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The Resources Agency of California  
Department of Fish and Game

BIOLOGY AND MANAGEMENT OF STEELHEAD TROUT IN CALIFORNIA<sup>1/</sup>

LEO SHAPOVALOV  
Inland Fisheries Branch

SUMMARY

The original range of steelhead (Salmo gairdnerii) was from central Alaska to the Mexican border. Water development has now decimated the populations south of San Francisco.

Roughly, steelhead may be divided into those of the fall run ("winter steelhead") and those of the spring run ("summer steelhead"). Adults of different runs enter streams at various times, but spawn most commonly in March and April.

Fish of many life history categories make up the runs. Total age rarely exceeds 6 years. In general, first spawners compose from 55 to 95% of the runs, but repeat spawners may constitute over 50% of a run.

In the more northerly streams, steelhead tend to reach a larger size because of longer residence in salt water.

Steelhead ascend both on rising and falling stream levels, mainly in the day-time. Spawning and embryology are similar to those of other stream-spawning salmonids.

Steelhead migrate to sea when 1 to 4 years old, mainly in the spring and summer. Survival to adult first spawning of naturally-spawned fish is roughly 2.5% for age 1 migrants, 6% for age 2 migrants, and 18% for age 3 and older migrants. Homing is highly developed.

The biology, and hence the management, of steelhead in California is inextricably interwoven with the biology of silver salmon (Oncorhynchus kisutch).

Artificial propagation is extensively practiced along the Pacific Coast. Experiments indicate that returns of planted fish are appreciably higher if the stocked fish weigh at least 8 fish per pound (6 inches fork length). Oregon and Washington have also tried rearing steelhead in natural ponds. Extensive rescue of juveniles from drying streams is carried on in California, but has not been evaluated. Washington and Oregon, but not California, use a punch card system to estimate the catch of steelhead (and salmon).

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This report was originally presented as part of the panel, "Steelhead Trout and Atlantic Salmon - Management and Biology", 95th Annual Meeting, American Fisheries Society, Portland, Oregon, September 24, 1965. It is being issued at this time in partial fulfillment of many requests for information about steelhead and, in particular, Fish Bulletin No. 98, which is out-of-print.

Steelhead are strictly a sport fish in California, with winter seasons for adult fish and summer seasons for juveniles. There is evidence that a greater harvest of adults could safely be taken by anglers, but questions regarding the extent and direction of desirable liberalization of existing regulations remain unanswered.

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## BIOLOGY

The original range of steelhead (Salmo gairdnerii) extended from central Alaska to the Mexican border. In California, steelhead inhabited virtually all coastal streams. With water development and diversion, they have been almost completely eliminated from streams in southern California, and their numbers have been decimated in most streams south of San Francisco.

Roughly, steelhead may be divided into those of the fall run, commonly called "winter steelhead", which in general enter the streams and migrate upstream as stream flows increase following the summer low-flow period, with sexual products in various stages of development, but spawn within the same season, and those of the spring run, commonly called "summer steelhead", which in general enter as stream flows decrease, while quite "green", and spawn in the following season. Summer steelhead do not occur in most California streams, because of lack of cold water to hold them over the summer months.

In general, the bulk of winter steelhead enter streams in the fall, winter, and early spring, while most summer steelhead enter in the spring and summer. In the larger rivers, such as the Sacramento, Eel, Klamath, and Columbia, and some British Columbia streams, some steelhead enter from the sea in all or nearly all months. Steelhead spawn most commonly in March and April. They spawn in both the smaller streams and suitable sections of some main rivers, but rarely ascend to the extreme headwaters.

Steelhead of many life history categories make up the runs. In California, and probably in Oregon and Washington, first spawners are composed mainly of fish which have spent years in fresh water and years at sea as follows: 2 stream, 1 ocean; 2 stream, 2 ocean; and 3 stream, 1 ocean. In British Columbia and the more northerly streams generally, fish which had migrated to sea when 3 years old appear to be more numerous. Steelhead of categories 3 stream, 2 ocean; 3 stream, 3 ocean; 2 stream, 3 ocean; and 2 stream, 2 ocean are common there. Total age rarely exceeds 6 years. A sex ratio close to 1 to 1 is typical.

In general, first spawners compose from 55 to 95% of the runs. Repeat spawners may form an important contribution, constituting over 50% of a run. Fish spawning more than twice form very minor parts of the runs.

The size of steelhead is not directly correlated with the size or latitude of the home stream, although in the more northerly streams steelhead tend to reach a larger size because of longer residence in salt water before spawning.

At least in California, males predominate in the life history categories comprising the lesser total ages, while females predominate in those comprising the greater total ages.

Survival following spawning is higher among females than among males.

At least in California, males predominate in the early portions of steelhead runs, while females predominate in the latter portions.

Steelhead ascend both on rising and falling stream levels. They move upstream mainly in the daytime.

Spawning has been well described; it is similar to that of other stream-spawning salmonids. Typically, over 95% of the eggs are fertilized and buried successfully in the gravels.

The embryology of steelhead is in general similar to that of other trout and of salmon. Silting is probably the principal factor in determining survival from fertilization to emergence from the gravel. Under favorable conditions, the average percentage of steelhead emerging from the gravel is probably between 65 and 85% of the eggs deposited.

Soon after the peak of emergence, there is a marked decline in the number of fry, due to mortality. Predatory fishes are believed to make the greatest inroads.

Steelhead migrate to sea when 1 to 4 years old. Some migrate downstream at all times of the year, but the largest numbers migrate in the spring and summer. The oldest fish appear first and are followed by progressively younger fish. The main seaward migration of 1- and 2-year-old smolts generally occurs during the months of April, May, and June. Some fish later migrate upstream and then downstream again before going to sea.

