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CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 7 | SACRAMENTO, JANUARY, 1921 | Number 1

CONTENTS.

THREE CALIFORNIA MARKED SALMON RECOVERED.

By J. O. Snyder, Stanford University.

Three marked king salmon were secured last summer by W. L. Scofield, who was engaged in making obeservations for the Fish and Game Commission. Each of the three specimens had the adipose and left ventral fins excised. The mutilations were of such a nature that they could not be attributed to any other causes than the methods used in marking small fish. One was taken at Monterey, April 6. It measured 73 centimeters. Along with others it was evicerated before anything unusual was noticed regarding the fins. The sex, therefore, could not be determined with certainty. The second was caught at Shelter Cove

and brought to Fort Bragg, August 17. It was a male, which measured 71 centimeters and weighed 8¼ pounds. The third was caught in the Sacramento River near Pittsburg. It, too, was a male and measured 68 centimeters. These three fish are the first captured from some marked ones liberated in the Sacramento River in 1918.

Mr. W. H. Shebley writes concerning these fish: "The eggs were collected during the fall of 1916 at the Bureau of Fisheries stations

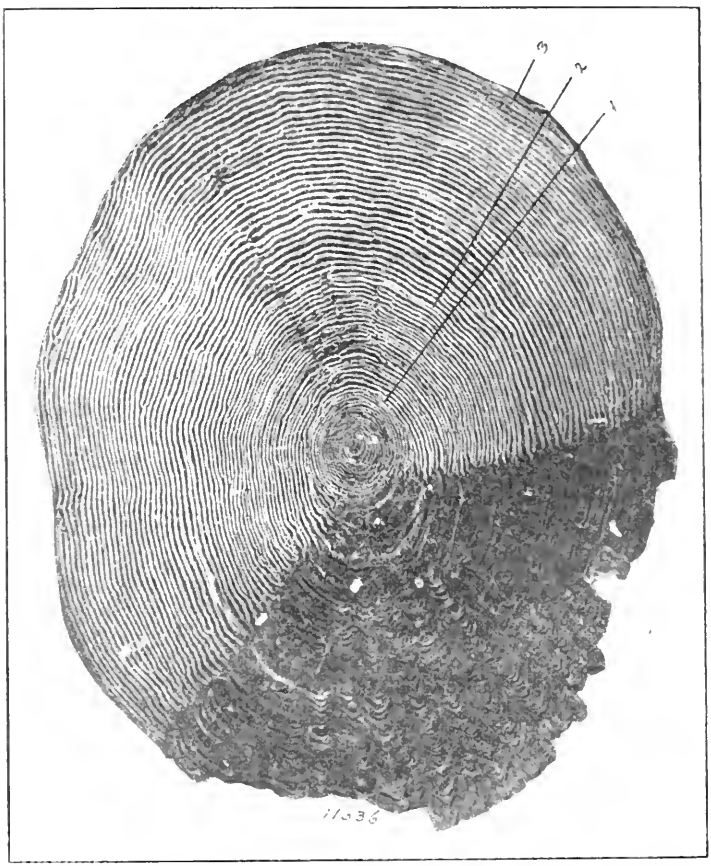

FIG. 1. Photomicrograph of scale of salmon marked at the Mount Shasta Hatchery in 1917 and taken at Monterey, April 6, 1920. Length 73 centimeters. Numerals mark the end of the first, second and third years of growth.

on the Sacramento River. The resulting fry were put in Sisson Lake in the spring of 1917 and held until October of the same year. They were then placed in the small rearing ponds at Mount Shasta hatchery. The fry were marked during November and December, 1917. These to the number of 18,000 were distributed in Cold Creek, a tributary of the Sacramento River, on March 19, 1918."

A photomicrograph of a scale from each of these fish is presented. It will be seen at a glance that the Pittsburg specimen differs markedly

from the others in that the edges are frayed or worn. This frayed appearance of the scales was characteristic of all fish observed at the time, and it plainly indicates that the absorption of reserve tissues was already in progress, a condition just preceding the breeding period. The fish from which this scale was taken was very dark in color, and the snout had become elongated and hooked.

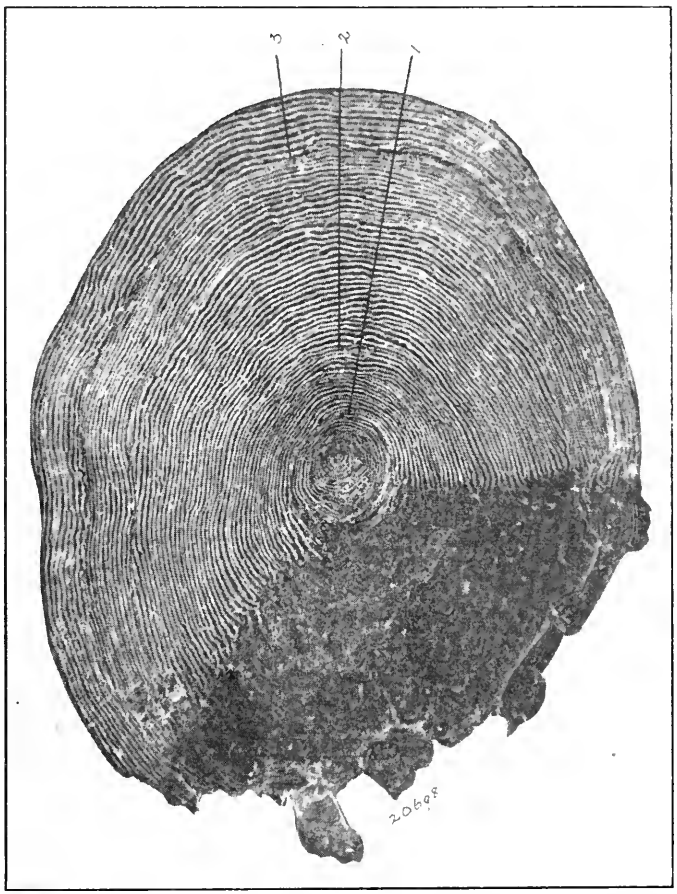

FIG. 2. Photomicrograph of scale of salmon marked at the Mount Shasta Hatchery in 1917 and taken in Shelter Cove, near Fort Bragg, on August 7, 1920. Sex, male; length 71 centimeters; weight 8¼ pounds. Numerals mark the end of the first, second and third years of growth.

A nuclear area of closely apposed rings appears near the center of each scale. This area corresponds with the period in the fish's life spent in fresh water, including the lake, pond and river. The nuclear area is surrounded by alternating bands of broad and narrow rings representing times of rapid or slower growth, which may be interpreted in periods of years, the second year growth ending at 2, the third at 3, while the fourth is in progress. The rapid growth of the fourth year was

early interrupted in the case of the Monterey fish, while allowed to progress farther in the Shelter Cove and Pittsburg examples.

The most valuable information coming to us with the capture of these marked fish is that the sea range of Sacramento salmon not only embraces Monterey Bay to the southward, but that it extends far northward as well. Now there is urgently desired at the present time some definite information regarding the source of supply of the marine salmon fisheries, and we have here a very plain suggestion as to the procedure necessary to gain at least some of that information. To be sure, it is perfectly well known that these salmon breed in certain large streams, but it is not known whether California streams alone contribute to our ocean supply, or whether we are in a measure reaping a harvest from seed sown north of our boundaries. The opinion has been freely expressed in some quarters that the salmon of Monterey Bay are from the Sacramento River, that those from Fort Bragg and Shelter Cove are from streams entering the ocean north of these localities, and in short, that young salmon on migrating into the ocean progress southward from their place of entry, where they live and grow until the approach of maturity. With a firm belief in the theory of southward migration, some fishermen and others of experience will even pretend to identify Columbia River salmon among those caught near Fort Bragg. We have at present very little to show that their belief is not well founded, but they have still less to demonstrate that it is. The capture of this marked Sacramento River fish at Shelter Cove, a long distance north of the mouth of the river, is then easily seen to be a matter of considerable importance. The evidence derived from a single example should not be overestimated, however, and it seems evident that only investigation involving carefully planned experiments will be of definite aid here and elsewhere in a profitable study of the life history of the salmon. It is very probable that such investigation might be carried on to better advantage in a stream much smaller than the Sacramento, for when one comes to consider the difficulties of obtaining results from a marking experiment, for example, in a very large river with the wide distribution and varied character of its fisheries, it is really remarkable that even three fish from a considerable number were secured. Moreover, the question as to whether some of our smaller streams may be made to contribute with profit to sea fishing is well worth considering, for the present rapid growth of irrigation and power projects, which seriously interfere with the natural breeding grounds of salmon in the Sacramento and Klamath rivers, foreshadows the time when some attention will be directed elsewhere if we seriously care to maintain our supply of these fish.

There is one point of interest connected with these scales to which, however, one is not as yet warranted in attaching any real significance. It will be observed that in the Shelter Cove scale, and particularly in that from the Sacramento River, the annual checks are very marked, while in the Monterey specimen they are much less distinct. A comparison of a large number of scales from the region of Fort Bragg and Shelter Cove, with many from Monterey Bay, seems to give the impression that the presence of sharply defined annual checks is not very characteristic of scales of Monterey salmon, but that, in contrast

with those from the region of Fort Bragg, they are much less pronounced and in many cases difficult to detect. Although one is not prepared to even speculate as to the reason for this, especially since the cause of the growth check is not known, it is, at any rate, of passing interest to observe that in the character of the growth check both the Monterey and Shelter Cove scales conform to what appears to be the fashion in each locality. And if appearances are not misleading, one would be tempted to suspect that the Sacramento fish

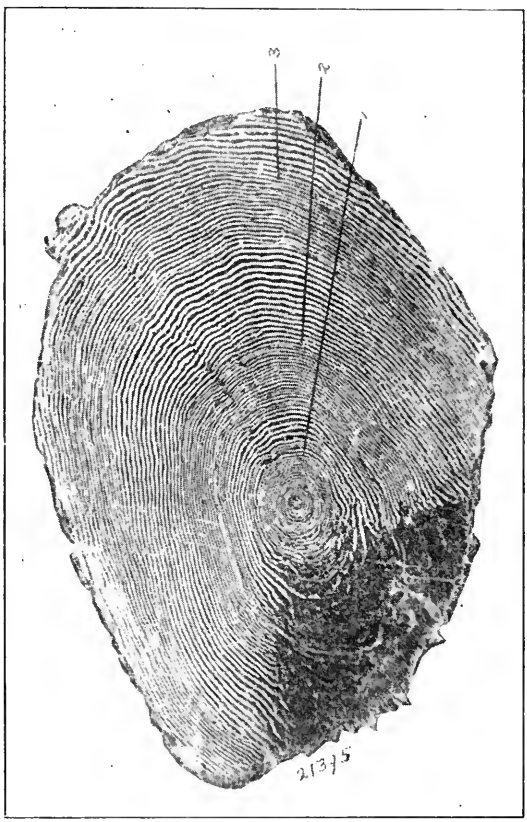

FIG. 3. Photomicrograph of scale of salmon marked at the Mount Shasta Hatchery in 1917 and taken in the Sacramento River at Pittsburg, September 15, 1920. Sex, male; length 68 centimeters. Numerals mark the end of the first, second and third years of growth.

had spent its sea life in the region of Fort Bragg or Shelter Cove. Furthermore, if we calculate the length attained by each fish at the end of the second and third years, which may be done with some degree of accuracy from measurements obtained from the scales, it will be seen that the Shelter Cove and Pittsburg specimens agree in being smaller than the one from Monterey.

Monterey ---------- second year 30 centimeters; third year 71 centimeters
Pittsburg ---------- second year 27 centimeters; third year 55 centimeters
Shelter Cove ------ second year 22 centimeters; third year 59 centimeters

This may be only a matter of coincidence, but interest will not be lost after a comparison of a number of fish from Fort Bragg and Monterey. From the scales of a hundred fish caught in Monterey Bay, and which had apparently entered the sea as yearlings, the average length at the end of the second and third years was computed. The same was done with a like number of similar fish from the vicinity of Fort Bragg. In both cases the specimens were taken at random as they appeared in the catch. The result was as follows:

Monterey ..... second year 38 centimeters; third year 65 centimeters
Fort Bragg ..... second year 35 centimeters; third year 59 centimeters

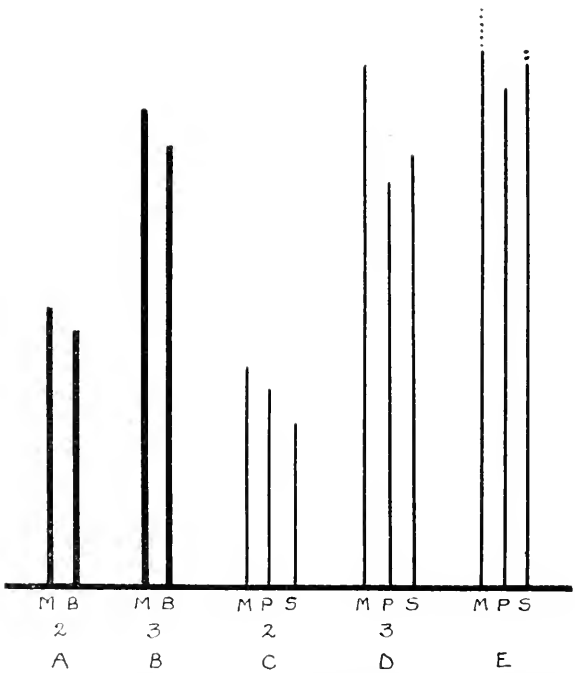

FIG. 4. Diagram showing the average length of marked and unmarked salmon, at two and three years of age, taken at various places.

A simple diagram will serve well to show these comparisons. A and B represent the average lengths at 2 and 3 years, M being the fish from Monterey, and B representing those from Fort Bragg, including Shelter Cove. C and D are the lengths of the marked fish from Monterey, Pittsburg and Shelter Cove at the end of second and third years. E represents the lengths of these fish at time of capture, the dotted tips indicating that growth was interrupted by capture before maturity.

Judging from the experience of investigators who have experimented with the marking of salmon, we may expect to see more of these fish in the fifth year. Their capture will be awaited with interest.

AN INSTANCE OF ADULT, SEA-RUN CHINOOK SALMON FOUND FEEDING IN FRESH WATER.*

By WILLIS H. RICH, Field Assistant, United States Bureau of Fisheries

During the course of the writer's investigation of the salmon of the Columbia River, it was learned, through apparently reliable sources, that the chinook salmon which entered the Cowlitz River during the early spring were feeding upon the smelt or euchalon (*Thaleichthys pacificus*) which run in large numbers at this time of year.

The Cowlitz River empties into the Columbia River nearly seventy miles above the mouth of the latter — well above the highest reach of brackish water. It is well known that the habit of adult salmon, entering streams for the purpose of spawning, is to cease feeding at least as soon as the fresh water is entered. In many cases the fish apparently cease to feed as soon as they leave the open ocean and definitely begin the journey to the spawning grounds even though the first part of the journey may be through pure, or nearly pure sea water. This is true of the Fraser River sockeyes which enter Puget Sound through the Strait of Juan de Fuca and which cease to feed as soon as the journey through the strait has begun.† The mature salmon taken just within the mouth of the Columbia River have ceased feeding although the water is only slightly fresher than sea water. Numerous other examples illustrating the same point might be cited. In view of these facts, the feeding of salmon so far from the ocean as the Cowlitz River formed a remarkable contradiction to the usual habit and it seemed desirable to fully investigate the report. On account of the spring closed season no commercial fishing for salmon was being carried on at the time the smelt were the most plentiful and it was necessary to make special efforts to secure specimens. On April 14, 1916, in company with a fisherman and one of the state fish wardens, several drifts with a gill net were made in the Cowlitz River

FIG. 5. Stomach of an adult sea-run Chinook salmon found feeding in the Cowlitz River, Washington. As a rule the stomach of a salmon found in fresh water shows no evidences of its being in use.

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†This is described by Gilbert in his paper on The Salmon of Swiftsure Bank, Report of the Commissioner of Fisheries, Province of British Columbia, 1912 (1913), page 116.

just below the town of Kelso. One chinook was finally secured—a female weighing about 25 pounds. The examination fully confirmed the reports, as the stomach contained upward of a dozen smelt in various stages of digestion. The stomach, partially dissected in order to expose the contents, is shown on the previous page.

This unusual habit is without doubt occasioned by and associated with the presence of enormous numbers of smelt. These smelt enter the Cowlitz and a few other tributaries of the Columbia River for the purpose of spawning and, at the height of the season, are gathered in close schools in small restricted localities. The laying of the eggs is apparently accomplished while they are thus aggregated. Evidently these conditions as found in the Cowlitz, where large numbers of small fish are closely schooled, approximate the normal feeding conditions as found in the ocean. Similar habits of the salmon will doubtless be found in other streams which have runs of smelt or other small anadromous fishes coinciding with a run of chinook salmon. Other species of salmon may also have a similar habit. It is probable that the salmon have followed the smelt run in from the ocean and that they continued to feed while passing up the main river and into the Cowlitz. This seems more likely than the alternative, that they had ceased feeding on leaving the ocean but began again on entering the Cowlitz.

In this connection it should be noted that the precocious male salmon which have matured after spending the first year in fresh water continue to feed even after the sex products have ripened. Such precociously mature males are commonly found both among wild fish and among those which have been reared in hatchery ponds. In certain instances it has been noted that these mature yearlings have recovered from the effects of maturity and have survived—contrary to the rule in the case of sea-run adults.*

It would seem that this is chiefly on account of the fact that the normal food supply has been constantly present so that it has not been necessary for the fish to cease feeding during the spawning period. The fact that adult, sea-run salmon will frequently take the hook when well into fresh water is further evidence that the normal feeding reaction is not disturbed merely by the entrance into fresh water. At many places chinook salmon may be taken by trolling with large spoon hooks. The salmon fishing at the Oregon City Falls on the Willamette River is well known. The steelhead fishing on other western streams, particularly the Rogue River, has a wide spread reputation, as has also the fishing for Atlantic salmon in Maine and Canada. In many cases these fish are taken hundreds of miles above the mouth of the streams.

It may be concluded from these observations that one of the factors which cause salmon on entering a stream for the purpose of spawning to cease feeding is the lack of a normal food supply. In the particular instance herein described, a normal food supply was present, with the result that the fish fed in a normal manner. It is possible that a longer residence in fresh water or the nearer approach of the spawning season would cause the fish to cease feeding even though a normal food supply was available.

* Early History and Seaward Migration of Chinook Salmon in the Columbia and Sacramento Rivers. By Willis H. Rich. Bulletin of the Bureau of Fisheries, XXXVII, 1919–20. Doc. 887, page 67.

