 1953 nesting activity was more widespread, and the study was conducted on both the Fleming Unit and private land. Data on the number of breeding pairs of ducks and coots are given in Table 2.

Two strip plots were used in 1951. These plots included all covered types present on the area. The combined area of the two strip plots was approximately 300 acres, or 15 percent of the total area of the Fleming unit.

In 1953 11 study plots were established to sample nesting on approximately 20,000 acres. They contained 328 acres, or approximately 1.6 percent of the total acreage in the study area.

#### DESCRIPTION OF THE 1951 STUDY

Practically all the open water and marsh area in northeastern Honey Lake Valley existed on the Fleming Unit of the Honey Lake Waterfowl Management Area. Water was



FIGURE 2.—Field recording of nest history data on a unisort analysis card.

TABLE 1.—Species composition of nests found.

Species	Total nests		Percentage of total	
	1951	1953	1951	1953
Mallard.....	63	143	31.2	39.8
Pintail.....	45	53	22.3	14.8
Cinnamon teal.....	22	125	10.9	34.8
Gadwall.....	18	13	8.9	3.6
Shoveller.....	17	7	8.4	2.0
Baldpate.....	--	1	0.0	0.3
Ruddy duck.....	--	6	0.0	1.7
Redhead.....	3	11	1.5	3.0
Unclassified.....	2	--	1.0	0.0
Unclassified, destroyed when found.....	15	--	7.4	0.0
Unclassified, hatched when found.....	17	--	8.4	0.0
Total ducks.....	202	359	100.0	100.0
Coot.....	20	143	9.0	28.0

TABLE 2.—Breeding pairs of ducks and coots in Honey Lake Valley 1951-1953.

Species	1951†	1952	1953
Mallard.....	734	1,214	1,010
Pintail.....	364	201	220
Cinnamon teal.....	266	262	283
Gadwall.....	668	714	294
Shoveller.....	173	110	68
Redhead.....	323	129	212
Scaup.....	5	1	8
Ruddy duck.....	40	28	10
Other.....	6	18	3
Total ducks.....	2,579	2,677	2,108
Coot.....	126	398	620

impounded in artificial ponds during the nesting season and early summer. As a result of the availability of this water and marsh area, most of the waterfowl nesting in the valley was believed to have been confined to the Waterfowl Management Area.

The information gathered during the 1951 study was compiled from nests found on the two strip plots located on the Fleming Unit which were representative of the cover types found on the unit. Plot A contained the following cover types: pasture grasses, volunteer barley, cultivated wheat, five-hooked bassia, ryegrass, Baltic rush, hardstem bulrush and others. Plot B contained five-hooked bassia, ryegrass, Baltic rush, hardstem bulrush, sagebrush, greasewood, and other cover types.

### DESCRIPTION OF THE 1953 STUDY PLOTS

Eleven study plots were established in nine different cover types representing the general cover types used most extensively by nesting waterfowl in the Honey Lake Valley in 1953. Seven plots of 40 acres each, two plots of 20 acres each, and two plots one mile long by 30 feet wide were used. The two one-mile plots were along a ditchbank and a levee and were both approximately four acres in area. In order to sample 40 acres of cover growing on ditchbanks and levies it would have taken 10 miles of ditchbank and levee, a factor not feasible in that study. The two 20-acre plots were of Baltic rush cover type. The seven 40-acre plots were established to include samples of the following major cover types: hard-stem bulrush, river bulrush, sagebrush and greasewood, five-hooked bassia, rye grass, salt grass, cereal crops, and other cover types.

### NEST SITES AND COVER TYPES

In compiling data on both studies, two broad headings were used in describing the locations of waterfowl nests. These headings or classifications were nest sites and cover types. The nest site classification described the physical characteristics of the terrain where the nest was located; e.g., in a marsh, on an island, or on a dike. The most abundant species of vegetation in the immediate vicinity of the nest was used to designate the cover type found at each site. As an example of cover type and nest site relationship, most of the duck nests found in 1953 were constructed in marsh nest sites and the dominant cover type around the nests was Baltic rush.

A description of the different nest sites used during the studies follows:

*Dike or Ditchbank.*—Elevated margins of any slough, creek, river, irrigation ditch, or dam embankment were classified as dike nest sites.

*Marsh.*—Areas such as lakeshores, artificial ponds, and all semiwet land were recorded as marsh-type sites.

*Island.*—Any sizable piece of land completely surrounded by water was considered to be an island nest site.