In California, most steelhead migrate to sea when 1 or 2 years old. The survival to adulthood of fish which migrate to sea when 2 years old or older is much higher than that of yearlings. Most likely, survival is a function of size more than of age.

Roughly, survival to adult first spawning of naturally-spawned steelhead may be expected as follows: age 1 seaward migrants, 2.5%; age 2 migrants, 6%; age 3 and older migrants, 18%.

Homing in steelhead is highly developed.

The biology of steelhead in California is inextricably interwoven with the biology of silver salmon (Oncorhynchus kisutch). The range of silver salmon does not extend as far south as that of steelhead, ending in streams tributary to Monterey Bay, but in most of their common range the two species use the same spawning and nursery areas. In some streams they are the only species of salmonids. Although silvers differ from steelhead in that all die after spawning once and in most areas no juveniles remain in fresh water more than 1 year, their life histories are really very similar. Numbers of individuals of both species have identical life histories; they are spawned in the same streams at the same time, migrate to sea at the same age and time, return as adults and spawn at the same age and time. Consequently, the management of the two species and regulations pertaining to them are also inextricably interwoven.

## MANAGEMENT

### Artificial Propagation

Steelhead hatchery operations form an important program in California, as in Oregon and Washington, and likely their importance will increase with continued water development and diversion.

California Fish and Game Commission Policy states: "Intensive hatchery work with . . . (salmon and steelhead) shall be limited to areas where it is necessary to salvage the eggs of fish which no longer have adequate or suitable spawning areas."

We are anxious to get the best results from our stocking, but at least in California we still need to know more about the proper time of year and size at which to plant. Experiments indicate that steelhead show appreciably higher returns if they weigh at least 8 fish per pound (6 inches fork length). (In California the highest percentage return from a single lot of fish was 8%, from a lot of 1953 brood year fish planted in the Sacramento River in January, 1954, at a size of 4 fish per pound and 8 inches fork length, marked Ad-BV.) At some hatcheries we have difficulty in achieving this size in one year.

Other studies have shown that the maturation of the osmotic and ionic regulatory system in juvenile steelhead appears to be growth dependent and not a function of chronological age. Therefore, one could expect fast-growing hatchery-reared steelhead to smoltify when younger than relatively slow-growing naturally-reared fish from the same area.

California has not attempted to rear steelhead in natural rearing ponds, as have Washington and Oregon. Natural ponds and sloughs suitable for this purpose are virtually nonexistent in California.

Many California streams reach very low stages or dry up during the summer months. Therefore, extensive rescue of steelhead is carried on, by trapping or seining. The results of this program have not been evaluated.

California has not used a punch card system to estimate the catch of steelhead or salmon, as have Washington and Oregon. Various estimates of catch, statewide and for more restricted areas, have been made from time to time on the basis of postal card surveys and creel censuses, sometimes in conjunction with marking or tagging programs.

#### Regulations

For many years, steelhead have been strictly a sport fish in California. In general, the sport fishing season for adult steelhead extends from November 1 through the last day of February, with bag limits of 3 or 2 trout or salmon in combination. There are few lure or bait restrictions; those in effect are designed principally to prevent snagging. Open waters are tidewaters and the main stems of streams and principal tributaries upstream to designated points.

In general, fishing for juvenile steelhead (and salmon) is permitted during a summer season lasting variously from the beginning of May or the end of May through October 31. There are some closures. The bag limit is 10 trout or salmon in combination. There is no size limit.

A great many young steelhead are caught in fresh water before they have migrated downstream to the sea. These fish are commonly less than 8 inches long. We do not know how many such juvenile steelhead may be taken without endangering a run.

#### DISCUSSION

California Fish and Game Commission policy states: "Steelhead and salmon management will . . . be concentrated on the maintenance of an adequate breeding stock and on maintenance of suitable spawning and natural rearing of the young to migratory size."

And further: "No stream can be expected to produce large numbers of young steelhead and salmon to migratory size and at the same time produce or support a crop of resident fish . . . The greatest productivity of the coastal streams can be attained by using them as rearing areas for young fish which will migrate to sea, grow rapidly and return to the stream to supply greater sport as well as more pounds of fish. Resident fish will therefore not be planted or developed in steelhead and salmon streams."

By and large, regulations and management of steelhead in California are aimed toward fulfillment of these policies. The end-of-May season opening in the main steelhead and silver salmon areas is designated to protect the seaward migrants during the month of May, which is one of the principal months of migration along the Pacific Coast. The winter season closure at the end of February is designed to protect spawning steelhead.

There is evidence that in most California streams a greater harvest of adult steelhead could safely be taken by anglers. The question then arises, to what extent and in what direction could and should the existing regulations and policies be liberalized? Could the winter open season be extended through March, or perhaps even beyond? Could the summer season open at the beginning of May, to conform with the general trout season opening in California? Could catchable-sized interior-stock rainbow trout be planted in steelhead and salmon streams without harm to the latter two?

The answers to these questions are not clear-cut. We think that a greater harvest of adult steelhead could be taken, but is it safe to make inroads into the March fish? These approximate only 30% of the runs, but are composed of older fish, preponderately females, whose eggs and fry are probably most apt to survive, because of reduced loss from floods and egg superimposition. We know that with a beginning-of-May opening large numbers of juvenile steelhead would be caught by anglers, but would this reduce the number of adults to a number less than needed to produce eggs and young to fill the carrying capacity of the nursery areas? We do not think that catchable-sized interior-stock rainbow trout would compete seriously with juvenile steelhead and salmon for living space and food, since they are caught out rapidly, but would their stocking result in too many juvenile steelhead and salmon being caught by anglers attracted by the planted trout?

These are some of the principal questions which need answers, but there are many others.