STEELHEADS CAUGHT AT SEA OFF THE COAST NEAR FORT BRAGG.

By J. O. Snyder, Stanford University.

Trollers fishing for salmon off the coast north of San Francisco have reported the capture of steelhead trout at sea. None of these trout has been available for study until this summer, when W. L. Scofield, while making observations for the Fish and Game Commission at Noyo River near Fort Bragg, was fortunate enough to separate 16 specimens from the mass of king and silver salmon brought in there. Material was preserved so that no doubt is involved in the identification of these fishes. From the collector's notes the following paragraph is taken:

The first steelheads appeared July 23, and the last one was seen August 25. On August 14 five specimens were found, and again on

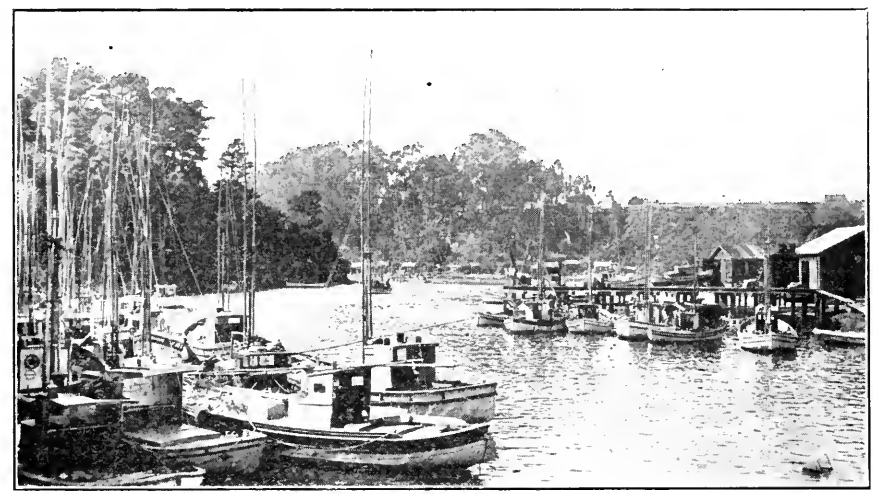

Fig. 6. Noyo Estuary, showing salmon fishing boats. Photograph by J. O. Snyder, 1926.

August 16 the same number were secured. In color they were of the characteristic steel blue above and bright silvery on the sides; the dark upper surface with small blackish spots, numerous on some examples, less abundant on others; the head with few or no spots. The dorsal, adipose and caudal fins were spotted, the size and number of spots varying considerably in different individuals. The pectoral and ventral fins were immaculate except for dark anterior margins. the lateral series of scales as recorded from twelve individuals number from 132 to 143, the count being made to base of caudal fin; the series from lateral line to back 25 to 34. They measured 19 to 29 inches, and weighed $2\frac{3}{4}$ to $9\frac{3}{4}$ pounds. There were eleven males.

These fishes are regarded as examples of *Salmo irideus*, the rainbow trout. This identification is based on what appears to the writer as a well-founded assumption, that but two species of trout* inhabit

* Bureau of Fisheries Document No. 638, page 183.

the costal region of California, *S. iridcus* and *Salmo clarkii*, the cutthroat trout, sea living individuals of both being known as steelheads.

The steelheads enter the rivers to spawn, their progeny in turn migrating to sea where food is plentiful, or remaining for an indefinite time in fresh water as the case may be, the latter being recognized as stream trout. The rainbow trout is a large scaled form, there being about 110 to 150 series of scales on the body, while the cutthroat has smaller scales, about 150 to 200 series. In their distribution the two species overlap, both occurring in the coastal streams from Redwood Creek northward.

In spite of the fact that these steelhead trout have been known for many years and that they are of considerable economic importance, our store of carefully observed and recorded facts concerning them is very meager. Some observations have lately been made on the Klamath, in which river both species enter from the sea and migrate for

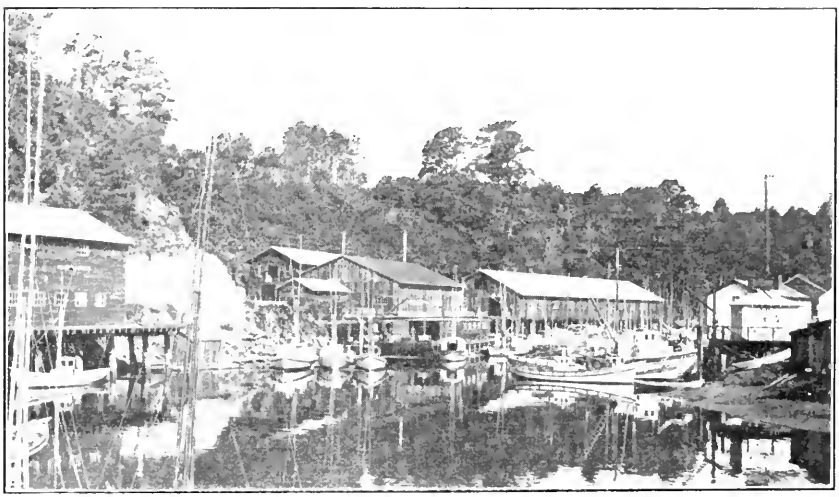

Fig. 7. Noyo Estuary, showing canneries. Photograph by J. O. Snyder, 1920.

spawning purposes. Here there are two fairly distinct migrations of steelheads, one occurring in the winter, the other in the summer. Of the winter run we know very little; nothing, in fact, of what species it is composed. The summer run consists almost entirely of *S. iridcus*, an example of *S. clarkii* occasionally appearing. The latter may be spoken of as one among thousands in the migration of the former. In the summer of 1919* the first steelheads were taken in salmon nets on July 11; the largest number were caught about August 27, and the run had about ceased October 22. The progress of the steelhead migration coincided in general with that of the king salmon, not only in its rise and decline, but in its periodical irregu-

* Agents of the Fish and Game Commission have been making observations on the trout and salmon for two summers in the estuary of Klamath River. Through the kindly interest of Mr. G. R. Field, they have been enabled to examine thousands of individuals, which his fishermen have taken.

larities as well, a large wave of steelheads being generally associated with a similarly large wave of salmon.

As these steelheads appear fresh from the ocean, many still bearing living salt water crustacea attached to their bodies, they are of a beautiful deep steel blue above, with highly burnished silvery sides. They have usually very definite black spots on the head and body, they are always present on the dorsal, adipose and caudal fins, while the remaining fins are immaculate. Sometimes the head is without spots and the body has very few. Counts on a number of examples resulted as follows: Head spots, 0 to 25; body, 8 to 271; dorsal fin, 47 to 98; adipose, 1 to 9; caudal, 14 to 220. The spots of the head are almost always round; those of the body elongate or linear. The ova found in these fishes are very small, their undeveloped condition giving rise to the suggestion that the steelheads have entered upon a very long migration or at least a considerable period in fresh water. Their stomachs are mostly empty, and they remain so at least while they are in the estuary for the very simple reason that there is not food enough in the river to supply such a horde, were its members inclined to eat. They occasionally strike a spinner, but they will not rise to fly, nor are they often attracted to a baited hook. Later in the season and farther up stream their appetites are said to return, and their behavior is governed accordingly. About the middle of August, steelheads that have begun to assume their nuptial colors are occasionally seen in the estuary. The cheeks become tinted with pink, and a broad reddish blush appears along the sides. At the same time the dark dorsal area loses its marine hue and becomes light olive. No salt water crustacea are found attached to these tinted individuals, and it appears probable that they have been in fresh water for some time. The steelheads fresh from the sea are plump, fat and full of energy. At times they have been seen in numbers leaping high from the water and falling with a resounding splash, in strong contrast to the salmon which only cut the surface with their backs and tails.

The largest steelhead caught in the Klamath is said to have weighed 32 pounds. Those which appear from day to day are much smaller. For example, on August 13 and 14 of this year, 248 specimens that were caught in gill nets measured $14\frac{1}{2}$ to 32 inches and weighed $1\frac{1}{8}$ to $14\frac{3}{8}$ pounds. The entire lot gave an average weight of 5.86 pounds; 10,862 examples showed an average weight of 4.3 pounds. Small fishes are not apt to become entangled in the coarse meshes of the drifting gill nets, and it is therefore of interest to find that a fine meshed seine will bring from the river not only large specimens but smaller ones as well, individuals 8 or 10 inches in length having been taken which exhibit every detail of color possessed by the larger steelhead fresh from the sea. Whether these small fishes have just come in from the ocean we are unable at present to say.

The scales of these Klamath steelheads which are identified as *Salmo irideus,* rainbow trout, number 116 to 150 in the lateral series. The steelhead trout taken at sea near Fort Bragg are of the same species as those that enter the Klamath in the summer in such large numbers. They may even be Klamath trout for all that we know, but it seems more reasonable to assume that their parent stream is somewhere nearer their place of capture.

THE RELATIVE MATURITY OF THE CHINOOK SALMON TAKEN IN THE OCEAN ALONG THE PACIFIC COAST.*

By WILLIS H. RICH, Field Assistant United States Bureau of Fisheries.

This paper is in the nature of a preliminary report dealing with the maturity of the chinook salmon taken by troll and purse-seine in the ocean along the Pacific coast, and is presented for the purpose of making immediately available some of the results of the investigation. It is also believed that the method used for determining the relative maturity is new and may be of value to others engaged in similar investigations. A later report will give in detail the data upon which the conclusions presented in this paper are based, and will discuss several topics treated very briefly, or omitted entirely from this paper.

The amount of trolling and purse-seining for chinook salmon along the Pacific coast has increased enormously during the past few years, especially along the northern coast of California, the coast of Oregon, and off the mouth of the Columbia River. To anyone who has observed even casually the fish thus taken in the ocean it is perfectly apparent that a great proportion are immature and it is a point of considerable interest and practical importance to know just what percentage are immature and the relative degree of immaturity. The determination of the age by means of scale studies will not, alone, give a sufficient index to the degree of immaturity since there is such a wide range in the age at which these fish reach the spawning stage—from two to six years. If the percentages of individuals of different ages among the mature fish were constant, it would be possible, from a determination of the percentages of fish of different ages taken by troll and purse-seine in the ocean, to estimate the percentage of fish of different degrees of maturity. This, however, is not the case. The percentages of fish of the various age-groups vary greatly at different times among the mature fish and also among those taken in the ocean. Presumably these variations are due quite largely to racial differences but our present knowledge of the various races of chinook salmon is quite too limited to aid in segregating the races from mixed lots. Even if our knowledge of the races were complete it might well be that they could not be identified and segregated accurately and fully enough to serve the purpose. It is apparent that some other means than the determination of the age is necessary in order to learn the percentages of mature and immature fish taken in the ocean and their relative maturity.

The method which has been developed for determining the relative maturity is based upon variations in the size of the eggs. Obviously this can be applied only to the females and no method has yet been devised for determining the relative maturity of the males. The percentages of males and females found among the mature fish of the various age groups will give some basis for estimating the percentages of mature and immature males from the determination of the relative maturity of the females, but a discussion of this topic must be reserved

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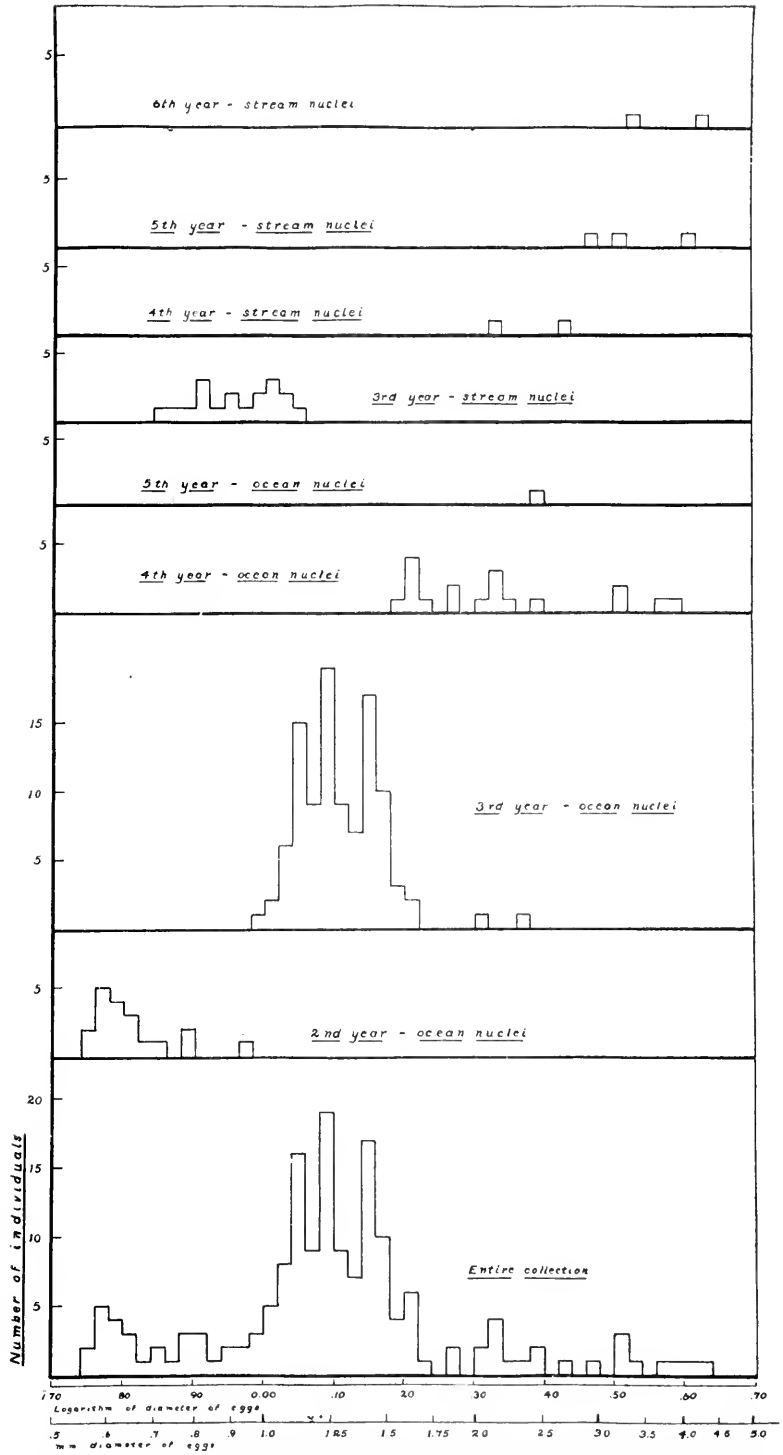

FIG. 8. Histogram showing frequency-distribution of 163 female salmon

for the complete report. It is sufficient to state here that, while there is a tendency for the males to mature somewhat younger than the females, the error which would result from assuming that the proportions of fish of similar degrees of maturity were equal in the males and females would not be serious.

Superficial examination of the eggs found in the females taken in the ocean shows that there is a wide diversity in the size and, further, that several more or less distinct size-groups are distinguishable even without careful measurement. It is a natural assumption that these various sizes of the eggs indicate different degrees of maturity. A careful study of several collections of fish taken within the Columbia River and by troll off the mouth of the Columbia, in Monterey Bay, California, and along the northern coast of California confirms this assumption and shows that, by means of a study of the variation in the size of the eggs and a determination of the age by means of the scales it is possible to distinguish, with certainty, in many cases, and with reasonable probability in most, between fish which would have spawned during the year in which they were taken and those which would not have spawned for at least one more year. The distinction between fish which would not have spawned for two years is not quite as definite but in some collections the interpretation is clear.

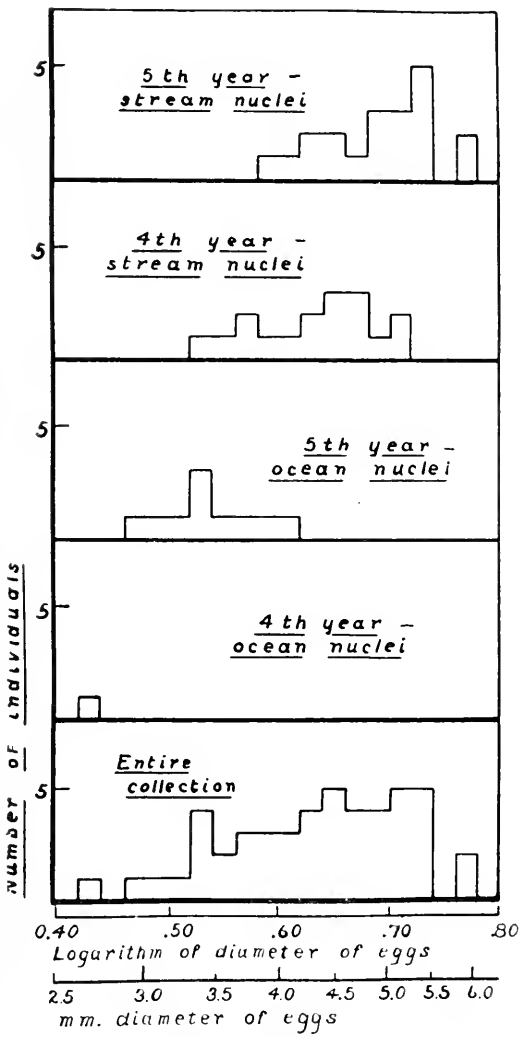

FIG. 9. Histogram showing frequency-distribution of 48 females taken by beach seines and wheels near Warrendale, Oregon, June 16, 1919, based on the logarithms of the diameters of the eggs.