*Agricultural Land.*—All land used for agricultural purposes was listed as agricultural nest sites. During both studies most of the agricultural land was either in irrigated pasture or in cereal crops.

*Uncultivated Land.*—Dry upland-type areas not under cultivation were classified as uncultivated land nest sites.

A difference was shown in the location of nest sites by ducks in 1951 and 1953. In 1951 nests were located primarily in dry upland areas. Dikes and uncultivated fields were the most common nest sites used by ducks that year. Results of the 1953 study showed an over-all change of location to the marsh type site. The change was attributed to the increased proportion of marsh nest sites available to the nesting waterfowl. The marsh nest sites contained 14.7 percent of all duck nests found in 1951 and 67.4 percent of all duck nests found in 1953. All coot nests found in 1951 and 98.6 percent of the coot nests found during the 1953 study were located in marsh nest sites. Location of nest sites by species is shown in Table 3.

TABLE 3.—Nest sites (percentage in each site).

Species	Dike	Island	Marsh	Uncultivated	Agricultural	Total
Mallard						
1951-----	39.7	1.6	23.8	19.0	15.9	100.0
1953-----	18.9	0.0	62.9	15.4	2.8	100.0
Pintail						
1951-----	26.7	4.4	4.4	22.2	42.3	100.0
1953-----	22.6	0.0	37.7	34.0	5.7	100.0
Cinnamon teal						
1951-----	59.0	9.2	9.2	18.1	4.5	100.0
1953-----	1.6	0.0	89.6	8.0	0.8	100.0
Gadwall						
1951-----	44.4	0.0	0.0	27.8	27.8	100.0
1953-----	7.7	0.0	23.1	69.2	0.0	100.0
Shoveller						
1951-----	29.4	0.0	17.7	23.5	29.4	100.0
1953-----	0.0	0.0	0.0	85.7	14.3	100.0
Baldpate						
1951-----	0.0	0.0	0.0	0.0	0.0	0.0
1953-----	0.0	0.0	0.0	100.0	0.0	100.0
Ruddy duck						
1951-----	0.0	0.0	0.0	0.0	0.0	0.0
1953-----	0.0	0.0	100.0	0.0	0.0	100.0
Redhead						
1951-----	0.0	0.0	100.0	0.0	0.0	100.0
1953-----	0.0	0.0	100.0	0.0	0.0	100.0
Unclassified						
1951-----	50.0	0.0	0.0	0.0	50.0	100.0
Average for ducks						
1951-----	37.7	2.9	14.7	20.6	24.1	100.0
1953-----	11.7	0.0	67.4	18.4	2.5	100.0
Coot						
1951-----	0.0	0.0	100.0	0.0	0.0	100.0
1953-----	0.7	0.0	98.6	0.7	0.0	100.0

The change in nest sites between 1951 and 1953 was accompanied by the change in cover types. The cover utilized most often by nesting ducks in 1951 was rye grass, five-hooked bassia and salt grass. These three plant species provided cover for 60.6 percent of all duck nests found that year. In 1953, 59.7 percent of all duck nests found were in Baltic rush. Emergent plants were the preferred cover types utilized by coots during both studies. During 1951, 95 percent of the coot nests found were in hardstem bulrush. Baltic rush, river bulrush, and hardstem bulrush provided cover for 98.6 percent of the coot nests found in 1953. The utilization of the different cover types during both studies is presented in Table 4.

TABLE 4.—Cover types utilized (percentage in each type).

Cover type	Mallard	Pintail	Cinnamon teal	Gadwall	Shoveller	Baldpate	Ruddy duck	Redhead	Unclassified	Average ducks	Coots
Baltic rush											
1951	7.8	6.6	9.0	5.6	29.4	0.0	0.0	66.7	0.0	10.6	0.0
1953	35.7	51.0	96.0	69.2	57.1	0.0	16.6	18.2	0.0	59.7	42.0
Hardstem bulrush											
1951	22.2	8.9	0.0	0.0	0.0	0.0	0.0	33.3	0.0	11.2	95.0
1953	31.4	7.5	0.8	0.0	0.0	0.0	88.4	72.7	0.0	17.6	23.8
River bulrush											
1951	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1953	1.4	1.9	0.0	0.0	0.0	0.0	0.0	9.1	0.0	1.1	32.8
Sagebrush-rye grass											
1951	7.8	4.4	4.5	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.0
1953	8.4	13.2	0.8	23.1	14.3	100.0	0.0	0.0	0.0	6.9	0.0
Bossia											
1951	25.5	17.8	4.5	22.2	5.9	0.0	0.0	0.0	50.0	18.2	0.0
1953	7.7	11.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.0
Rye grass											
1951	23.8	33.3	55.0	38.8	23.5	0.0	0.0	0.0	0.0	31.2	0.0
1953	7.7	5.7	0.0	7.7	0.0	0.0	0.0	0.0	0.0	4.2	0.0
Salt grass											
1951	3.3	13.4	18.0	5.6	29.4	0.0	0.0	0.0	50.0	11.2	0.0
1953	2.8	0.0	1.6	0.0	28.6	0.0	0.0	0.0	0.0	2.2	0.0
Cereal crops											
1951	4.8	15.6	0.0	11.2	11.8	0.0	0.0	0.0	0.0	8.2	0.0
1953	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Other											
1951	4.8	0.0	9.0	16.6	0.0	0.0	0.0	0.0	0.0	4.7	5.0
1953	4.2	9.4	0.8	0.0	0.0	0.0	0.0	0.0	0.0	3.3	1.4
Total											
1951	100.0	100.0	100.0	100.0	100.0	0.0	0.0	100.0	100.0	100.0	100.0
1953	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	100.0

In order to get the overall trend of the preferred nesting sites and cover types, information from these two classifications was combined in Table 5.

TABLE 5.—Nest site—cover type relationships.

Species	Nest site *		Cover type	
	1951	1953	1951	1953
	Mallard	General	General	Bassia Rye grass Hardstem bulrush
Pintail	General	General	Rye grass Bassia	Baltic rush
Cinnamon teal	General	Marsh	Rye grass	Baltic rush
Gadwall	Dike	Uncultivated	Rye grass Bassia	Baltic rush
Shoveller	Dike	Uncultivated	Salt grass Baltic rush	Baltic rush Grasses
Baldpate	--	Uncultivated	--	Sagebrush-grease-wood
Ruddy duck	--	Marsh	--	Hardstem bulrush
Redhead	Marsh	Marsh	Baltic rush Hardstem bulrush	Hardstem bulrush
Average duck	Dike	Marsh	Rye grass Hardstem bulrush Bassia	Baltic rush Hardstem bulrush
Coot	Marsh	Marsh	Hardstem bulrush	Baltic rush River bulrush Hardstem bulrush

\* Where the term "general" is used, there was no definite preference for a nest site, and nesting occurred in the nest sites with about the same frequency.

### NESTING PERIODS

The springs of 1951 and 1953 were considered favorable for nesting waterfowl in Honey Lake Valley. Although a change in location of nest sites and cover types was found in the two studies, the nesting periods and hatching dates were quite similar. The first nest found in 1951 was on 19 April; in 1953 the first nest was found on 22 April. The last nest history in 1951 was completed on 25 July and in 1953 on 17 July. Nesting continued in the valley after these dates during both years, but it is believed that the number of nests hatched after 25 July was nominal and had little or no effect on the peak of hatch.

Nesting periods similar to those shown above were recorded at the Tule Lake and Lower Klamath National Wildlife Refuges in Siskiyou County (Miller and Collins, 1954).

Information concerning peak of hatch for both ducks and coots is illustrated (Figure 3).