In studying these collections the age has been determined by the usual method of scale study. The size of the eggs has been determined by measuring ten of each sample and taking the average. The larger eggs—those over 1 mm. in diameter—were measured in a simple device

which consists essentially of a small trough, V-shaped in cross-section and with closed ends, which is graduated in millimeters. In use this is partially filled with water, the eggs are placed in a row in the bottom

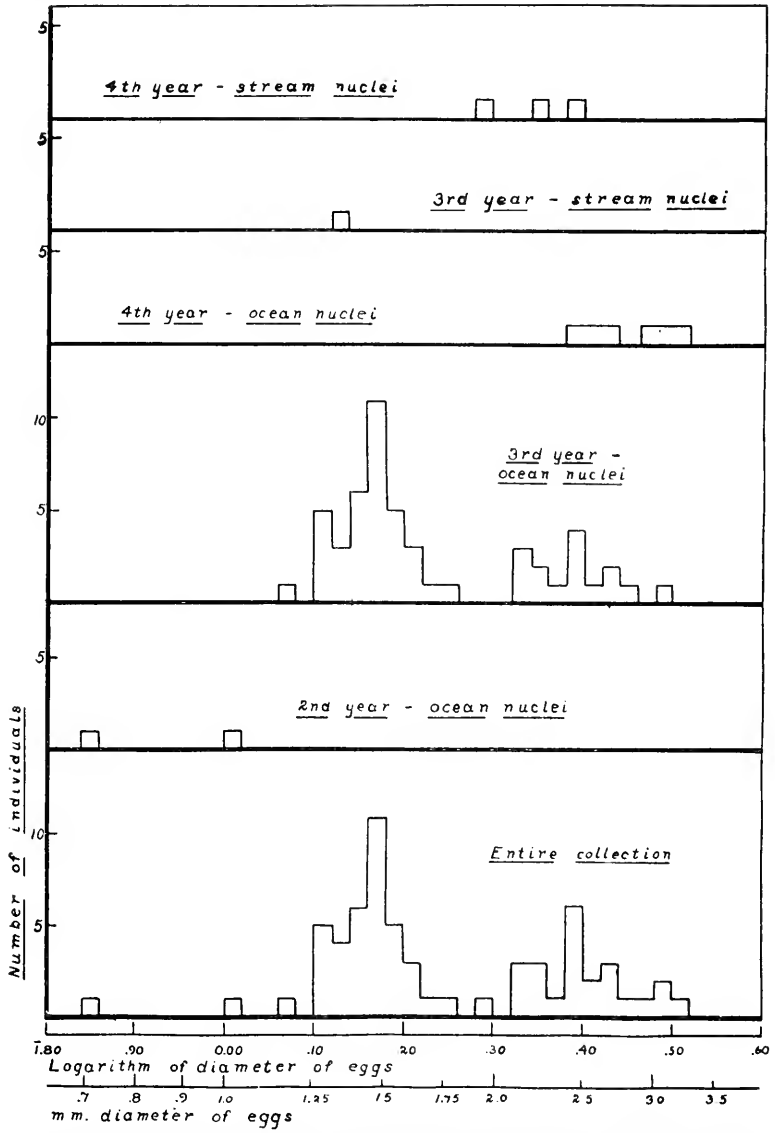

FIG. 10. Histogram showing frequency-distribution of 63 females taken by troll in Monterey Bay, California, June 19–21, 1918, based on the logarithms of the diameters of the eggs.

of the trough, and then are carefully pushed up to the zero end of the scale by means of a small piece which fits the bottom of the trough and on which is graduated a vernier enabling one to read accurately to tenths of a millimeter. The measurement of ten eggs by this scale

gives directly, by simply moving the decimal point one place to the left, the average size of the eggs to hundredths of a millimeter. As a matter of fact this measurement is finer than is necessary in the great majority of cases. In preparing eggs for this measurement it is necessary to free them very carefully from the ovarian membranes so as not to break the delicate shell and yet to clear them of all shreds of tissue which might tend to affect the measurement. The smaller eggs—those less than 1 mm. in diameter—were measured by means of a microscope fitted with an eyepiece micrometer carefully standardized. In using this method it was necessary, of course, to measure the ten eggs separately and then the average of these measurements was found.

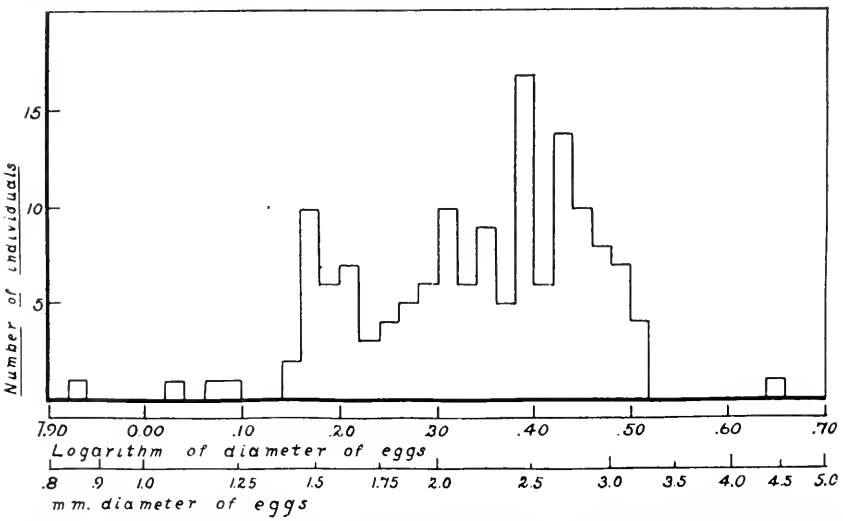

FIG. 11. Histogram showing frequency-distribution of 144 females taken by troll in Monterey Bay, June 29, 1915, based on the logarithms of the diameters of the eggs.

The tabulating and plotting of these egg measurements has been done on a logarithmic basis—that is, the logarithms of the actual measurements have been tabulated rather than the measurements themselves. The main advantage of this sort of tabulation lies in the fact that proportional variations in size are equally shown independent of the actual size, and it is the relative size of the eggs, rather than the actual diameter, which is significant.[1]

In preparing the tables and charts the classes have been arranged with intervals of .02 in the logarithm of the diameter of the eggs. This signifies that the mid-value of each class is 4.713 per cent greater than that of the class next preceding.

The following collections have been used in the preparation of this preliminary report:

1. 163 females taken by troll off the mouth of the Columbia River, May 8, 1919.
2. 68 females taken by troll off the mouth of the Columbia River, June 4, 1919.
3. 48 females taken by beach seines in the Columbia River near Warrendale, Oregon, June 16, 1919. (Warrendale is approximately 150 miles above the mouth of the river.)

[1] The writer is indebted to Prof. F. W. Weymouth of Stanford University for an acquaintance with this method of tabulating.

4. 48 females taken by traps in Baker Bay, Columbia River, July 3, 1919. (Baker Bay and Sand Island, where the next collection was taken, are both just within the mouth of the river.)

5. 41 females taken by beach seines on Sand Island, Columbia River, July 6, 1919.

6. 101 females taken by troll off the mouth of the Columbia River during August 13 to 17 and September 16 to 17, 1918. (But five of these were taken in September and these have been considered with the August collections.)

7. 95 females taken by troll off the mouth of the Columbia River, August 13, 1919.

8. 63 females taken by troll in Monterey Bay, California, June 19 to 21, 1918.

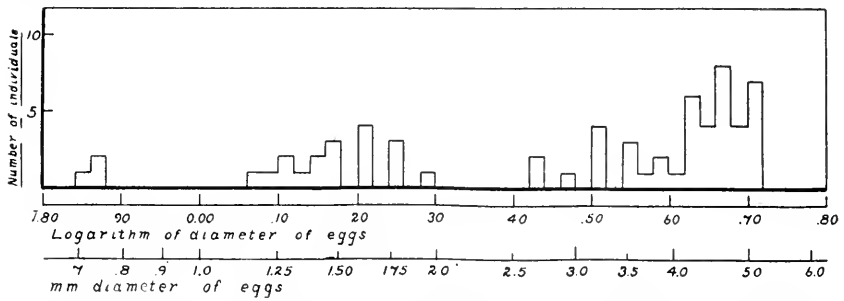

FIG. 12. Histogram showing frequency-distribution of 64 females taken by troll near Drake's Bay and Fort Bragg, California, July and August, 1918, based on the logarithms of the diameters of the eggs.

Full data including scales were taken with each of the above collections. In addition to these the following two collections consisting of eggs alone were studied:

9. Eggs from 144 females taken by troll in Monterey Bay, June 29, 1915.

10. Eggs from 64 females taken by troll near Drake's Bay, August 15 and 16, 1918, and Fort Bragg, July 17, 1918, on the coast of northern California. Scales and data were also collected from the females at the same time the collections of egg samples were made, but the records were not kept so that the egg samples could be referred to the corresponding data and scales. It has been necessary, therefore, to treat egg samples and other data independently.

It will be impossible, in this report, to give in detail the evidence necessary to prove the validity of this method for determining the relative maturity. The graphs will, however, give illustrations of typical results obtained from the measurement and tabulation of the eggs. An examination of the graphs shows that, in the collection of undoubtedly mature fish from Warrendale, the eggs were fairly uniform in size, ranging from about 2.5 to 6 mm. in diameter. The obvious graduation in size of the eggs in the different age-groups is probably significant of racial differences, but a discussion of this point cannot be given in this paper. In the case of the fish taken by troll in the ocean the frequency-distribution based on egg sizes shows a distinct grouping around several modes which are usually quite well separated.

Three modes are especially distinct and, in the case of the collections for which age determinations were also made, and which have, therefore, been separated into the component age-groups (Monterey, 1919, and Columbia River, May, 1919) it is apparent that the group characterized by the largest eggs (above 2 mm. in diameter) is composed chiefly of

fish in their third, fourth and fifth years, whose scales show the ocean type of nucleus, and of fish in their fourth and fifth years whose scales show the stream type of nucleus. [The nuclear growth here referred to is that located close to the center of the scales and represents the portion of the scales formed during the first year. The "stream" type indicates that the fish remained in the stream during the entire first year of its life. The "ocean" type of nuclei indicate that the fish have migrated seaward sometime during the first year, usually early.]

The group representing the next smaller size of eggs (1.25 to 1.5 mm.) in diameter is characterized especially by fish in their third year with either ocean or stream nuclei, while the group representing the smallest eggs (.6 to .8 mm.) is characterized chiefly by fish in their second year with ocean nuclei. The size of the eggs in the group having the largest eggs corresponds, in each instance, with the size of eggs in the Warrendale collection and are, therefore, without doubt fish which would have matured during the year in which they were taken.

It is apparent, then, that in general the group characterized by the largest eggs is composed of fish one year older than those composing the group with eggs of the next smaller size, and that these in turn are one year older than those composing the group with the smallest eggs. These differences in the size of the eggs are not dependent on corresponding differences in the size of the fish. There is, indeed, a distinct correlation between the size of the fish and the size of the eggs, but, as will be shown in the more detailed report, this correlation is by no means ample and is unquestionably modified by the approach of maturity. Of particular interest and significance is the presence of two groups of individuals within the same age-group which may be definitely separated on the basis of egg sizes. This is shown with unusual clearness in the third year fish with ocean nuclei taken at Monterey in 1918. The group with eggs greater than 2 mm. would undoubtedly have spawned during the fall of the same year in which they were taken, while the fish composing the other group would not have spawned for at least one more year. These facts which have been so briefly and incompletely discussed seem to fully justify the conclusion that the size of the eggs is a fairly reliable index of the relative degree of maturity of chinook salmon.

Without attempting to discuss further the method used for determining relative maturity, a tabular summary will be given of the results obtained by the study of the ten collections which have formed the basis for this report. It is hoped that further study will increase the accuracy of the results, and it seems probable that some of the percentages given in the table may be somewhat modified by additional investigations. It is believed, however, that the results as given here are fairly reliable. In preparing the table care has been taken to include doubtful cases always with the more mature of the two groups to which they might be assigned. This has been done in order not to exaggerate the degree of immaturity exhibited by any of the various collections.

TABLE I.

Composition as to age groups and relative maturity of a collection of 165 females taken by troll off the mouth of the Columbia River, May 8 to 10, 1919.

Age groups	Number of specimens and per cent which would mature during: Year taken		Following year		Second year following		Total	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 2d year					19	100	19	11.5
In 3d year	2	2	100	98			102	61.8
In 4th year	18	100					18	10.9
In 5th year	1	100					1	.6
Stream nuclei—								
In 3d year			18	100			18	10.9
In 4th year	2	100					2	1.2
In 5th year	3	100					3	1.8
In 6th year	2	100					2	1.2
Totals	28	17	118	71.5	19	11.5	165	

TABLE II.

Composition as to age groups and relative maturity of a collection of 68 females taken by troll off the mouth of the Columbia River, June 4, 1918.

Age groups	Number of specimens and per cent which would mature during: Year taken		Following year		Second year following		Total	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 2d year					18	100	18	26.5
In 3d year			32	97	1	3	33	48.5
In 4th year			1	100			1	1.5
In 5th year	1	100					1	1.5
Stream nuclei—								
In 3d year			10	100			10	14.7
In 4th year	2	50	2	50			4	5.8
In 5th year			1	100			1	1.5
Totals	3	4	46	68	19	28	68	

TABLE III.

Composition as to age groups and relative maturity of a collection of 48 females taken by seines and wheels near Warrendale, Oregon, June 16 and 17, 1919.

Age groups	Number of specimens and per cent which would mature during: Year taken		Following year		Second year following		Total	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 4th year	1	100					1	2
In 5th year	10	100					10	21
Stream nuclei—								
In 4th year	17	100					17	35
In 5th year	20	100					20	42
Totals	48	100					48	

TABLE IV.

Composition as to age groups and relative maturity of a collection of 51 females taken by traps in Baker Bay, Columbia River, July 3, 1919.

Age groups	Number of specimens and per cent which would mature during: Year taken		Following year		Second year following		Total	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 3d year	1	100					1	2
In 4th year	24	100					24	47
In 5th year	17	100					17	33
In 6th year	3	100					3	6
Stream nuclei—								
In 3d year			1	100			1	2
In 4th year	4	100					4	8
In 5th year	1	100					1	2
Totals	50	98	1	2			51	

TABLE V.

Composition as to age groups and relative maturity of a collection of 41 females taken by beach seines on Sand Island, Columbia River, July 7, 1919.

Age groups	Number of specimens and per cent which would mature during: Year taken		Following year		Second year following		Total	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 2d year					5	100	5	12.4
In 3d year	1	50	1	50			2	4.8
In 4th year	20	100					20	48.8
In 5th year	8	100					8	19.5
Stream nuclei—								
In 3d year					4	100	4	9.7
In 4th year	1	100					1	2.4
In 5th year	1	100					1	2.4
Totals	31	76	1	2	9	22	41	

TABLE VI.

Composition as to age groups and relative maturity of a collection of 102 females taken by troll off the mouth of the Columbia River, August and September, 1918.

Age groups	Number of specimens and per cent which would mature during: Year taken		Following year		Second year following		Total	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 2d year			1	20	4	80	5	5
In 3d year	21	84	4	16			25	24.5
In 4th year	19	95	1	5			20	19.5
In 5th year	19	100					19	18.5
Stream nuclei								
In 3d year			2	100			2	2
In 4th year	3	100					3	3
In 5th year	27	100					27	26.5
In 6th year	1	100					1	1
Totals	90	88.3	8	7.8	4	3.9	102	

TABLE VII.

Composition as to age groups and relative maturity of a collection of 95 females taken by troll off the mouth of the Columbia River, August 13, 1919.

Age groups	Number of specimens and per cent which would mature during:						Total	
	Year taken		Following year		Second year following			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 2d year			1	50	1	50	2	2.1
In 3d year	9	60	6	40			15	15.8
In 4th year	63	95.5	3	4.5			66	69.5
In 5th year	4	100					4	4.2
Stream nuclei—								
In 3d year			1	100			1	1.1
In 4th year	6	85.7	1	14.3			7	7.3
Totals	82	86	12	13	1	1	95	

TABLE VIII.

Composition as to age groups and relative maturity of a collection of 63 females taken by troll in Monterey Bay, June 19 to 21, 1918.

Age groups	Number of specimens and per cent which would mature during:						Total	
	Year taken		Following year		Second year following			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 2d year			1	50	1	50	2	3.2
In 3d year	15	29	36	71			51	81
In 4th year	6	100					6	9.5
Stream nuclei—								
In 3d year			1	100			1	1.6
In 4th year	3	100					3	4.7
Totals	24	38	38	60	1	2	63	

TABLE IX.

Composition as to relative maturity of a collection of 144 females taken by troll in Monterey Bay, California, June 29, 1915. Determined from a study of the eggs alone.

Age groups	Number of specimens and per cent which would mature during:		
	Year taken	Following year	Second year following
Number	108	35	1
Per cent	75	24.3	.7

TABLE X.

Composition as to relative maturity of a collection of 64 females taken by troll near Drake's Bay and Fort Bragg, California, July and August, 1918. Determined from a study of the eggs only.

Age groups	Number of specimens and per cent which would mature during:		
	Year taken	Following year	Second year following
Number	43	18	3
Per cent	67	28	5

From the data contained in these tables the following generalizations may be made:

1. The fish taken in the ocean off the mouth of the Columbia River contain, in the spring and early summer, approximately 70 per cent of individuals which will not become sexually mature for one or two years.

2. By the middle of August this condition has changed so that nearly 90 per cent are fish which will soon enter the river for the purpose of spawning. The rate at which this change takes place and the time at which it occurs have not yet been determined, but will be taken up in the later report.

3. A comparatively small percentage of the fish found just within the mouth of the Columbia River are immature. It should be mentioned in this connection that it is only occasionally when unusual tidal conditions obtain that any immature fish are taken inside the mouth of the stream.

4. The fish taken by troll in Monterey Bay in June contain a considerable proportion of immature individuals. The data obtained in 1918 are most reliable, and indicate that only about 40 per cent of the fish taken would have spawned during the same year. The data for 1915 indicates that 75 per cent were mature, but selection may well have taken place in making this collection which, as noted above, consists of egg samples only.

5. The fish taken near Drake's Bay and Fort Bragg in July and August, 1918, contain approximately 30 per cent of immature fish. It is of interest to note that this is an approach to the conditions found off the mouth of the Columbia River in August and suggests that the composition of all the schools found near the coast changes materially during the summer season.

GEAR USED FOR SALMON TROLLING IN CALIFORNIA IN 1920.

By W. L. Scofield.

Object. These notes, by no means complete, are intended to be a rough record of the type of gear used in open sea salmon trolling in California at present (1920) as a partial supplement to the system of triplicate receipts for statistics of catch recently installed by the Fish and Game Commission. The fact that gear and methods have changed decidedly in the past few years and no doubt will continue to change makes this summary necessary.

The notes deal chiefly with *gear* used. Such subjects as history of trolling, points at which trolling is practiced and its extent, location for trolling in a given local area, prospecting for schools, and deep vs. shallow fishing, although most important, are omitted or merely touched upon here.

Variation in Methods. There is considerable variation in methods and equipment, with great divergence of opinion on most of the subjects taken up in these notes. While the industry was new this was an advantage, as established custom did not limit experimenting,

but the results of the experimenting were not kept in definite form to be used, each fisherman satisfying only his own opinion without giving others the benefit. As a result there has been much duplication and improvement has been slower than need be. As fishing practice is now more established future improvements will result from more accurate experimenting with definitely recorded results.

Location for Trolling. Most of the fishermen move from one region to another following the salmon runs. The Monterey season opens first (January or February) and the local Monterey fleet is doubled or trebled by boats that go down from northern points, chiefly from San Francisco. Toward the end of the Monterey season (June) these boats begin leaving for San Francisco. They either fish for a time out of San Francisco or Point Reyes or go on up the coast to Bodega Bay, Fort Bragg and Shelter Cove. About August they begin returning to San Francisco. This year several boats, after completing the season at Shelter Cove, went farther north, some bound for Astoria.

In a given region the greatest and most difficult single factor in success is picking the good place to troll. Some days the big catches are made near shore in shallow water. At other times the trolling is best far out in deep water. In Monterey a quite generally believed theory is that schools come up from the south, enter the bay to feed for a few days and then leave. Other fishermen cite cases where the schools come from the north. Some fishermen prospect far out in order to locate entering schools. Cases are known where such a school has been fished day after day on its way to Monterey and while in the bay. Other schools have been followed far up the coast.

In the choice of location most fishermen merely follow some "hunch" and go it blind, keeping an eye on the other boats till they see someone landing fish and then go to that locality. When a large school is biting the whole fleet is often bunched in a small area. A plan often followed at Fort Bragg is to start trolling near shore with a shallow set and work farther out, gradually increasing the depth of line while prospecting for a school. Undoubtedly the successful fishermen have gathered a great amount of knowledge from experience but these "trade secrets" are not discussed freely. A knowledge of the habits of sardines, anchovies and squid is undoubtedly a help to some fishermen. Little is known of the effects of local currents carrying food and the consequent behavior of salmon.

Deep vs. Shallow Fishing. The most successful fishermen experiment at different depths and prospect to locate schools. It is a common saying that small Chinooks are caught more often in shallow water near shore. Silver salmon are said to be caught near the surface. There are, however, many exceptions. Some days when the fish are feeding actively the large Chinooks are caught near the surface. A common method of prospecting is to set one line with two to five fathoms of main line out (above leads) and the other line set with 10 to 20 fathoms out. Good catches are made at a great variety of depths on different days and practically nothing is definitely known of the reasons. Whether or not different schools feed differently is not known. Whether or not the weather affects the depth is not known, but some fishermen work on the theory that deep fishing is best on a clear bright day and that the set should be shallow for

cloudy dark days. This suggests the possibility of plankton sinking to greater depths on clear days, small fish following the plankton and salmon following the small fish. Practically nothing is known of the effect on salmon of different water temperatures. Color of the water is believed by fishermen to be important. Clear water is believed to be poor for salmon fishing and at such times deep fishing is said to be more successful than shallow. Dark, murky or even reddish water is thought to be best for salmon catches and can be fished nearer the surface. The "red water" of deep color sometimes seen along shore is not good for trolling.

Boats. The type of boat most used is a clipper bow boat of wide flare forward and a pointed compromise stern. Often there is a small cockpit near the tiller and a high narrow house open at the back that is little more than a wind and spray screen when standing at the wheel near the engine. As the change from sail to power fishing has been recent there are a number of converted sailboats in use, especially the small Mediterranean type of boat that formerly used a latine sail. There are also a number of converted pleasure boats of a great variety of types. The pointed stern is usually favored rather than a rounding fantail stern because with the narrow stern it is easier to haul a fish up alongside on either side while still operating the tiller. The first troll boats were square sterns. Then the rounding or fantails were found to be better suited to landing the fish as there were no corners for the line to catch on and the stern is low in the water. The low stern was not so good when the boats began going out farther in rough water. Now that two-line fishing is almost universal the bluntly pointed compromise stern is used most.

As fish are becoming less plentiful the tendency has been to use increasingly larger boats capable of going farther out with comfort. The clipper bow type ranges in size from 20 to 40 feet over all with 30 feet as about the average size. The few 40 foot boats usually fish four poles.

The older boats have only a small hatch forward to allow a man to crawl below deck. A recent tendency toward comfort has been to raise the forward deck to allow more room below and a number of boats now have a low house extending forward with portholes to admit light and air. This could be more general since the forward deck is not used except for stowing the anchor and chain.

Nearly all boats carry but one fisherman. The larger boats fishing four lines sometimes carry two men, one handling the starboard lines and the other the port, but frequently one man operates the boat and handles four lines. The catch of a large boat is usually not equal to the catches of two smaller two-line boats, so experienced fishermen prefer to fish alone and not divide profits. Many of the one-man boats are decked over the stern and this is much more dangerous for the fisherman than having a small cockpit. The gunwale is only three or four inches high, the deck is wet, the boat rolls in a rough sea and while landing a fish the fisherman often has to keep one leg on the tiller so that his chances of going overboard seem fairly good, and once overboard with the engine running and his rubber boots too heavy for swimming, his only chance is to be picked up by some other boat.

Engines. Boat engines are of one and two cylinders, the majority being one-cylinder. The two-cylinder engines are nearly all 12 horsepower. The one-cylinder engines develop 6 or 8 horsepower capable of giving a boat speed of about seven miles per hour. The Hicks engine is the most popular engine for trolling boats, but there are many Standard engines in use. In all there are about 20 different makes used, including the Ford automobile engine. Eastern engines built for pleasure boats are also used, such as the Buffalo and Scrips. Most of the boats under 30 feet long have a one-cylinder and boats over 30 feet have a two-cylinder engine.

Speed of Boats. When trolling the engine is choked down till the boat travels at from 2 to 4 miles per hour, 2½ to 3 miles is usually preferred. The speed is greater when fishing near the surface. The deeper the lines the slower the boat is run. This is partially based on the theory that the fish on the surface are more active in taking bait or spoon and that fish deeper are more easily tempted by an object moving more slowly. A greater influence in slowing down for deep fishing is the fact that the line may be given a deeper set with the addition of but few extra weights. The slower the speed the deeper the set for a given amount of leads and hauling in a deep set, heavily weighted line on a rapidly moving boat with the resulting water drag on the line is back breaking work, so that the theory of deep fish being more sluggish fits in nicely. The speed is greater when fishing spoons rather than bait is used. Most spoons do not have the proper motion (spinning or side to side weaving) when the boat is run as slowly as is customary in bait fishing.

Poles. Poles are made from young peeled saplings, seasoned and trimmed down, usually of pine, eucalyptus or Douglas fir. Many bamboo poles are used, a single large pole or three small diameter poles lashed together. Often a short section of bamboo is lashed to the pole near the tip as a reinforcement at the point where a break is most apt to occur.

For small boats a general rule is to have the length of pole equal to the length of the boat as this is believed to give better balance. Boats using four poles have two short poles forward and two very long poles aft. Twenty-five feet is about the average length of pole.

Placing of Poles. Since there are many different styles of boats used there is great variation in the arrangement and position of the poles on the boat, each fisherman following his own ideas to best fit the deck plan of his boat. In some cases the poles are far forward, in most cases amidships and in some cases far aft. When the boat is small and of narrow beam the poles are usually crossed so that the base of the starboard pole rests in the scuppers of the port gunwale. This arrangement does not require a mast. In large boats the poles are used with a short mast, the base of the pole fitting into a socket or bolted at the foot of the mast. Since the distance from the mast foot to the gunwale is short, the pole when under strain has a great leverage. The strain is relieved by guy lines run from the bows. When very long poles are used even on larger boats they are sometimes crossed thus giving a longer pole base support within the boat.

Pole Supports. In all cases the pole has a vertical support on the gunwale to give the tip the necessary elevation. These supports may be simply two boards nailed together like a letter X, or a single board

with a U notch cut in the upper end to receive the pole. Some have a notch cut to curve aft so that the pole jams in and is held down tight when the boat rolls violently. Other supports are made by bending the end of an iron rod into a U-shaped receiver for the pole.

Stowing Poles. When not trolling the poles are seldom left spread because of the danger of being broken. In some cases they are laid on deck along the gunwales, sometimes lashed to the top of the house with their bases in the bows, often drawn up vertically beside the short mast, fitting in notches at the mast head. Sometimes the pole base is hinged so that the poles may be lowered aft against the top of the house. In a few cases the mast is set on a hinged base so that mast and poles may be lowered at night or to pass under a bridge.

Pole Line. In trolling the main line is not attached to the pole directly. There is a short large-sized line or "pole line" with one end tied to the pole tip and the other end provided with a snap hook which is snapped into the main line at any desired point. The upper portion of the main line then hangs loose from the snap to the stern of the boat and provides a very convenient method of pulling in the line, since the pole line and snap are from 15 to 25 feet out from the stern while trolling.

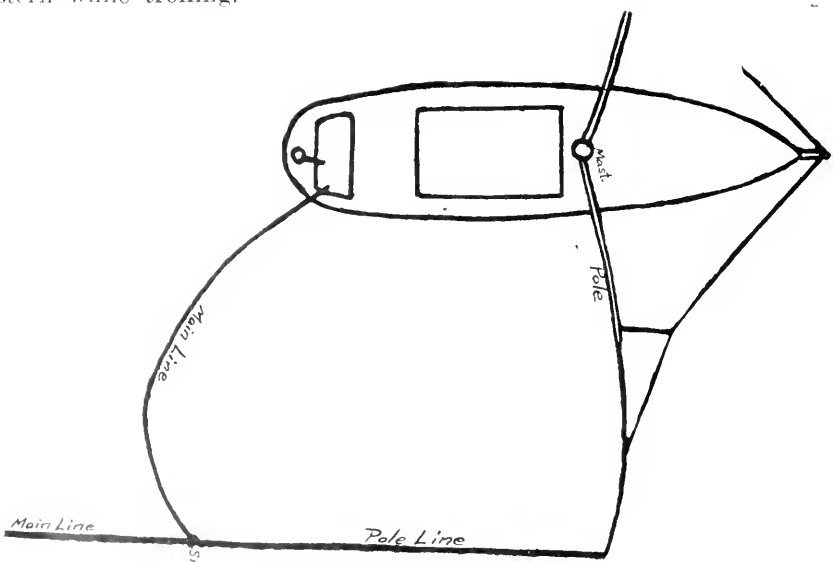

FIG. 13. Diagram showing gear arrangement on a salmon boat.

The pole line is a few feet longer than the pole so that it may be unsnapped from the main line and snapped into a cord loop on the gunwale near the stern when the main line is being hauled or when the poles are stowed against the mast. This arrangement easily allows the main line to be fished at any desired depth. The snap may be used in the loop of any lead or in loops tied in the main line two and one-half or five fathoms apart. The main line loop is made by doubling back the line and tying a simple hard knot leaving two or three inches free to form the small loop, just enough to receive the snap conveniently.

Plan of Rig. Although there is great variation in details of the arrangement of weights and line the "taper line" is almost universally used. The taper line is heavy (large) at the top, tapering in size toward the bottom. The size of the leads also tapers off, with the lightest at the bottom. The object of the tapering size of line is largely to avoid loss of the whole line when the lower hooks catch on rocks.

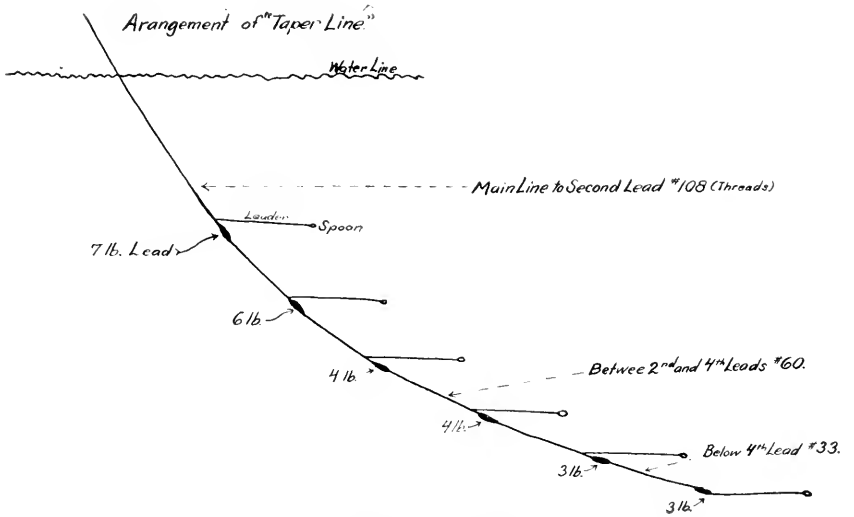

FIG. 14. Diagram showing arrangement of a taper line.

The strain breaks the line only part way up so that only the bottom portion is lost. Also the decreasing size of line and leads decreases the water drag on the lower portion where the drag is hardest. The tapering size of leads toward the bottom has the effect of allowing the far end of the line to trail out more nearly approaching the horizontal, thus bringing the bottom three or four hooks within a more limited vertical range. This plan of rig allows great variation in depth of fishing without changing the rig. When it is desired to fish near the surface the bottom three leads and leaders may be paid out, the lightness of rig being an advantage. To increase the depth, one or two more leaders are paid out. When all leaders are out the depth is increased by paying out more main line (up to 10 fathoms. Over 10 fathoms greater depth is best obtained by adding more lead).

When a school is located the depth of the school may be determined by noticing which hook is taken and the taper line is then lowered till the second or third hook from the bottom is at the determined depth. Thus the bottom four hooks are brought close to the desired depth.

In taper lines the size of the line is tapered by three or often four changes in size. There is no uniform plan of taper lines approved more than another. An arrangement often used is a No. 108 main line to the second lead from the top, No. 60 line between the third and fourth leads and No. 33 or No. 30 below the fourth lead. (See paragraph on Line Sizes.)

Another plan of rig rarely used is very different from the taper line in that the object is to have the hooks fall at approximately equal distances apart vertically instead of within a limited vertical range. In this plan a uniformly heavy line is used (No. 144 for example) with the leads arranged just the opposite to the taper-line plan, that is, the lighter on the top and the heaviest at the bottom. With this arrangement the line is more nearly vertical and can be given a deeper set than the taper line. This line offers the greatest resistance in the water and if snagged on the bottom the whole line, with all the hooks and leads, may be lost.

Number of Lines Used. The number of lines used from a single boat varies from one to four with two as the usual number. Early in open sea trolling one line was used but is seldom seen now. Nearly all boats use two poles with a line from the tip of each pole. An occasional boat fishes a third line directly astern but this line is lightly weighted to keep near the surface. An occasional boat fishes four lines from *two* extra long poles, in which case the two additional lines are attached about midway out the pole. Several of the largest boats fish four lines from four poles, two short poles placed well forward and two long poles placed about at the boat's greatest beam in order that these lines may be as far out as possible to avoid tangling with the forward lines.

Whatever the arrangement of lines, care is used to keep the lines separated to avoid tangling while set or while hauling in. The fisherman stands in the cockpit or on the deck far aft so that he may control the tiller with his foot while hauling in. In good weather the tiller is often disregarded but in a strong wind or current a fairly straight course is kept because a sharp turn is apt to tangle lines.

Number of Hooks per Line. The number of hooks used on each line varies from one to nine but five or six is the usual number. Most of the lines are rigged with six hooks (or spoons). Lines rigged with nine hooks are sometimes used in prospecting but when fish are located and fishing is begun the number is reduced by removing leaders and leads. A two-hook line is occasionally used in surface fishing.

Line Sizes. The line commonly used is a cotton seine-line which is made in three grades, soft, medium and hard laid. For trolling the hard laid line is used. Practically all line used is made up of three strands twisted, each strand being made up of a number of threads. A four strand line is rarely used. The sizes of line are designated by a number which represents the total number of threads. For example No. 30 is a line of 10 threads to each of the three strands. Up to No. 36 the sizes are numbered at the addition of each three threads, as No. 21, No. 24, No. 27, etc. From 36 to 60 the addition of six threads is used in numbering, as No. 36, No. 42, No. 48, No. 54, No. 60. Above 60 the size numbers designate the addition of twelve threads as No. 60, No. 72, No. 84, No. 96, No. 108, No. 120, No. 132, No. 144, No. 156. The sizes of line commonly used range from No. 21 to No. 156.

The main line varies greatly in size according to the arrangement of leads. With a deepset heavy weight line No. 132, No. 144 or No. 156 is used. The upper portion (above the leads) of a "Taper Line"

varies from No. 84 to No. 156 but sizes from No. 108 to No. 144 are more frequently used.

Leaders are No. 21 to No. 42 but Nos. 27, 30, 33 and 36 are the usual sizes, No. 30 being used most.

The bottom portion of the taper line is usually the same or more frequently one size larger than the leaders. Some taper lines have a different sized line between each two leads, as for example from the top downward, No. 144, No. 108, No. 84, No. 60, No. 48, No. 36. Light taper lines generally use only three sizes as No. 108 to the second lead from the top, No. 60 between the second and fourth leads and No. 33 below the fourth lead. A more frequent arrangement of sizes for taper lines is four sizes—No. 144 to the first (top) lead, No. 108 from the first to third lead, No. 60 from third to fifth lead and No. 33 below the fifth lead.

The size of line makes no apparent difference in the catch. Evidently the fish are no more wary of a large line than of a small. The line must be strong enough to hold the strain of a fighting salmon added to the resistance of line and leads in the water. Beyond this the individual preference of the fisherman determines the size. The very large lines are better in that they do not cut the hands so much while hauling in but they offer a decidedly greater resistance in the water and require harder pulling and more lead.

Color of Lines. Opinions are conflicting as to the best color for lines. Some fishermen use the white untreated line as it comes from the store. Most fishermen tan the lines brown, more for the purpose of preserving than making the line invisible. Some fishermen dye the lines green, believing that this color decreases visibility and insures better catches. Blue line is sometimes used. Many fishermen believe that color makes no difference in the catch.

Depth of Lines. On a two-pole boat the poles are usually elevated so that the line enters the water at a point about opposite the boat's stern. The line usually enters the water at an angle to the water surface of 30 to 45 degrees. Water resistance then curves the line astern. The taper line curves astern till the bottom of the line is nearly horizontal. The actual depth reached by different types of line is not known and makes no particular difference to the fisherman except in avoiding snagging rocks. He is chiefly concerned with the relative depth for his plan of rig, that is, how much line to pay out to bring his hooks to the depth where fish are biting best that day. A six-hook taper line with six fathoms between leaders means 30 fathoms of line. This line is fished with from 0 to 40 fathoms of line (above top lead) so that a total of 70 fathoms of line may be out in extreme cases but the greatest actual depth reached is probably not over 30 fathoms assuming the average angle of the line to be about 25 degrees to the water surface. This is an extreme case since 25 fathoms of main line (above leads) is generally the greatest amount used and 5 to 10 fathoms are most frequently used. With 10 fathoms out (40 fathoms total) the usual depth reached is probably 20 fathoms.