NESTING STUDIES OF DUCKS AND COOTS

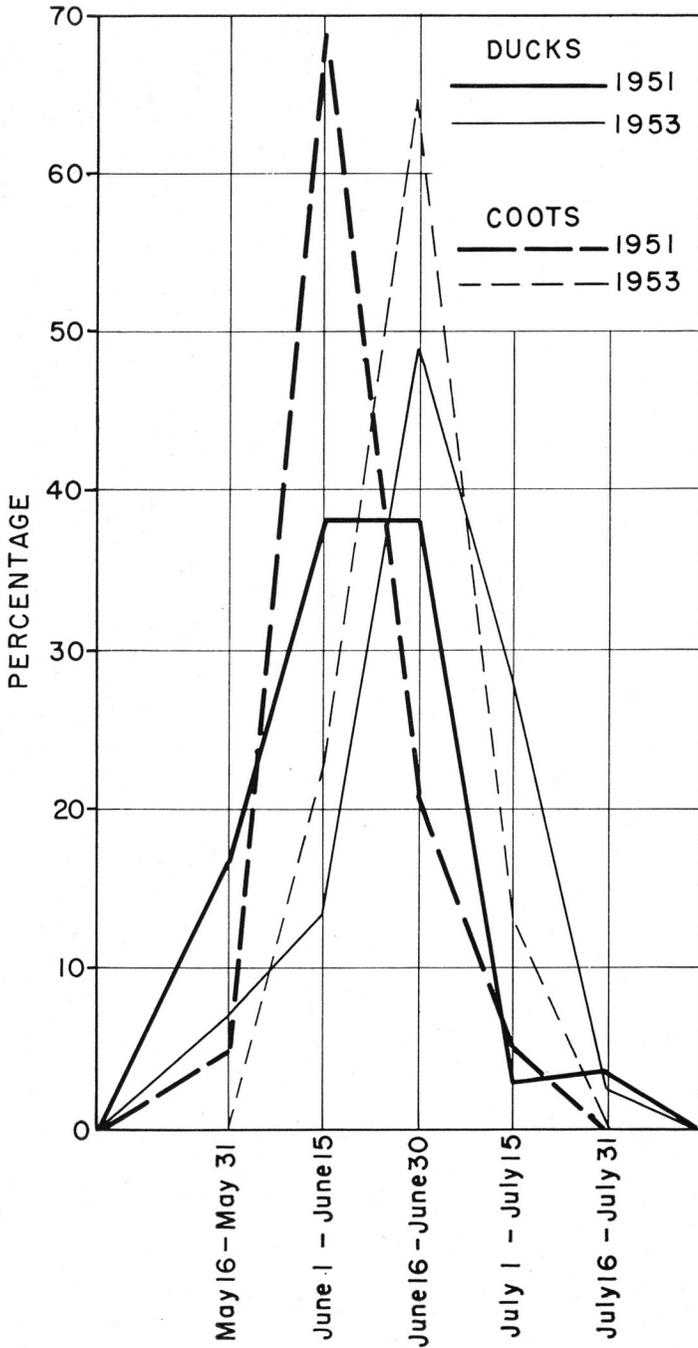


FIGURE 3.—Hatching periods and peak of hatch for duck and coot nests in Honey Lake Valley.

## FATE OF NESTS

The categories used in classifying fates of nests were the same as those used in several other nesting studies in California. The fate of nest classification used was as follows: (1) hatched nests, (2) deserted nests, (3) flooded nests, (4) destroyed nests and (5) fate unknown nests. A definition of these categories has been published by Miller and Collins (1953). Table 6 shows the fate of all nests found during the studies.

TABLE 6.—Fate of nests.\*

Species	Number of nests	Percent-age nests hatched	Percent-age nests destroyed	Percent-age nests deserted	Percent-age nests flooded	Total
Mallard						
1951.....	63	60.4	28.5	7.9	3.2	100.0
1953.....	143	47.6	36.4	14.0	2.0	100.0
Pintail						
1951.....	45	33.3	57.8	4.5	4.4	100.0
1953.....	53	45.3	45.3	9.4	0.0	100.0
Cinnamon teal						
1951.....	22	54.6	13.6	31.8	0.0	100.0
1953.....	125	56.0	28.8	13.6	1.6	100.0
Gadwall						
1951.....	18	66.7	22.1	5.6	5.6	100.0
1953.....	13	38.5	46.1	15.4	0.0	100.0
Shoveller						
1951.....	17	58.8	41.2	0.0	0.0	100.0
1953.....	7	28.6	42.8	28.6	0.0	100.0
Ruddy duck						
1951.....	--	0.0	0.0	0.0	0.0	0.0
1953.....	6	66.7	0.0	33.3	0.0	100.0
Redhead						
1951.....	3	33.3	66.7	0.0	0.0	100.0
1953.....	11	54.5	9.1	36.4	0.0	100.0
Total ducks						
1951.....	168	52.5	35.0	9.5	3.0	100.0
1953.....	359	50.1	34.3	14.2	1.4	100.
Coot						
1951.....	20	95.0	5.0	0.0	0.0	100.0
1953.....	143	97.2	2.1	0.7	0.0	100.0

\* 34 nests not shown from the 1951 study were: 2 unclassified, 15 destroyed when found, 17 hatched when found. One nest not shown from the 1953 study was a baldpate nest that was destroyed.

### SUCCESSFUL NESTS

The average nesting success for the duck nests found on study plots during both years was similar. In 1951, 52.5 percent of the duck nests hatched, while in 1953 success rate dropped slightly, with a hatch of 50.1 percent.

The overall hatching success of dabbling ducks was lower in 1953 than in 1951. The pintail was the only dabbling duck that showed any appreciable gain in nesting success in 1953. The rate of success found in cinnamon teal nesting was relatively constant during both studies. In 1951 gadwall, mallard, and shoveler were the most successful nesters of the dabbling ducks, with success rates of 66.7, 60.4, and 58.8 percent, respectively. In 1953 the three species of dabbling ducks that were the most successful nesters were the cinnamon teal, mallard, and pintail. The success rates for these species were 56.0, 47.6, and 45.3 percent, respectively. The success rates of the nests of diving ducks found during the studies were 33.3 percent for redheads in 1951 and 54.5 percent in 1953. The hatching success of ruddy duck nests was 66.7 percent in 1953. No ruddy duck nests were found in 1951.

All recent duck and coot nesting surveys in northeastern California have indicated that the coot is the most successful nester with respect to hatching success and hatchability of eggs. The success rate for coots at Honey Lake was 95.0 percent in 1951 and 97.2 percent in 1953. The success rate for coots at the Tule Lake and Lower Klamath National Wildlife refuges was 94.6 percent in 1952 (Miller and Collins, 1954).

### UNSUCCESSFUL NESTS

*Destruction.*—Predation on nests of both ducks and coots was the greatest single cause of nesting failures during both studies. The amount of destruction attributed to predation was relatively constant during both studies. Of all the duck nests that were found, 35.0 percent were destroyed in 1951, while 34.3 percent were destroyed in 1953. The amount of predation on coot nests was light, with 5.0 percent of the nests destroyed in 1951 and 2.1 percent destroyed in 1953.

The cause of nest destruction was difficult to determine in many cases. The lack of sufficient evidence to establish definitely the cause of predation was responsible for the large number of nests attributed to destruction by unknown causes (Table 7). If there was any doubt as to the identity of the predator a nest was listed as destroyed by unknown causes. Mammalian predators known to occur in the area were the striped skunk, coyote, house cat, badger, bobcat, and weasel; the avian species which prey on nests were the California and ring-billed gulls, the black-billed magpie, the crow, and the raven. An instance of nest destruction by unnatural causes occurred during 1951, when five nests were destroyed by land-leveling operations.

Preseason trapping of predators by a State trapper on the Honey Lake Waterfowl Management Area resulted in the capture of 23 striped skunks, 4 coyotes, 9 house cats, and 2 bobcats in 1951 and 31 striped skunks, 1 coyote, and 5 house cats in 1953.

*Desertion.*—The amount of desertion found in duck nests was 9.5 percent in 1951 and 14.2 percent in 1953. This higher rate of desertion was the greatest difference found in comparing the results of the fate of nests in the two studies.

TABLE 7.—Percentage of destroyed duck nests found in each nest site.

	Dike	Island	Marsh	Uncultivated land	Agricultural land	Total
Destroyed by mammal						
1951-----	64.0	0.0	33.3	85.7	38.9	55.4
1953-----	25.7	0.0	40.0	45.3	16.7	36.6
Destroyed by bird						
1951-----	12.0	0.0	50.0	0.0	5.5	12.5
1953-----	20.0	0.0	27.5	11.9	16.7	19.5
Destroyed by unknown causes						
1951-----	24.0	0.0	16.7	14.3	27.8	23.2
1953-----	54.3	0.0	32.5	42.8	66.6	43.9
Destroyed by unnatural causes						
1951-----	0.0	0.0	0.0	0.0	27.8	8.9
1953-----	0.0	0.0	0.0	0.0	0.0	0.0
Total						
1951-----	100.0	0.0	100.0	100.0	100.0	100.0
1953-----	100.0	0.0	100.0	100.0	100.0	100.0

One coot nest was destroyed in 1951 and three coot nests were destroyed in 1953 in marsh nest sites and are not shown in the table.

Competition for preferred nest sites among the ducks probably accounted for some desertion. However, data concerning desertion due to competition for preferred nest sites were inconsistent, and no definite statement can be made on this subject.

Parasitism occurred in 2.7 percent of the total duck nests found in 1951 and in 6.2 percent of the total duck nests found in 1953. Any nest containing eggs laid by two species of ducks or a duck and pheasant was considered parasitized (Figure 4). There were no instances of a duck nest being parasitized by another species of duck during the 1951 study. In 1953, 13 (42 percent) of the duck nests parasitized contained eggs laid by another species of duck. Parasitism of duck nests by pheasants occurred in all five of the parasitized nest found in 1951 and in 18 (58 percent) of the duck nests parasitized in 1953. Some desertion resulting directly from parasitism in duck nests probably occurred, but data gathered during both studies showed that parasitism was not an important cause of desertion. No instance of parasitism was found in coot nests during either study.