With the ordinary arrangement, a total of 27 to 30 pounds of lead and 10 fathoms of main line (above leads), the paying out of more main line does not materially increase the depth because the water resistance to the large line merely trails the whole gear astern. A greater

depth is then obtained by adding more lead rather than more main line. The size of the main line is an important factor in depth because a given weight will take a small line much deeper than a large line.

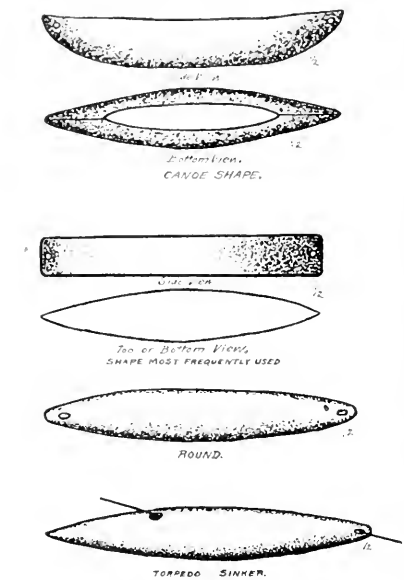

FIG. 15. Types of lead sinkers.

Leads. Although suitable lead weights may be purchased, they are usually home-made, an easy method being to bend two pieces of strap iron into a rough boat shape pointed at both ends and pour in the molten lead, using a sheet of paper over sand for bottom. Some leads are made rounded and pointed at each end. Others are quite carefully moulded in boat shape with the bottom tapered back and smaller than the top. This canoe shape is intended to ride upright with the least possible resistance to the water but it fails of its purpose because it is supported at an angle by the main line and its points of attachment, being near the top, allows the bottom to shear off to one side (skate). The result is that the weight meets the water broadside instead of bow on as intended. The lead cast in a rough boat shape with straight bow and stern with top and bottom the same size and shape is the lead most used because it rides straight without skating, is the simplest and easiest to make and does not roll on the deck. It is generally agreed that the best possible shape is the round lead (cigar shape) elongated and pointed at each end. This lead offers the least possible resistance to the water and therefore greater depth can be had with less weight, but it has two disadvantages, the greatest of which is that it rolls on the deck and is a great inconvenience in tangling up the lines when on deck. It is also expensive to buy or, if home-made, very difficult to mold.

Boats coming down to the California coast from the north (especially the Columbia River boats) frequently carry much larger leads, a common shape being a round lead of large diameter, slightly elongated with bluntly rounded ends, the lead being more the shape of a keg than a cigar. This same general shape is sometimes used slightly flattened but this shape usually sheers off so that the lead meets the water broadside. Another lead occasionally seen is a very large round lead pointed at one end and perfectly flat at the other, giving the shape of an old style beehive.

Another type of lead is credited with obtaining the greatest depth for a given weight. This is the "torpedo sinker," cigar-shaped but the forward attachment to the line instead of being at the pointed end is about one-third of the way back on one side (top) of the lead. This method of hanging allows the forward point to dig downward into the water with the tendency to deepen the whole line. The objections to this lead, aside from the difficulty of rigging it, are that the free point tangles the line on deck, the lead rolls on deck and when in

the water it gathers up floating seaweed in the angle formed by the line and the free point of the sinker.

The weight of a single lead in most cases varies from 2 to 10 pounds the usual weights being 3, 4, 5, 6, and 7 pounds. Occasionally a metal ring is cast in the lead for convenience in attaching the line, but this is apt to cut the line. The usual method is to bore a hole through the end of the lead and tie in a short piece of heavy line leaving a long loop or "strap" into which the main line may be tied with a bowline. An occasional fisherman rigs his leads with a swivel snap at each end so that the lead may be easily exchanged for a lead of a different size. This would be particularly convenient in prospecting and experimental fishing.

Amount of Lead. There is little uniformity in the total amount of lead used, each fisherman having his own ideas. Lines carry from 4 to 40 pounds of lead, 18 to 35 pounds being the most general range for taper lines of 6 hooks, with 27 pounds as the weight most frequently used. For surface fishing as little as four pounds of lead (two 2-pound leads) is sometimes used on a two-hook line.

In taper lines no arrangement can be considered typical but the weight is often distributed somewhat as follows from top to bottom—7, 7, 6, 5, 5, 3, totaling 33 pounds. Fishermen preferring less weight have some such arrangement as 7, 6, 4, 4, 3, 3, totaling 27 pounds. A frequently used total weight for a six-hook taper line is 29 pounds arranged 8, 6, 5, 4, 3, 3, pounds. Many of the fishermen that fish five hooks use as much or more lead than on the six-hook lines. The arrangement on such a five-hook line is frequently 10, 8, 4, 5, 3, totaling 30 pounds. Heavy deep set lines, though rarely used, are arranged from top to bottom somewhat as follows—4, 5, 6, 7, 7, 8, totaling 37 pounds.

On any one line the amount of lead used is not fixed but varies from day to day and may be changed several times during a day.

Leaders. Each hook (or spoon) is attached to the main line by a "leader" or short line 3 to 6 fathoms long. The weighted main line extends downward at an angle allowing the unweighted leader to trail out behind horizontally.

The length of the leader depends on the distance between leaders on the main line, the leaders being a little shorter than the distance between leaders. This is to avoid tangling in case the boat stops and the lines hang straight down, and also while hauling in the line. The distances used most commonly are 6 fathoms between leaders with a $5\frac{1}{2}$-fathom leader. Another plan of rig frequently used is $3\frac{1}{2}$-fathom leaders placed 4 fathoms apart. This rig with 4 fathoms between leaders allows more hooks within a limited vertical range when a school is located and found to be biting at a fairly uniform depth.

Attachment of Leader to Main Line. Leaders are attached to the main line from one to two feet above the lead sinkers, the usual distance being 18 to 20 inches. When ocean trolling for salmon started on the coast, it was the practice to attach the leader to the loop at the upper end of the lead but it was found that a hooked fish in fighting would tear loose from the hook because the heavy lead supported by the taut line offered too much resistance to the sudden jerk. For this reason the leader is a little above the lead so

that the taut main line will give more spring to the sudden jerking of the fish. The bottom leader is usually attached to the bottom of the last lead in taper lines and in order to offer a less solid resistance to the fighting fish a light rather than a heavy lead is used at the bottom, a three-pound lead being most frequently used.

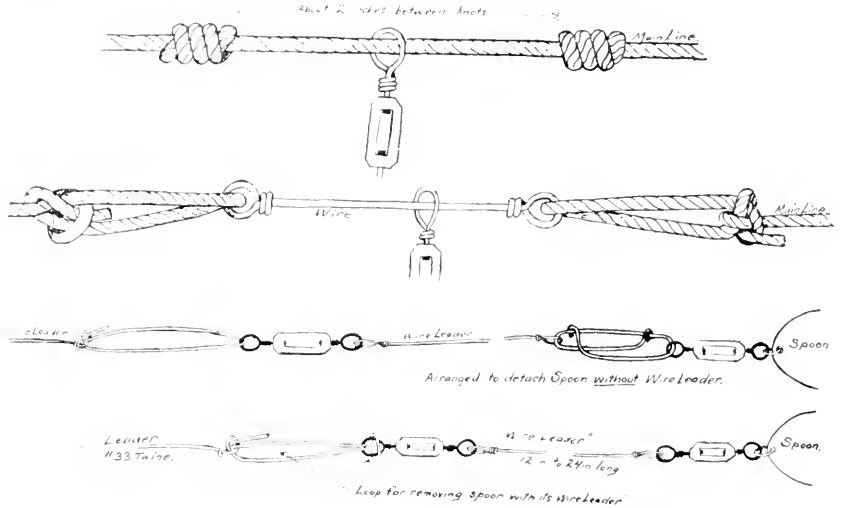

FIG. 16. Diagram showing method of attachment of leader to line.

The usual method of attaching the leader is to tie a "running knot" in the main line which leaves the line straight as if threaded through three or four wraps of itself. The name "running knot" refers to the fact that the line runs straight through but the knot itself is perfectly solid. The line is then threaded through one ring of a swivel and another running knot tied at from two to four inches from the first. The leader is then tied into the other ring of the swivel with a bowline. The swivel protects the main line from being twisted by the leader and the distance between knots allows some play for the leader without crawling up or slipping down. The wire ring of the swivel is apt to wear on the lower knot and to avoid this a short wire section is sometimes inserted in the main line. This wire is about two inches long, threads through a swivel ring and looped at each end with the ends wrapped into a shoulder to keep the swivel. The main line is tied with a bowline into each loop of this wire section. By this arrangement the swivel plays on wire but the strain of the whole line now falls on the loop of the bowline bearing on the wire loop and this is apt to cut under a heavy strain.

Bait vs. Spoons. There is the greatest divergence of opinion among fishermen on the relative merits of spoon and bait. One fisherman will remain in because no fresh bait is available, another will use nothing but spoons, another insists on having both, while most fishermen change from one to the other at different times in the season. At Fort Bragg, for instance, there is a general belief that the spoons are more successful during the early part of the season and that bait is better for the latter part of the season. The majority of fishermen

prefer fresh bait, but when it is difficult to get or expensive, they use spoons. At Monterey most of the Japanese prefer spoons throughout the season and most of the white fishermen prefer bait at all times even when it has to be purchased at from 75 cents to $2 a bucketful.

A few half-hearted experiments have been tried by using one line baited and the other rigged with spoons, but such trials have been brief and the findings merely personal opinion rather than actual figures of the catch.

A fresh sardine about seven inches long is almost universally preferred as bait. Squid tear off the hook. Anchovies are too small. Salted and formalin-preserved sardines are occasionally used but without much success, generally attributed to the loss of the bright shining appearance of the fresh fish.

Spoons. A variety of spoons are used, no one being a universal favorite. A number of fishermen prefer the hook attached solidly to the spoon (as in the Dubrow) because they believe that the salmon is more apt to be hooked, claiming that the swinging hook is apt to be brushed aside. Some fishermen prefer the Wilson spoon with a free swinging hook that is attached about one-third of the way up the spoon, because they believe this arrangement is more apt to hook the fish. However, most makes of spoons have the hook swinging from the lower end of the spoon, as in the McMahon, Diamond and Kewell-Stewart.

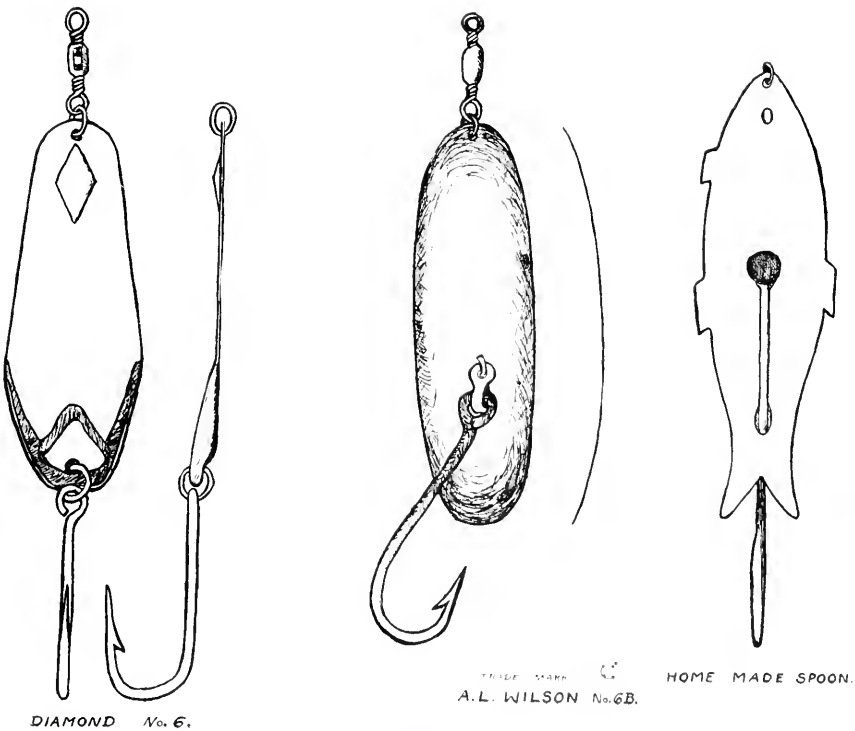

FIG. 17. Various types of salmon spoons.

The chief consideration in any spoon is its shape to govern its motion in the water. Although the spoons are of polished silver plating or brass to attract salmon by their shining, it is their action in the water resembling a swimming sardine that is most important. Some spoons are designed to spin in the water with a wriggling motion. Most spoons zigzag while constantly tipping from side to side so that the broad shining surface is displayed as often as possible. The Dubrow spoon for instance is curved to give a zigzag motion when trolled slowly and the tails are curved propeller fashion to spin the spoon when moving more rapidly. The McMahon spoon was the most popular at Fort Bragg during the 1920 season. This spoon tips rapidly from side to side when trolled and follows a fairly straight course. This tipping is continued even when the speed is greatly slowed down and the McMahon's popularity is largely due to the fact that it can be trolled slower than most other spoons. The Stewart and Wilson spoons tip less from side to side but follow a more zigzag course. Fishermen who have used Dubrow, Wilson, Stewart and McMahon spoons almost equally throughout a season claim to have had equal success with all four spoons but favor the McMahon because it is successful at a slower speed. There are quite a few home-made spoons in use, the spoon being cut from a sheet of plated brass. A successful home-made spoon is made on the Dubrow plan by riveting in a No. 11 or No. 12 long-shanked eye hook. Home-made spoons of the Kewell-Stewart type are most frequently used and are more easily made than the other types. The Wilson type is also seen frequently and is comparatively easy to make.

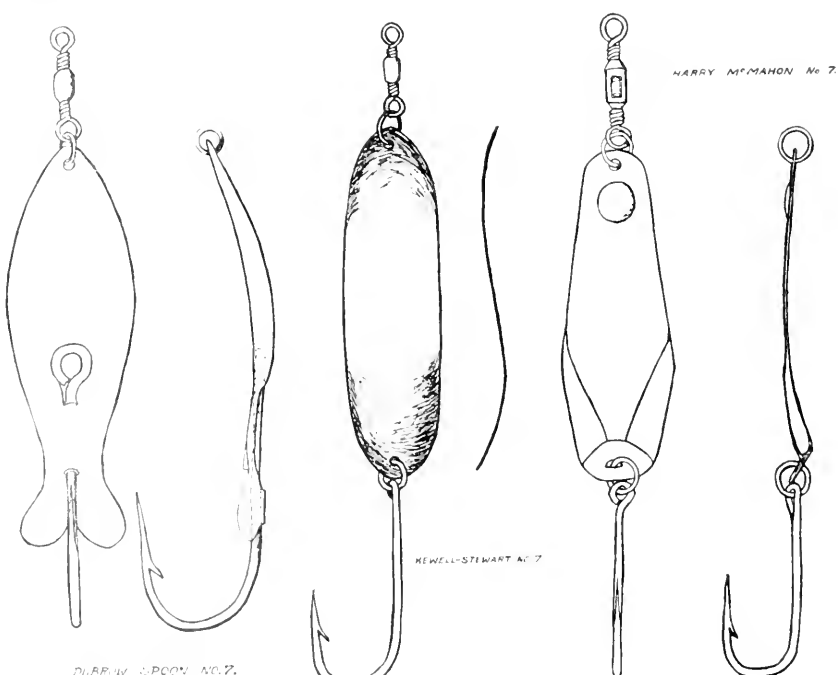

FIG. 18. Various types of salmon spoons.

The size of the spoon does not vary greatly, No. 6 and No. 7 being the favorites. McMahon No. 7 is used most although some No. 6 are used. The No. 6 Dubrow is used more than the No. 7. In Kewell-Stewart spoons No. 7 is used most. In Diamond spoons, No. 6 is preferred.

Bait Hooks. When fresh bait is used (sardines almost universally) the hook is passed twice through the head (through the eyes) of the sardine so that a couple of firm hitches are made on the head by the line. The sardine is then bent to one side at about the same curve as that of the hook and the hook passed through the body longitudinally, in at the mouth and the curve of the hook out at the anal opening leaving the shank of the hook inside the body. Because of this preferred method of attaching the bait a *long* shanked hook with a knob head is used. The knob, much like the head of a finishing nail, is the diameter of the shank and is formed by the shank diameter being reduced just below the knob.

Many of the hooks are made in Norway, especially the Kirby hooks, which have a slant to one side in addition to the curve so that the point sets at an angle to the shank. Most fishermen prefer a straight hook without the side slant and the Kirby hooks are often straightened in a vise before using. In all hooks the point is considered to bend in too sharply toward the shank and most fishermen bend the points outward a little before using.

When using a short-shanked hook the bait is more apt to be swallowed by the salmon and the hook is then difficult to extract and the leader is more apt to be cut on the teeth of the fish. A hook with a large diameter at the curve is preferred because it is less apt to tear out of the salmon's mouth.

The sizes used range from No. 9 (small) to No. 13 (large), sizes 11, 12, and 13 being used most. There is a quite general belief among fishermen that the first of the season runs small fish and the end of the season large fish. Some fishermen therefore use No. 11 sized hooks at the first of the season and No. 13 toward the end of the season. No. 12 is the most popular size for bait hooks.

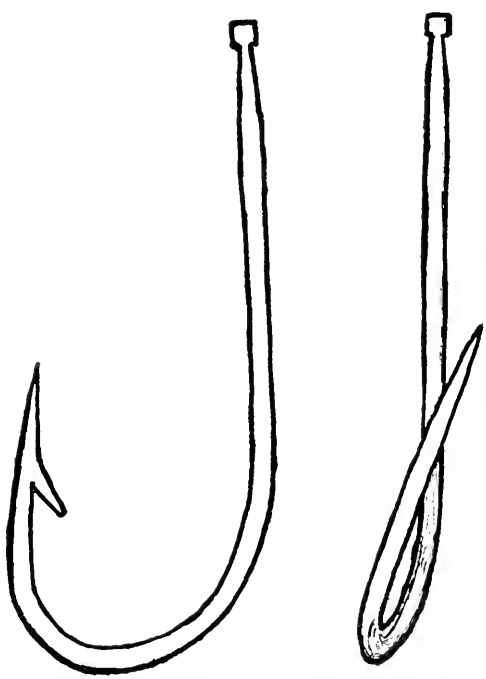

FIG. 19. Kirby hook No. 12. Natural size.