Only one coot nest was recorded as deserted during the 1953 study, and none was deserted during the 1951 study. It was believed that overcrowding in preferred nest sites and parasitism that may exist in duck nests were not factors that affected coot nesting. The pugnacity with which the coot defends a nesting territory might be a reason for such a low desertion rate.

*Flooding.*—The flooding of nests was of minor significance in the success of duck and coot nesting. Five duck nests were found flooded during each of the studies. No instance of a coot nest being flooded was recorded. Stable or receding water levels during the nest season accounted for the low incidence of flooded nests.



FIGURE 4.—Mallard duck nest parasitized by a pheasant. The six pheasant eggs show darker and smaller than the five duck eggs.

### FATE OF EGGS AND CLUTCH SIZE OF SUCCESSFUL NESTS

The information collected from successful nests was used to determine the average clutch and fate of eggs. The average clutch size of both ducks and coots was found to be slightly lower in 1953 than in 1951 (Table 8).

TABLE 8.—Clutch size and average hatch per clutch.

Species	Successful nests	Total eggs	Average clutch	Average hatch per clutch
Mallard				
1951	38	339	8.9	8.3
1953	64	529	8.3	6.9
Pintail				
1951	15	111	7.4	6.8
1953	25	176	7.0	5.9
Cinnamon teal				
1951	12	125	10.4	9.7
1953	64	583	9.1	7.8
Gadwall				
1951	12	126	10.5	9.6
1953	5	50	10.0	7.4
Shoveller				
1951	10	109	10.9	10.1
1953	2	20	10.0	10.0
Ruddy duck				
1951	0	0	0.0	0.0
1953	3	15	5.0	5.0
Redhead				
1951	1	14	14.0	4.0
1953	5	42	8.4	5.4
All ducks				
1951	88	824	9.4	8.1
1953	168	1,415	8.4	7.1
Coot				
1951	19	154	8.1	7.9
1953	123	913	7.4	7.4

All available data concerning the fate of eggs were recorded in the following categories: (1) number of eggs hatched, (2) number of eggs destroyed, (3) number of eggs infertile, (4) number of eggs containing dead embryos, (5) number of eggs missing, and (6) number of dead in nest. The fate of eggs in successful nests is shown in Table 9. The number of dead young in nests were included in the percentage of eggs hatched.

The successful duck nests produced 824 eggs in the 1951 study and 1,415 eggs in the 1953 study, of which 755 hatched in 1951 and 1,187 hatched in 1953. The hatching success of the duck eggs in 1951 was 91.7 percent; in 1953 it was 83.9 percent. The hatching success of coot eggs was 97.5 percent in 1951 and 99.3 percent in 1953. Only four coot eggs out of 154 in 1951 and seven out of 913 in 1953 did not hatch.

The total number of eggs attributed to parasitism in successfully hatched duck nests was 26 in 1953 and two in 1951. Of the 26 eggs found in 1953, 16 were duck eggs and 10 were pheasant eggs; both of the eggs found in 1951 were pheasant eggs. The small number of eggs resulting from parasitism made little difference in the total number of eggs in the successfully hatched nests and was not computed in the fate of eggs or average clutch.

TABLE 9.—Fate of eggs expressed in percentages.

Species	Hatched	Dead embryo	Infertile	Destroyed	Missing	Total
Mallard						
1951-----	93.5	5.0	0.0	0.0	1.5	100.0
1953-----	83.5	12.8	0.2	1.3	2.2	100.0
Pintail						
1951-----	91.9	7.2	0.9	0.0	0.0	100.0
1953-----	84.2	10.7	1.1	0.6	3.4	100.0
Cinnamon teal						
1951-----	92.8	0.8	0.8	0.0	5.6	100.0
1953-----	85.5	11.2	0.0	1.0	2.3	100.0
Gadwall						
1951-----	91.2	3.2	1.6	0.0	4.0	100.0
1953-----	74.0	16.0	0.0	4.0	6.0	100.0
Shoveller						
1951-----	92.7	4.6	0.9	0.0	1.8	100.0
1953-----	100.0	0.0	0.0	0.0	0.0	100.0
Ruddy duck						
1951-----	0.0	0.0	0.0	0.0	0.0	0.0
1953-----	100.0	0.0	0.0	0.0	0.0	100.0
Redhead						
1951-----	28.6	71.4	0.0	0.0	0.0	100.0
1953-----	61.9	26.2	11.9	0.0	0.0	100.0
Average of all ducks						
1951-----	91.7	5.4	0.6	0.0	2.3	100.0
1953-----	83.9	12.0	0.6	1.0	2.5	100.0
Coot						
1951-----	97.5	0.0	0.6	0.0	1.9	100.0
1953-----	99.3	0.3	0.0	0.4	0.0	100.0

Infertile eggs and eggs containing dead embryos that were found in successfully hatched nests were classified by the method described by Kossack (1950). An egg was considered infertile if the yolk was suspended in the albumen and no indication of development was present. Any egg that contained a dead embryo in any stage of development or contained yellow custard-like material was classified as a dead embryo.

In all, 45 eggs containing dead embryos and five infertile eggs were found in successfully hatched duck nests in 1951, and 172 eggs containing dead embryos and eight infertile eggs were found in 1953. In all the successfully hatched coot nests only three eggs containing dead embryos and no infertile eggs were found in 1953, and no dead embryos and one infertile egg were found in 1951.

A total of 50 eggs was either destroyed or missing from the successfully hatched duck nests in 1953, while in 1951 there were 19 eggs missing from successful duck nests, but no eggs were destroyed. Successful coot nests contained four destroyed eggs and had no eggs missing in 1953; there were no destroyed eggs and four eggs were missing in 1951.

### BROOD DATA

The number of duck brood counts taken during the two studies was 132 and 1951 and 151 in 1953. Most of the duck broods counted were either one or two weeks old. Only 30.1 percent of the duck broods counted during 1951 and 44.3 percent of the duck broods counted during 1953 were over two weeks old. Losses in broods during the first week of life averaged 0.1 bird in 1951 and 0.7 bird in 1953.

No coot broods were counted during 1951, and only 24 coot broods were counted during 1953. Since a pair of coots will often split the brood between them, brood count may not accurately reflect the actual brood size. Therefore, observers tallied only those broods that could be considered complete. An average loss of 3.0 coots per brood during the first week of life occurred in the few coot broods taken. This loss was undoubtedly due to the general helplessness of young coots during their first few days of life (Gullion, 1954).

### DISCUSSION

The amount of water in Honey Lake has a definite bearing on the number of waterfowl utilizing the valley throughout the year. The lake in wet years provides an adequate resting place for the spring migrants and attracts breeding pairs that remain to nest in the area. Fall migrating waterfowl feed and rest in the vicinity of the lake and, together with the waterfowl produced in the valley, provide hunting during the waterfowl season.

In 1951 most of the duck nesting occurred in dry, upland-type habitat that was adjacent to artificial ponds. These nesting areas provided a combination of good nesting cover and sufficient water for rearing broods. The preferred nesting cover under 1951 conditions was rye grass, five-hooked bassia, and salt grass. These plant species grew in clumps and provided cover that was relatively low and dense. In 1953 there was not only an abundant growth of upland plant species, instant growth of emergent plant species, including rye grass, five-hooked bassia, and salt grass, but also an abundant growth of emergent plant species, such as Baltic rush. The Baltic rush offered the same concealment factors as the rye grass, five-hooked bassia, and salt grass and was usually growing in or near water. Approximately the same percentage of duck nests was found in the Baltic rush in 1953 as

was found in rye grass, five-hooked bassia, and salt grass in 1951. Apparently the conditions that prevailed at the nest location, such as concealment and proximity to water, were more important to the nesting ducks than the selection of a certain plant species in which to build a nest. The coot nesting during both studies was confined to areas that grew emergent plant species.

From observations made of coots it appears that both parents participate in incubation of the egg. A further observation is that the coot often commences incubation at some interval after the first egg is laid and before the final egg of the clutch is laid. This would enable the coot to hatch several of the young and allow one parent to take the young from the nest and the other parent to continue incubating until all eggs in the clutch were hatched. These observations followed the coot nesting behavior described by Gullion (1954) and others. As an example of the frequency of this behavior, 83 of the 139 coot nests hatched during the 1953 study were hatched in this manner. The early start in incubation would also give the coot eggs more protection than that received by duck eggs.