Hook and Spoon Leaders. A No. 33 cotton leader attached to the hook knob would be too large for convenient threading through the bait. For this reason a short hook-leader is used, a line of Irish linen

being preferred as it is small, light, pliable, and strong. The most popular make is the Cuttyhunk, a three-strand linen bass line. The sizes used range from 24 to 60 but the sizes 27 and 42 are used most although all sizes between are occasionally used. For hook-leaders a No. 6 or No. 7 Irish flax salmon thread doubled is sometimes used. Other fishermen use No. 7 airplane thread doubled and twisted. Such thread is attached to the hook by taking a piece four or five feet long, making a double half or clove hitch over the hook knob in the center of the thread and twisting the ends.

The length of the hook leader varies from one and one-half to three feet, two or two and one-half being preferred by most fishermen.

A swivel is used between the hook-leader and main cotton leader, using a bowline at each end of the swivel. Some fishermen think that the loop of the bowline over the Cuttyhunk leader cuts in and weakens the leader, so they double back the end and tie a plain hard knot in the doubled Cuttyhunk. This may be attached to the swivel end by inserting the loop through the swivel eye and threading the hook and leader through the free end of the loop, making a reef hitch. This hitch also has the advantage that the hook and its leader may be removed by unthreading without untying any knots. This same hitch is frequently used at the lower end of the main leader where it attaches to the swivel, especially when a wire spoon leader is used. The main leader is less apt to cut on the swivel eye but the chief advantage is that the swivel, wire leader and spoon may be easily removed without untying any knots.

When spoons are used a Cuttyhunk spoon leader is sometimes used but a short wire leader is usually preferred because the linen thread is apt to be cut on the fishes' teeth and especially when a shark is hooked or is attacking the hooked salmon. For this purpose a two or three foot brass or plated brass wire is generally used, belt lacing wire being the favorite as it is pliable and very strong, but it can be broken if the fish in thrashing about gets a kink in the wire. To avoid this some fishermen use piano wire since it is exceedingly strong and so stiff that it is not kinked and broken, but its stiffness makes it much more inconvenient to handle, especially in removing spoons. In order to overcome this inconvenience some fishermen use some form of home-made stiff wire snap or fastener to free the spoon. This snap is sometimes inserted just below the swivel so that the wire leader is removed with the spoon, or just above the swivel of the spoon so that the wire leader remains attached to the main cotton leader. Some such scheme for easily removing the spoons is a great convenience because the wet spoons soon tarnish when left exposed to the air. To prevent tarnishing the spoons should be removed at the end of the day's fishing and placed in a bucket of salt water or wet sand.

The swivels used are of two types. Most spoons sold in the stores have the closed or barrel type attached but the wire knobs inside the barrel may wear down and break. The open type of swivel is preferred because the wire knobs can be seen through the openings and the swivel exchanged for a new one when wearing occurs.

Markers. In prospecting for a school a boat may be trolling for some time with no sign of fish and then suddenly have two or three strikes at once on each line. By the time the fisherman hauls in and resets each line considerable time has elapsed and the boat has covered

quite a distance. It is then difficult to circle back and pick up the spot where the strikes occurred. Some fishermen carry a marker that may be heaved overboard at the point where the strikes occur so that the place can be picked up again without trouble.

The marker is a small float that supports a light flagged pole 6 to 10 feet long. The lightest marker is a cork float about 18 inches square and 4 inches thick, supporting a bamboo pole. The float is often of wood. The flagpole is passed through the float and weighted on the bottom end to insure floating upright.

Detecting a Strike. The drag of the line bends the pole tip backward. The rolling of the boat causes a motion of the pole tip due to lessening and increasing strain, but this slow movement with the boat roll is easily recognized and not confused with the more rapid jerking of the pole tip when a salmon is hooked.

Stiff poles are more apt to break with the sudden extra strain of a boat roll. In some cases this is obviated by using a coiled wire spring at the pole tip, but springs have not met with general favor.

Landing Fish. Hauling in the line takes some time and the hooked salmon has time to wear himself out fighting against the drag of the leads so that pulling him alongside is usually a hard dead pull without excitement. In shallow short-line fishing the salmon is more quickly pulled in and often puts up a hard fight, charging back and forth, even jumping clear of the water, tangling the gear generally and sometimes wrecking it. Silver salmon are credited with fighting much harder than Chinooks. Small Chinooks are said to fight harder than large fish, but this is probably due to the fact that small fish are more frequently hooked near the surface and on the shorter lines.

Some fishermen use a large landing net to bring the fish on deck, but a gaff hook is more commonly used. Sometimes the fish is so exhausted that he may be landed by a hand inserted in his gills. To prevent the fish flopping on deck he is killed by clubbing over the head with the gaff hook or a special club carried for the purpose.

Hauling in Lines. Practically all hauling in is done by hand. A few fishermen have small drums operated by the engine with rod and gearing, but this power hauling saves only the first (and hardest) pull to the first leader as weights and leaders can not be wound on the drum.

To prevent the line cutting the hands most men wear over the fingers a three or four inch section of automobile rubber inner tubing. The stores sell rubber "clinchers," which are a circular band of thick rubber with a sunken grove for the line and intended to be worn over the hand as is the auto tubing. The clinchers seem to serve better when cut in two and a cord used over the back of the hand instead of the complete rubber ring.

The line is coiled on the deck or in a small cracker box with the hooks inserted in notches in their proper order. The leaders are coiled separately from the main line in a smaller coil near the hook so that the bait or spoon can be thrown far out and tangling avoided.

Lost Fish. An attempt was made to learn the percentage of strikes that are lost but no records are kept and the opinions of fishermen are at such variance that nothing of value was learned. The percentage of lost fish evidently varies from time to time, possibly with the degree of hunger of the fish. Fishermen claim that on some days one-third of the strikes are lost, but on other days practically every fish is landed.

Whether or not small Chinooks are lost more than the large was not determined. The majority of fishermen think that many more small fish are lost than large, but they cannot be sure but that the small fish were silver salmon in most cases. Opinion is agreed that silver salmon are lost more than Chinooks and two reasons are given. Silvers are said to fight harder and their mouths are more tender. It is noticeable in looking over a mixed catch of the two species that many of the silver salmon have the lower jaw torn apart.

Salmon after being securely hooked are often attacked by enemies that are following the school. This is apparently more common in the northern waters, but is not uncommon at Monterey. Sea lions and seals are said to play a part, but sharks are the chief offenders. Sharks are often seen following a hooked salmon while the lines are being hauled in, even coming alongside, pursuing the salmon till he is hauled out on deck. It is no uncommon thing to see a 15-pound salmon delivered that has been bitten in two, leaving only the head and a little of the body on the hook. Spoons, leaders and leads are often lost from sharks biting off the lines and trolling is seriously interfered with, particularly along the northern coast and especially at Nogo and Shelter Cove.

THE FUTURE OF THE SARDINE.*

By Will F. Thompson.

Our greatest fishery is that for the sardine; indeed, it is overwhelming in importance, constituting during January, February and March of 1920 about 85 per cent of the total fish of all kinds taken. Will the sardine remain, or will it vanish at times as does its cousin the herring of the North Atlantic, and as the sardine itself probably does in British Columbia and Alaska? Upon the answer to that question depend millions of dollars and the welfare of a great industry. What are we doing to answer it?

We have not known thus far whether or not our sardine fishery is subject to great fluctuations—its history is so brief, having begun in 1914. It is possible to surmise that it is, because in the North Pacific this same species of sardine was practically unknown until two years ago—indeed the occasional specimen that was taken with the herrings was hailed as a curious stranger. Then they came in a great flood, cluttering the traps and the nets, and a canning industry of importance sprang into being. And if they were lacking once they may well be lacking again, not only in British Columbia but in California. So the most ordinary business sense dictates an energetic inquiry into the probability that such great changes will occur in California, and into the chance of foreseeing them.

This is, you will note, entirely aside from the chance of overfishing. And we do not know enough about our Pacific fisheries to know whether they can stand anything approaching the strain that the Atlantic herring and sardine have stood. Perhaps even in the Atlantic it is possible that the herring or sardine will one day suffer from man's

* California State Fisheries Laboratory, Contribution No. 22.

operations as have other species. Our experiences on this coast have not been reassuring—that is certain—as witness the disastrous story of the halibut and salmon, for which our only great fisheries existed before the sardine and albacore became of importance. But before we can discuss overfishing, before we can tell whether it is happening, we must know something about those great fluctuations mentioned above, which may be confused with it. Indeed, in the sardine fishery the great natural changes in abundance may be so overwhelming as to completely overshadow depletion.

To the study of these changes in abundance we have therefore addressed ourselves earnestly, along lines suggested by a scrutiny of the phenomena in the herring and other fisheries. It has been shown that the relative success of the spawning seasons is of predominant importance in explaining these changes. It has been found in the herring fishery that in some given year the spawning was very successful, and that the result was a vast number of herrings of a single age, and as year after year this great age-group became older it made the fishery very successful for that particular size to which it had attained.

To make this point clear a diagram is attached which, while it does not represent the actual condition in any particular fishery, may for our purposes be thought of as applying to that for the sardine.

The successive years are shown at the various levels, and the ages are shown in succession from left to right. With each passing year the groups fall each into the next higher age class, and thus the predominating group passes successively through the ages from the third to the eighth. The oblique line traces its course. The height of the blocks represents the relative importance of the particular age considered in the catch. It will be noticed that each age-group becomes smaller as the years go on, because of the annual natural death of a certain proportion, in this case assumed to be a fourth.

In the case of the herring a successful period of fishing was ushered in by the incoming of just such a highly successful age group as is first shown in the third year old class on the diagram, and a poor period was characterized by its lack. Such a phenomenon may be happening in our sardine fishery; and we are analyzing the catch to see whether it is or not.

For instance, during last season, the first we investigated, the group we may regard as being in their fourth year predominated and made, at Monterey, a good pack for "half-pound oval" cans, much as the dominating class in our diagram was in 1904. Will this year's catch be of fish one year older, hence less choice, and will the next be of fish two years older? Or will the catch continue to be of the same size and equally good for packing such cans? In other words, do the age-groups of fish vary widely in their abundance, as we have represented in the diagram, and will the fishery vary between success or failure with their growth in size, and with the presence or absence of a successful year? The packer, wondering whether the fishery is to remain good, and whether he will be able to pack "quarter oil" sizes, or obtain good "half-pound oval" sizes, naturally wishes to know the answer. We already have the catch of last year analyzed. What will our analysis this year show? It should, if we obtain our material and know from it

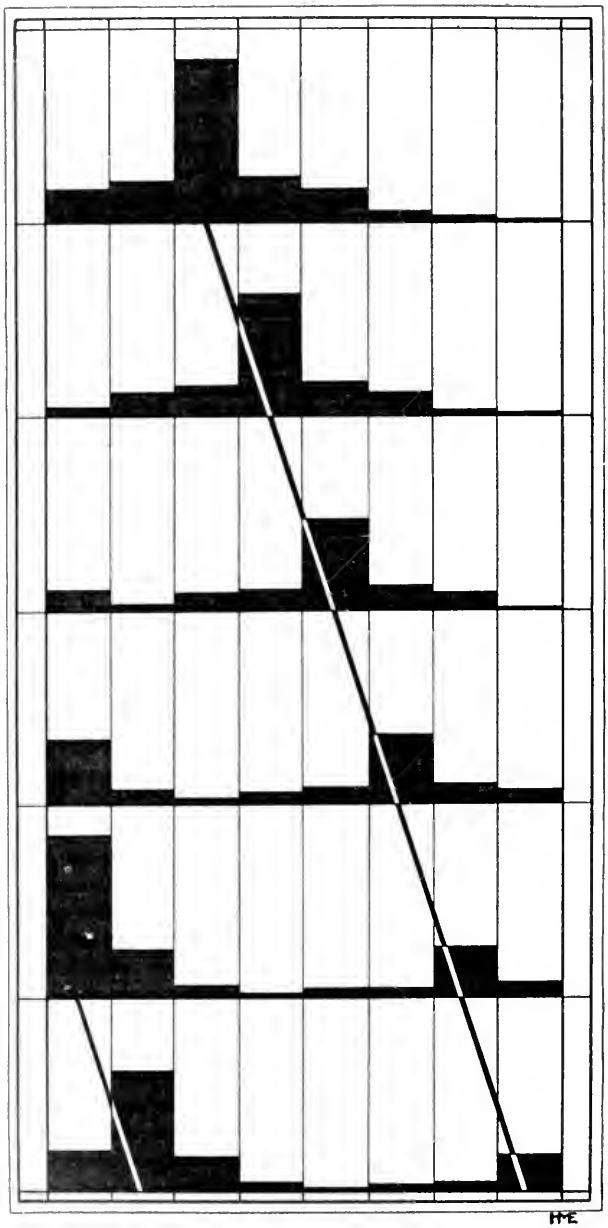

FIG. 20. Diagram showing theoretical effect of an abundant age group on the catch of successive years. The height of the blocks represents the relative abundance. If the diagram is thought of as applying to the sardine fishery, the following classification might hold:

Age I—Too small for canning.
II—"Quarter Oil" sizes.
III and IV—"Half-pound Oval" sizes.
V to VIII—Pound Oval and larger.

whether the predominating class is a year older, answer the questions of the packer, and indicate what we may expect in the future. Perhaps, when we know the exact rate of growth, we may be able to prophesy very exactly the character of the catch. Who knows, indeed?

But note the proviso, *if we know the rate of growth*. That indicates the importance of the fact upon which it is necessary to lavish much care and thought. It is a cornerstone for our edifice. So we are concentrating upon age and rate of growth.

Yet this knowledge of age is not sufficient unto itself. We must know whether our analysis of the catch really shows which age predominates. And there is only one way to do that, namely to take extensive series of samples for observation and comparison throughout the year. So there are two men stationed, one at Monterey and one at San Pedro, who are doing nothing else. Last year we obtained a great series of samples and are subjecting it to the closest analysis to see whether the age that predominates does so because of its actual abundance or because of some influencing factor. And so, also, the same is being done this year for comparison, to see whether the dominating class does become a year older. So far as we know, no fisheries investigation has been based as thoroughly and as carefully as will be that of the sardine.

And so we are confident that we will be able to answer the queries of the packer and the fishermen. We will be able to determine whether or not the fishery is to be one that varies greatly from success to failure through periods of years. We will be able to prophesy, if it is possible, as to the character of the coming catch.

But our objects are also to meet many other queries of the dealer, the packer, the fisherman, the legislator and the public, and what we have said in this article covers but one phase of our investigations; there are others as important. And we hope ultimately to be able to meet competently and scientifically that grave question which always awaits us in all discussions of the fisheries, that of the presence, the absence or the probability of overfishing, and its remedies.

CALIFORNIA FISH AND GAME

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All material for publication should be sent to H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.

FEBRUARY, 1921.

Ignorance of the law is no excuse for violation of it. Therefore, because of continual changes, it is most necessary that you acquaint yourself with the existing statutes before going afield.

A SALMON NUMBER.

Certain details of the life history of the Chinook salmon, one of California's finest food fishes, have long been a mystery. Does a salmon always return to the stream where it was born? Why do salmon refuse food when in fresh water? Where do the two- and three-year-old salmon feed when in the ocean? Answers to these questions are being sought by scientists to complete our knowledge of the life and habits of this notable fish. In this January issue of CALIFORNIA FISH AND GAME we present a "Salmon number" containing several contributions bearing on the above points which merit thorough perusal by all our readers. Not only are these papers of more than ordinary interest so far as subject matter is concerned, but those by Dr. J. O. Snyder and W. L. Scofield are published results of the marking experiments and other investigations on salmon undertaken by the California Fish and Game Commission.

KLAMATH RIVER SALMON THREATENED WITH EXTERMINATION.

The Electro-Metals Company of San Francisco and Mr. A. P. Seybold of San Francisco, have each applied to the Federal Power Commission for preliminary permits to build dams on the Klamath River to divert water for power projects. One of these projects is located above the town of Orleans and the other a few miles below this place.

Nothing in recent years has so threatened the salmon fishery as these proposals. The Klamath River still has a good run of salmon. A large cannery is located at the mouth of the river and large numbers of fish are used for food by people living along the stream. A large take of salmon eggs for the use of the hatchery is also secured on the Klamath River near Hornbrook. If the Federal Power Commission permits the building of these dams, 90 per cent of the spawning ground of the salmon in this river will be destroyed and ultimately the whole salmon run.

The power companies will argue that fish ladders can be built over the dams. Ladders, of course, could be built, but there is little chance that they would be successful on dams 100 feet high, or over. Furthermore, such fishways would be an impediment to the young salmon attempting to reach the ocean from the spawning grounds. Nor could a successful hatchery be maintained below these dams, for the salmon reaching such a station would not be mature and it would be impossible to hold them until ready for spawning.

The catch in the Sacramento River and other rivers in Alaska has fallen off during the past few years, and unless some of the better streams are protected as spawning grounds for these fish, the salmon will soon be a thing of the past. There is no opposition to power projects in general, but there is opposition to projects which destroy spawning grounds of salmon and other food fishes. Other streams where there is a poor salmon run, as for instance the Trinity River, should be utilized rather than the best of our salmon streams.

It is to be hoped that the above applicants will be denied permits and that the Klamath River and its tributaries will be permanently maintained as spawning grounds for salmon and steelhead, and thus continue to be a source of supply for the fishing industry and a resort for the angler.

IN MEMORIAM.

RALPH W. REQUA.

Ralph W. Requa, a former trusted employee of the Fish and Game Commission, departed this life July 7, 1920. He was born at Xenia, Kansas, November 26, 1874, being the son of George W. Requa, one of the pioneers of Kansas and a prominent citizen and politician.

Ralph Requa graduated from the schools of his native state and at the age of eighteen entered the United States Postal Service as a delivery mail clerk. This work was not to his liking, as he was interested in the conservation of fishes, so he soon entered the employ of the United States Bureau of Fisheries.

For several years he was employed as a messenger in the distribution of fish by the Federal Bureau of Fisheries, and the knowledge he obtained in traveling over the different sections of the United States in this work, was of great value to him later.

Mr. Requa resigned from the Bureau of Fisheries in June, 1895, to accept a position with the California Fish and Game Commission. He was placed in charge of the distribution work at Sisson Hatchery and subsequently became foreman and assistant superintendent, greatly assisting in the building up of this hatchery, as his practical knowledge was of great value in all lines of fish-cultural work. Considerable of his energies were devoted to the improvement of automatic screens for the saving of fish from destruction in ditches and canals, and he patented several devices for this purpose. Many of the best screens in the state have been installed under his direction.

His arduous duties as superintendent of one of the first distribution cars undermined his health and for the last six years he was employed only periodically by the Commission on screens and aquarium exhibitions, although in charge of the salmon experimental work at the experimental station in Bidwell Park near Chico. An expert on the arranging and placing of fish in acquariums, his work at the different county and state fairs attracted wide attention.

He was married to Florence Getchell in 1901. Her death in November, 1918, hastened his end. He left two children, Francis and George Requa.

Untiring in his efforts in all lines of fisheulture, there was no day too long or task too hard for him if he thought the work depended on his services. He was one of the faithful employees who have made the work of the California Fish and Game Commission one of the most successful of any in this or any other state.

Ralph Requa was a man of the highest integrity, and his associates will ever remember him as a kind friend and a loyal champion of those whom he trusted as his friends. No nobler tribute can be paid him than the following extract from a letter written by a friend and colaborer of his in the work of the Fish and Game Commission: "He went with me into the high mountains and started me right in the fish planting business. I learned him then, the heart of him, as men will do when all alone in the high country. I formed a strong attachment for him and have always held it. He was another example of a faithful employee, martyr to a cause."

Ralph W. Requa.

In the passing of Ralph Requa, the state has lost a good citizen, his children, a kind and loving father, and the Commission a dependable and faithful employee.—W. H. S.

THE 1920 BIENNIAL REPORT.

The Fish and Game Commission's 1920 biennial report to the Governor will be off the press early in the year. It is to be bound in an attractive cover giving a four-color reproduction of a Loch Leven trout. The report will contain full statements of the work and accomplishments of the past two fiscal years by department heads, together with many illustrations. The appendix will include statistical reports on fish planting, license sales, arrests, seizures and expenditures. In spite of war economy, the Commission has made a remarkable showing. Outstanding features of the past biennium are: The successful rearing and planting of over 30,000,000 trout and over 26,500,000 salmon; the splendid administration of commercial fisheries and valuable scientific research connected therewith; the establishment of a great chain of game refuges; and a worth while educational and publicity campaign.

SPORTSMEN'S AND ANGLERS' ORGANIZATIONS.

The sportsmen's and anglers' organizations of California or any state may be considered as wild life educational assets. Through them a greater number of people are made familiar with the fish and game laws; right sportsmanship is stimulated and the importance of conservation is better appreciated. The Fish and Game Commission stands ready to encourage these clubs in any way possible, for it feels that by cooperating with them both the sportsmen and the Commission will be benefited; the sportsmen will be more alert to the work of the Commission in its effort to insure the ever increasing numbers of fishermen and hunters with an adequate supply of fish and game, and the Commission by being more in touch with the people, will be better prepared to meet their demands and any lurking spirit of dissatisfaction.

The Commission feels that it can be of service to these organizations by loaning its splendid wild life films (or stereopticon slides) and providing a lecturer to explain the pictures, when desired, and acting as a clearing house for dependable information on game resources, fish and game conditions and fish and game laws.

PROPOSED FEDERAL HUNTING LICENSE.

Those interested in the working out of the Migratory Bird Treaty Act are disturbed over the small appropriation available for the enforcement of the act and the consequent small number of federal game wardens. The congressional appropriation of $142,500 permits the employment of but 29 salaried wardens.

That sentiment favors a stronger governmental support of the measure is evidenced by the action taken by the International Association of Fish, Game and Conservation Commissioners. At its recent meeting in Ottawa, the association adopted a resolution calling for the issuance of federal licenses for hunting migratory birds. Licenses in the form of special stamps to be issued by postmasters and attached to state licenses were recommended. It was estimated that the revenue from such licenses would amount to between $1,000,000 and $2,000,000, an adequate sum to be used for the protection of game.

GOLDEN TROUT.

Golden trout received wide distribution owing to the successful results in the hatching and rearing of golden trout at the Mount Whitney Hatchery in Inyo County. The California Fish and Game Commission has been able to stock many barren streams and lakes in the southern Sierra with golden trout. Until recently the stocking of streams was dependent upon the capturing of golden trout by hook and line and the transportation of the fish thus caught. Now the Mount Whitney Hatchery has an output of nearly one million golden trout annually.

During the past fall, under the direction of Commissioner M. J. Connell of Los Angeles, the golden trout fry from the Mount Whitney Hatchery have received wide distribution. With Deputy E. H. Ober in charge of the pack train, plants have been made in tributaries to the Middle Fork of the San Joaquin, Madera County. Until they received their quota of golden trout these streams were barren of fish life. The plan is to plant desirable streams and to keep the stock pure. Crystal Lake, which was planted in September, 1918, was found this year to be teeming with beautiful fish ranging from five to ten inches in length.

WHY?

Although the Fish and Game Commission has been having splendid success in convicting violators of the fish and game laws, yet their efforts are occasionally handicapped by some judge who fails to make a conviction possible. As evidence, the following may be cited:

Deputy Harrington arrested Mr. H. Zirn of San Pedro for having in his possession 250 pounds of spiny lobsters over the size limit of sixteen inches. Most of these lobsters measured from seventeen to twenty-two and a half inches in length, and were consequently illegal. When the case was tried by one of the San Pedro judges, two of the lobsters properly labeled were presented as evidence, but because these lobsters had been boiled to preserve them, the judge ruled that the evidence had been changed and therefore that the violator could not be ruled guilty.

Why should such unreasonable technicalities be advanced allowing a guilty violator to escape punishment?

of Richmond Harbor. These nets were confiscated. One was found to be 1800 feet in length and the other 1600 feet, making a total of 2400 feet of net. One of the owners of the nets was captured and paid a fine of $100 in addition to the loss of the nets confiscated.

BOTTOM DROPS OUT OF THE FUR MARKET.

According to a letter written by Funston Brothers and Company of St. Louis, published in the Illinois Sportsman, October 14, 1920, the fur market is still stocked with the bulk of last year's catch and the above named company advocates, therefore, little if any trapping during the coming season. To explain the situation they write as follows:

"One of the principal reasons why the dealer is carrying such an enormous stock is due to the fact that the manufacturing end of the business has had a strike since last May. Ten thousand men have been out, and a great many of them are still out. This has resulted in the fur dealer being compelled to carry the furs all

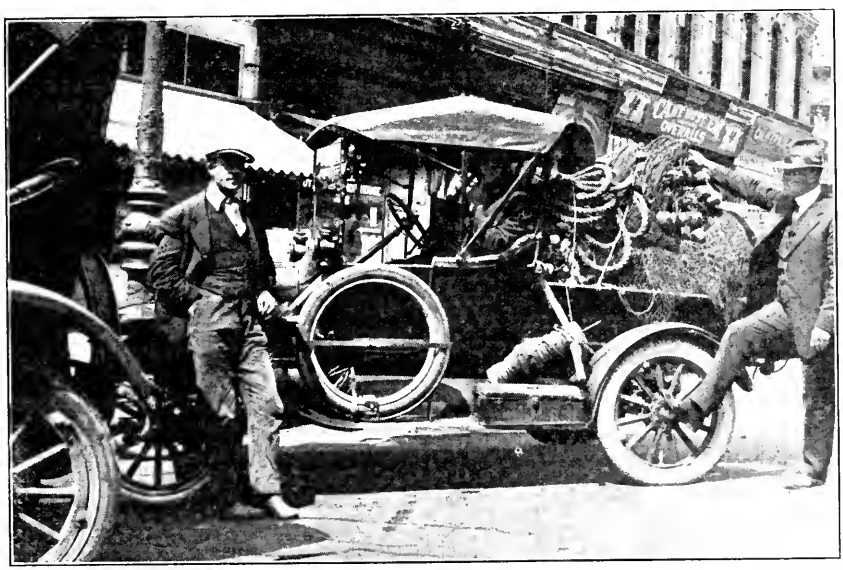

FIG. 21. Net 2,400 feet in length confiscated by deputies of the Fish and Game Commission at Richmond Harbor, August 31, 1920.

NETS CONFISCATED.

On August 31, 1920, deputies A. Mack, Bert Leahy and M. S. Clark of the Fish and Game Commission discovered two large "illegally" used nets at the mouth

during the manufacturing season, and he still has them on hand with a new fur season coming on."

It is stated that the market price of furs will be reasonable, the fur dealers being willing to sell at a loss, and that

until conditions improve it is advisable that the trapper should not trap and ship furs this season. If they do the prices which they receive will not be remunerative, as financial conditions among the manufacturers are such that the fur dealers will be unable to buy much of the new fur.

Little is said of the conservation side of the question, but in order that the fur-bearing animals marketed should be saved from extravagant waste, it seems even more advisable to discourage the seasonal trapping of the year.

COMMISSION COMPLIMENTED BY BUREAU OFFICIALS.

Lewis Radcliffe and Henry O'Malley of the United States Bureau of Fisheries have recently been making an investigation of the fisheries of California and the conservation work of the state's Department of Commercial Fisheries. These officials appeared very much pleased with the work carried on by the California Commission, and stated that the Bureau of Fisheries appreciated the public spirit of the Commission in maintaining the preservation laboratory at San Pedro until appropriations would allow the Bureau of Fisheries to again support the project.

The Bureau of Fisheries is at present making a thorough investigation of the methods of caring for and preserving fishing gear in which $15,000,000 is now invested in the United States, exclusive of boats. The life of nets and other gear is very short under existing conditions, and other ways and means of increasing the length of time they can be used are being sought.

HUNTING AND ANGLING LICENSES.

There has been a remarkable growth in the number of hunters and anglers in the State of California, as evidenced by the sale of licenses. In 1914 the number of angling licenses totalled about 84,000 and the hunting licenses about 165,000. In 1919, the anglers numbered over 145,000 and the hunters 178,000. According to current compilations of the number of hunting licenses issued in the various states, Pennsylvania, New York, Ohio, Illinois and Wisconsin, in the order named, lead California in the number of hunting licenses sold. In the whole United States there are about 7,000,000 hunters who pay a license fee and it is estimated that over 3,000,000 more are exempted from the fee by various state laws.

DUCKS MOVE TO NEW FEEDING GROUNDS.

The lack of fresh water in the larger streams has greatly increased destruction to pilings by the teredo in or at the mouth of the San Joaquin-Sacramento rivers. Many wharfs along the Carquinez Straits have had to be abandoned and continual repairs are being made on others. Soft-shelled clams which heretofore have been restricted to San Pablo Bay are now thriving in Suisun Bay, with the result that such ducks as the canvasback and the lesser scaup are utilizing the upper bay more largely as a feeding ground.—H. E. F.

HELP SAVE THE WOOD DUCK

The wood duck, said to be the most beautiful duck in the whole world, is protected by federal law, but not all shooters are able to identify the females, or the males in immature plumage. In an attempt to prevent the killing of wood ducks by mistake, the Department of Conservation of Massachusetts has issued a poster giving colored illustrations of the wood duck in flight, showing its different plumages, with the request to "look before you shoot."

The following marks for field indentification are offered:

(1) Any duck with a white breast found near streams or fresh-water meadows in September or early October is almost certainly a wood duck.

(2) Any ducks, which when suddenly startled, fly away without quacking, have the tail longer and the neck shorter than that of the black duck, will probably be wood ducks.

(3) Any duck which can be heard uttering a peculiar note, sounding like "Oo-eek," is a wood duck.

GAME LAWS FOR 1920.

The total number of game laws enacted in 1920 probably will not exceed 60, which is about normal for "even" years, when only a few states hold legislative sessions. In the laws enacted further progress was

made along the line of harmonizing state legislation with the migratory bird treaty act regulations.

The most important changes affecting big game were in New York and Quebec. New York reenacted the buck law and limited the hunter to one buck a season. The deer season was also modified in several localities. In Quebec the season was shortened 19 days on deer and bull moose, except in four counties, and 50 days on caribou.

Legislation of far-reaching importance looking to the preservation of quail and other upland game birds included an act of Congress, approved December 18, 1919, prohibiting the sale of upland game birds in the District of Columbia, and an act in Maryland prohibiting the sale of quail, ruffled grouse, introduced pheasant and wild turkey in that state.

For the convenient use of sportsmen and others the Biological Survey of the United States Department of Agriculture has compiled information resulting from game legislation, and this has been published as Farmers' Bulletin 1138. This contains a summary of federal, state, and provincial laws for 1920; a summary of laws relating to seasons, licenses, limits, sale and export; disposition of game raised in captivity; the text of the Lacey Act regulating interstate commerce in game, and of the tariff act prohibiting importation of plumage; the law protecting birds and their eggs on federal bird reservations; the regulation regarding hunting on national forests; the treaty for the protection of migratory birds; the migratory bird treaty act and the federal and Canadian regulations; text of order of Secretary of Agriculture permitting the killing of reedbirds; a list of officials from whom copies of game laws may be obtained; and a list of the publications of the Department of Agriculture relating to game. Farmers' Bulletin 1138 may be had upon request of the United States Department of Agriculture, Washington, D. C.

WRONG SEASON ON DOVES.

On the opening day of the dove season (1920), the writer and one of his friends went out for a try at the doves. We had to go about two and a half miles to an orchard where we found plenty of the birds. I got thirteen and my friend got eight. He had a twenty-two rifle and I used a shotgun. I could have taken my limit but I waited until I could take two at a shot, making them come at two and a half cents apiece.

As we started to come home we took a longer way back in order that we might shoot some jack rabbits for the dogs. I found three dove nests while hunting for the rabbits and my friend found four. Two of those which I found had eggs in them and one had squabs, almost ready to fly. The nests which my friend found held two eggs each. This seems to me to demonstrate quite clearly that the dove season opened too early.—CHARLES FOLLETT, *Merced, California.*

TWO DEER AT ONE SHOT.

We all hear of the man who discovers himself short of ammunition and uses this as an excuse for his inability to secure a deer, but it is seldom that we hear of a man lucky enough to secure his limit of deer in one shot. The opening day of the season found Fred McKenzie, an employee of the Ukiah post office, together with friends, camped on Baldy Mountain. On the day before leaving this camp, two three-point bucks appeared standing side by side. McKenzie pulled up and shot, the bullet passed through the neck of the first deer and struck the second in the base of the brain.

Although this sounds like the usual hunting story, it has been verified by Fish and Game Deputy B. H. Miller.

FACTS OF CURRENT INTEREST.

A more than ordinary rainfall during the winter months so scattered the ducks that bags have been small.

The comparatively small run of salmon the past year has emphasized the necessity of a careful scientific investigation of the life and habits of this fish, such as is in progress.

The first of the year finds the sardine canneries burdened with a large part of last year's pack. As the price of canned sardines advanced in price but a very small per cent, a reduction in price to move last year's pack means a distinct loss to the canner.

A new State Fisheries Laboratory is under construction at San Pedro. This laboratory will afford facilities for the scientific staff engaged in investigations on the commercial fisheries.

During the past biennial period 1891 arrests for violation of the fish and game laws have been made, and fines totaling $46,373 collected.

State lion hunter Jay Bruce has succeeded in killing thirty mountain lions during the past year. When it is known that this means a saving of at least 1400 deer, it will be seen that the salary outlay for Mr. Bruce is well spent.

A fisherman on the Sacramento River arrested for having illegal nets in his possession was recently sentenced to one hundred days in jail by Judge Quince of Benicia.

HATCHERY NOTES.

W. H. Shebley, Editor

TROUT AND SALMON DISTRIBUTION.

The distribution of trout and salmon fry from the hatcheries and ponds of the Commission was completed November 5. While the number of fry distributed was not as great as last season, the fry were in better condition and the distribution was systematically carried out, so that the results obtained were very gratifying.

With very few exceptions all the shipments were under the supervision of the car messengers and the hatchery employees and the fry were planted in good condition. Some of the shipments were turned over to applicants who have had several years' experience in planting fry and who used their efforts to make the work of distribution in the streams and lakes in which they were interested a success. On the long trips from the railroad stations to the interior districts, there were less fish lost than in any previous season, judging from the reports received from applicants.

There were about eight thousand cans containing sixteen and one-half million trout fry sent out from the hatcheries, by truck and distribution cars and, as far as can be learned, there was only one serious loss during the season and that was caused by the breaking down of a truck. This shipment was turned over to the Forestry officials who sent out a driver without an assistant. This driver neglected the fish during the time that his truck was being repaired and consequently a great many of the fish were lost. Our men on the distribution car were not to blame, as the Forestry officials who have had experience in planting fish were to handle this shipment. Mention is made of this to demonstrate the fact that our system of planting the fry is very successful.

The demand for trout fry was very great this last season owing to the depleted condition of the streams caused by the excessive fishing during the period of low water which has prevailed over the entire state for the last three years. The fish were confined to the larger pools and were easily taken by the anglers. Some of our best trout streams were fished almost to depletion during the period of drought and an increased number of fry will be necessary to restore the streams to normal conditions again as well as a shorter open season, so that the fish will have a chance to grow.

The present season in most of our fish and game districts is open too long to give the fry a chance to grow and mature into breeders. The season should be shortened by the coming legislature, so that the fry will have a chance to grow and give the anglers better sport.

SALMON EGG COLLECTING, FALL OF 1919.

The extremely low water of last fall prevented the salmon from entering the tributary streams of the Sacramento River on which are located the egg-collecting stations of the Bureau of Fisheries. Consequently, the number of eggs collected was very much smaller than usual and all the eggs that the Bureau could spare for our Mount Shasta station was 4,235,000.

The resulting fry were held and fed until late in the spring, when 3,100,000 of them were placed in the large rearing ponds connected with the Mount Shasta Hatchery. Here they made a rapid growth and were released in excellent condition during October in the tributary streams of the headwaters of the Sacramento River.

Twenty thousand of the fry were marked and will be liberated as soon as all danger of fin regeneration is over.

The run of salmon on the Klamath River did not reach our egg-collecting station in as large numbers as we expected as the lack of rain caused them to spawn lower down the river and in some of the small tributary streams miles below our racks.

A large percentage of the breeding salmon that enter the small tributaries of the Klamath River as well as the Sacramento tributaries are taken by persons with spears at a time when they are hardly fit for food. The taking of these fish by persons desiring them for food, when the fish are on the spawning ground is not only destructive to natural propagation, when confined to the number that can be legally taken, but there is a wanton waste of the fish by persons who spear them on the spawning beds and are forced to throw them away when they find them in no condition to use as food. Oftentimes fish are speared until a fish is taken that is considered edible. A large majority of the breeding salmon after they reach the spawning grounds are emaciated and covered with patches of fungus, making them unfit for food.

The take of salmon at Klamathon during the fall of 1919 was 4,974,000 eggs. Of these eggs 3,307,000 were taken to the new Fall Creek Hatchery, located twelve miles above Klamathon on Fall Creek, one of the finest streams of water for the rearing of fish on the coast. The resulting fry were placed in ponds and held until October, when they were liberated in good condition.