The most frequent cause of nest failure was predation. Approximately one-third of all nests found during both studies were destroyed by predators. The species of ducks that nested in the dry upland locations sustained the majority of the nest destruction in each study. Many of the ducks nesting in the upland areas preferred ditch banks and dikes for a nest location. Mammalian predators, principally the striped skunk, seemed to hunt these areas extensively in search of food. Nest destruction in the marsh area was very limited, apparently because of protection afforded by standing water. Undoubtedly the absence of such aquatic predators as the mink was also a factor in the low incidence of predation in the marsh area. The rate of nest destruction by avian predators was low in marshy areas and moderate in the upland areas during both studies. Since coots habitually built their nests overwater they were protected from most mammalian predators, and thus were the most successful nesters studied. Another factor which may have contributed to the high rate of nesting success of coots was the participation of both parents in guarding the nest.

An insufficient number of broods was counted to determine accurately brood regression during either study. The utilization of dense escape cover by the duck and coot broods made brood counting difficult. The one- and two-week-old broods were the only age classes that were counted frequently. Information taken from the brood cards regarding week-old duck broods indicated that there was a slight reduction in brood size during the first week of life. The coot broods that were counted showed a loss of approximately 40 percent of the number of hatched young during the first week of life.

#### SUMMARY

1. Studies on nesting ducks and coots were conducted during the spring of 1951 and 1953 in Honey Lake Valley, Lassen County, California.
2. Two sample strips with a total area of 300 acres were studied during 1951; 11 study plots with a total area of 328 acres were studied during 1953.
3. Nest histories were completed on 202 duck nests and 20 coot nests during 1951. In 1953 nest histories were completed on 359 duck nests and 143 coot nests.
4. The peak of hatch for coot nests was between 1 June and 15 June during 1951; for duck nests, between 1 June and 30 June. The peak of hatch for both ducks and coots during 1953 was between 16 June and 30 June.

5. The nesting success for all nets found in 1951 was 52.5 percent for ducks and 95.0 percent for coots; in 1953 the nesting success for all nests found was 50.1 percent for ducks and 97.2 percent for coots.
6. Predation was the most important cause of unsuccessful nesting of ducks and coots during both studies.
7. The hatching success of eggs in the successful nests in 1951 was 91.7 percent for ducks and 97.5 percent for coots; in 1953, the hatching success was 83.9 percent for ducks and 99.3 percent for coots.
8. In 1951, 132 duck broods were counted, while in 1953, 151 duck broods were tallied. The brood count data showed that on the average less than one duck per brood was lost during the first week of life. The 24 coot broods counted in 1953 revealed an average reduction of 3 coots per brood during the first week of life.

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## APPENDIX 1.—Scientific Names of Animals and Plants Listed in the Text

## Birds

- Mallard—*Anas platyrhynchos*  
Pintail—*Anas acuta tztizhoa*  
Cinnamon Teal—*Anas cyanoptera*  
Gadwall—*Anas strepera*  
Shoveller—*Spatula clypeata*  
Baldpate—*Mareca americana*  
Ruddy Duck—*Oxyura jamaicensis rubida*  
Redhead—*Aithya americana*  
Coot—*Fulica americana*  
California Gull—*Larus californicus*  
Ring-billed Gull—*Larus delawarensis*  
Black-billed Magpie—*Pica pica hudsonia*  
Western Crow—*Corvus brachyrhynchos hesperis*  
Raven—*Corvus corax*

## Mammals

- Great Basin Striped Skunk—*Mephitis mephitis major*  
Mountain Coyote—*Canis latrans lestes*  
Pallid Bobcat—*Lynx rufus pallescens*  
California Badger—*Taxidea taxus neglecta*  
Weasel—*Mustela* sp.  
Housecat—*Felis domesticus*

## Plants

- Grasses—*Gramineae*  
Cultivated Barley—*Hordeum vulgare*  
Cultivated Wheat—*Triticum aestivum*  
Black Greasewood—*Sarcobatus vermiculatus*  
Sagebrush—*Artemisia tridentata*  
Five-hooked Bassia—*Bassia hyssopifolia*  
Rye Grass—*Elymus* sp.  
Baltic Rush—*Juncus balticus*  
Hardstem Bulrush—*Scirpus acutus*  
River Bulrush—*Scirpus fluviatilis*  
Alkali Bulrush—*Scirpus paludosus*  
Salt grass—*Distichlis spicata*  
Alfalfa—*Medicago sativa*