Extensive plans were made this fall to take a large number of salmon eggs at our Klamathon Egg-Collecting Station. The Bureau of Fisheries also was prepared to operate its Battle Creek and Mill Creek stations on the Sacramento River to their full capacity. The unusually heavy rainfall during November caused the streams to rise very rapidly and at the height of the salmon run, November 17, the racks at Klamathon were so badly damaged by the high water that the salmon that were ascending the river escaped above the racks and our take of eggs was considerably less than expected.

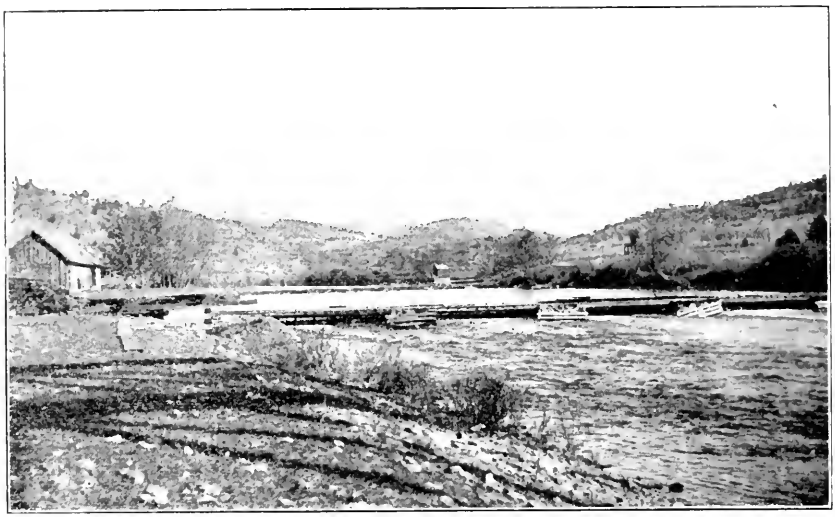

FIG. 22. Racks in the Klamath River used to capture salmon for spawning purposes. Photograph by L. J. Stinnett.

The racks at Mill Creek and Battle Creek stations of the Bureau of Fisheries were washed out at the height of the salmon run. The loss in eggs that could have been collected from the salmon which escaped above the racks is estimated at between 20,000,000 and 25,000,000, at all stations damaged by the high water. This would not be so serious during normal seasons, as the natural propagation would take place on the spawning beds and a certain percentage of the eggs would hatch, but during periods of torrential floods in the streams frequented by the spawning salmon, the shifting sand

and gravel disturbs and moves the eggs and a great many of them are destroyed or are buried so deep that they cannot possibly hatch out.

The total take on the Klamath River was about 7,000,000 eggs, and from unofficial reports received the number taken by the Bureau of Fisheries was approximately the same.

While the loss in eggs is to be regretted we will be able to give the eggs collected extra care and, in a measure, make up for the shortage of eggs at the hatcheries.

SAN JOAQUIN RIVER SALMON.

The Kerckhoff Dam, property of the San Joaquin Light and Power Company, that has recently been completed, near Aubery's on the San Joaquin, prevents the passage of the salmon to their former breeding grounds on the upper reaches of the river.

The Merced River will no longer afford a spawning ground for salmon, as a large irrigation project is planned that will hold back the flood waters of the Merced in a lake to be made by the construction of a high dam across the river near Exchequer. Plans had been made for the construction of fishways over the small dams in the Merced River, property of the San Joaquin Light and Power Company, and arrangements made for their construction, but the plan of the large irrigation reservoir makes it impracticable to attempt any further efforts to perpetuate the run of salmon in the Merced River. With the completion of the Kerckhoff Dam and the proposed dam at Exchequer, the spawning grounds for salmon on the San Joaquin River and its tributaries are practically all cut off from the breeding salmon. During seasons of normal rainfall a few salmon will probably spawn near Friants, below Power House No. 4 of the San Joaquin Light and Power Company. This area is very small and would not have any effect in keeping up the run of salmon in the river.

An experimental salmon culture station is being established on the San Joaquin River with the object in view of determining what the expense will be of collecting the eggs near Friants in the fall and transporting them to the hatchery on Willow Creek, a distance of about thirty-five miles, hatching the eggs and rearing the fry in ponds, the fry to be held in the ponds until the following fall, then convey them by auto truck to the river below the Kerckhoff Dam.

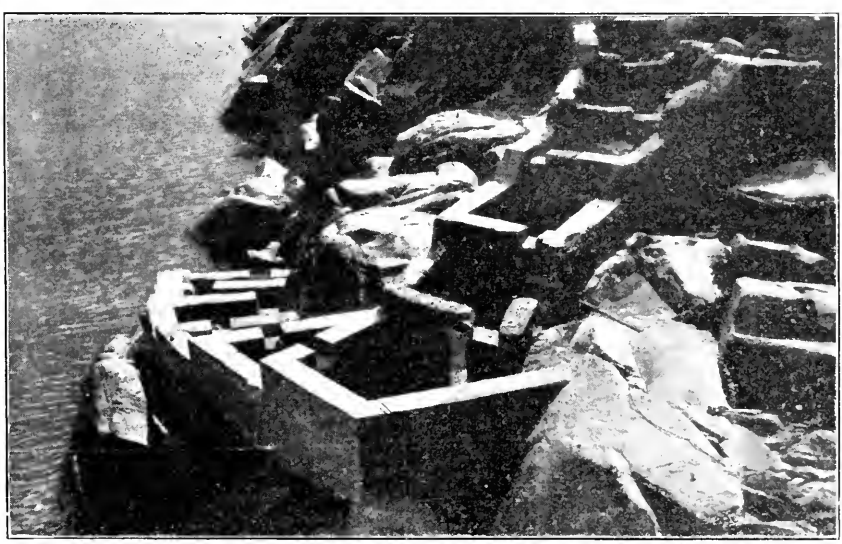

FIG. 23. Fishway while under construction at the Folsom Dam, on the American River. This fishway, recently completed, is one of the highest and best yet constructed in California. Photograph by A. E. Doney, October 24, 1919.

Two or three important features enter into this undertaking that will be the determining factor as to whether a successful salmon culture station can be established or not on the San Joaquin River. One is the expense of transporting the fry from the ponds to a point below the dams and the other is the screening of the large canals taking water from the San Joaquin River, from Friants to the diversion at the Temple Canal.

The expense on the transportation by auto truck of 2,000,000 or 3,000,000 fry each fall from the rearing ponds to the river below the dam should not stand in the way of keeping up this valuable supply of food fish for the people. A three-ton truck, with two men in charge, could transplant the fish in thirty days.

The river bed from this point to the Kerckhoff Dam, which diverts the water through a 17,000-foot tunnel, is dry during the summer and fall, as all the water is used for the operation of the power house. Under present conditions all the salmon that ascend past this point on the river, during the spring when the river is high, will pass the power house and lie in the pools between the power house and the dam for a distance of approximately fourteen miles. These will perish during the summer and fall when all the water of the river is diverted through the tunnel for power purposes. These fish cannot be saved at present, and very few are taken for food as the river from the dam to the power house flows through an almost impassable gorge, where few persons ever enter. If the plan of hatching the eggs at Willow Creek proves a success, racks will have to be placed across the river below the power house and the fish prevented from passing into the gorge.

There is a project started that will probably be completed during the next year or two, which consists of a high dam across the San Joaquin River at Friants to hold back the flood waters of the San Joaquin River for irrigation purposes. If this project goes through there will be no necessity for the racks as the salmon can be taken at the dam during the fall and their eggs collected and taken to the hatchery.

All of the above conditions must be carefully investigated and if it is practicable, plans must be made to save this valuable run of salmon on the San Joaquin River.

SALMON IN THE EEL RIVER.

The commercial fishing at the mouth of the Eel River and the spearing of the breeding salmon on the riffles on the upper reaches of the river necessitated the propagation of salmon in larger numbers on Eel River. Experimental work was carried on at an experimental station on Bull Creek, one of the tributaries of the South Fork of the Eel River and also in the main river near the mouth. The results of these experiments of the last three years have not justified the expense of establishing a permanent egg-collecting station on the lower reaches of the river.

There are several conditions on the lower reaches of the river that in our judgment makes it impracticable to establish an egg-collecting station in that region. The salmon when they enter the mouth of the river are compelled to remain in the large pond below Loleta until the river rises in the fall, as there is not enough water during the seasons of normal rainfall to allow the fish to pass over the wide, shallow riffles connecting the large pools from South Fork to the large pool at the mouth of the river.

As a rule the river rises to a considerable extent, but not before the majority of the salmon are caught by the commercial fishermen at the mouth of the river in the large pool. It has been suggested that eggs be collected from the fish in the large pool during the early fall before they ascend the river or are taken by the commercial fishermen but we find that the fish do not ripen in numbers great enough to justify the expense of seining them up and separating the few ripe ones from those that are green or immature. Furthermore, there is no water near the mouth of the river suitable for hatchery purposes. If eggs could be taken in sufficient quantities to justify the expense of collecting them they would have to be taken direct to Fort Seward Hatchery on the railroad, some sixty miles up the

river. The eggs collected would in all probability be in such small lots that it would not pay to keep the necessary help and equipment.

Any attempt to place racks across the main Eel River or the South Fork, anywhere near its mouth, is almost impossible as the loose nature of the formation is not solid enough to hold the racks and, even if this were overcome, the tremendous amount of water that comes down Eel River during flood periods, carrying logs and debris of all kinds would make it impossible to retain any kind of a rack in the river. Furthermore, if a rack could be built that would stand the flood water of the river when the salmon were running, the number of fish that would be entering the river would be all fresh run from the ocean and would have to be held too long in order to have them mature.

An egg-collecting station on Eel River or its tributaries must be situated far up the stream, away from the tremendous floods and the floatage matter in the river, and must be in the upper reaches near the spawning grounds, where the fish have spent the necessary time in fresh water for the breeders to mature.

A careful examination has been made of the Eel River and its tributaries for a suitable site and an experimental station has been located near Branscomb on the South Fork of the Eel River in Mendocino County, about one hundred and twenty-five miles from the mouth of the main river. The material for the racks, trap, cabin and temporary hatchery were ordered with the expectation that the station could be finished this fall in time to catch the salmon run that ascends the South Fork, the principal spawning stream of the Eel River system, but the unusually heavy rainfall during November delayed the hauling of the material and caused the river to rise to such a height that it became impossible to complete the work. Plans are being made to finish the work next season and to carry on the experimental work at this station to determine whether there are enough breeding salmon in this reach of the river to justify the expense of establishing a permanent station at this place to collect eggs for the Fort Seward Hatchery. At this hatchery the eggs can be hatched and the fry reared to a suitable size to stock the Eel River and its tributaries.

It takes less fry to stock Eel River and maintain the run of salmon than any other river on the coast as there are few natural enemies of the young of the salmon to be found in the river. There are few predatory fishes, no diverting canals to carry off the water where fry are lost, or overflow basins, and very few water snakes or other natural enemies. If only a few million eggs can be collected and the resulting fry planted each season the run of salmon in Eel River can be easily maintained provided the fishing at the mouth of the river is regulated as well as the ocean fishing, where large numbers of salmon are taken each season.

In our judgment all net fishing should be prohibited in Eel River, as the salmon supply of that region will not stand for the heavy toll taken in the ocean as well as in the Eel River when the fish enter the fresh water to spawn. A law should be passed prohibiting all fishing in Eel River except by trolling. The steelhead trout would then have a better chance, as a considerable number of the adult fish are taken by the nets. The Eel River should be protected as a fish perserve to furnish both steelhead and salmon eggs for propagation.

Every precaution should be used by the Commission to prevent the introduction of any predaceous fish into the waters of Eel River as the stream is one of the few that can be depended on to furnish a large supply of steelhead as well as salmon eggs, if properly protected against too great a drain by commercial fishermen.

The commercial fisheries are increasing off the coast each season and the number of salmon taken in the ocean must surely lessen the number that enter the river to breed. As fish are in prime condition when taken from the salt water, fishing in the ocean should be allowed, but a restriction on the number that can be taken should be made. On the other hand, all net fishing in the Eel River should be prohibited.

COMMERCIAL FISHERY NOTES.

N. B. Scofield, Editor.

SOME CONSIDERATIONS CONCERNING THE SALTING OF FISH.

Mr. Donald K. Tressler of the Division of Fishery Industries, U. S. Bureau of Fisheries, has recently carried on some very interesting experiments on the salting of fish.* Mr. Tressler's work has to do chiefly with the fishes of New England and the Eastern coast, but a study of his work might be of benefit to the packers of the Pacific coast.

Previous to this time very little work had been done on this phase of the fishing industry. It required the stimulus of the enormous demand for food caused by the war to arouse an interest in fish salting and a demand for better methods. The purpose of these experiments was to work out, if possible, a method of salting fish applicable in warmer climates, 70 degrees Fahrenheit and above.

The standards of quality differ from place to place, some localities demanding a hard, dry, salted fish, while others want a white, colorless fish with a softer meat. Two methods of salting are now in common use on the Eastern coast, the dry or "tight packed" method and the brine or pickle method. The former method is almost universally used in the south and the other method in the north.

From a study of the procedure followed at the various places on the Atlantic Coast where fish are salted it would seem that there are perhaps three general methods of applying salt to the fish: (1) the fish are immersed in a solution of salt which is kept saturated, or nearly so, by the addition of salt from day to day; (2) the fish are packed in water-tight containers with dry salt and are allowed to develop their own pickle;

*Some considerations concerning the salting of fish. By Donald K. Tressler, U. S. Bur. Fisheries, Doc. 881 (1920), pp. 1-55.

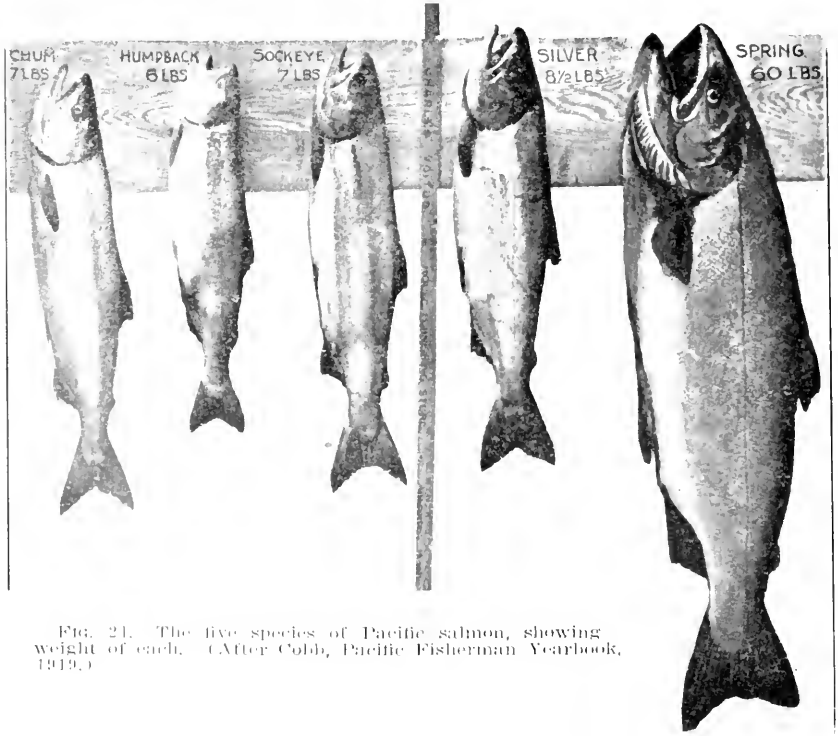

FIG. 21. The five species of Pacific salmon, showing weight of each. (After Cobb, Pacific Fisherman Yearbook, 1919.)

(3) the fish are packed in piles and the pickle allowed to run off the fish as it is formed. This last way is only used in cold weather in an emergency when no containers are at hand.

In storing of salt fish, these general methods are in use: (1) brine; (2) dry, with salt; (3) dry, with boracic acid. In case the first one is used, if the pickle becomes dirty, fresh pickle (salt solution) is added. New brine is always added if the fish are to be stored where it is not cool. If the fish are packed dry they are either sprinkled with dry salt or salt containing four-tenths per cent boracic acid. In all cases the fish must be kept at low temperature if stored for any length of time or they are very likely to "rust." "Rusting" is due to oxidation of the fish oil, giving the fish a dark-brown color. Packing in brine prevents this to a large extent.

Mr. Tressler has found that the impurities in salt exert a great influence on properties of the salted fish as to hardness, whiteness, etc. Pure salt is pure sodium chloride, but there are no salts on the market that are 100 per cent pure. Most American salt is of great purity. Calcium and magnesium salts and sulphates as impurities in salt retard the penetration of the salt into the fish. The investigator also found the following things to be true: That fish packed in dry salt, without the addition of brine, may be kept at a higher temperature than fish salted in brine; the removal of all blood and viscera, including milt and roe, is absolutely essential for the salting of fish at high temperatures; and that during warm weather freshness of fish is essential to successful salting.

From the results obtained by Mr. Tressler, it seems very probable that fresh fish may be salted in any climate of the United States if the following precautions are taken:

1. All viscera and blood must be removed in cleaning.
2. Large fish must be split.
3. Fish must be salted in reasonably fresh condition.
4. No brine should be added in salting.
5. Salts low in calcium must be used.

—A. W. WELLS, *Bureau of Fisheries Preservation Laboratory.*

FIG. 25. Seining for salmon on the Sacramento River near William's Bar. Photograph by R. B. Heacock, April, 1916.

SALMON CONSERVATION AND SALMON TROLLING.

The commercial method of catching salmon by trolling is described in an article by W. L. Scofield in this issue. The catching of salmon by this method has now become an industry of great importance to this state, Oregon, Washington and Alaska. The principal trolling districts in this state are in Monterey

Bay, off San Francisco and near Fort Bragg, Mendocino County. At each of these places about five hundred boats were employed this year. Before sea trolling became important in California salmon were nearly all caught by means of nets in the rivers which they enter at maturity for the purpose of spawning. To show the catch by these two methods we give the following from an article on "Ocean and Stream Salmon Catches," in the October issue of this magazine:

Total Yearly Salmon Catch of the State in Round Numbers.

	River caught	Ocean caught	Season total
1919	5,987,000	7,158,000	13,145,000
1918	7,173,000	5,920,000	13,093,000
1917	5,493,000	5,563,000	11,056,000
1916	5,342,000	5,501,000	10,843,000

The salmon caught in Monterey Bay, off San Francisco and in the Sacramento River are generally classed together as a unit under the assumption that they are the product of the Sacramento River. The following table shows the catch by trolling in these two outside regions contrasted with the catch by nets in the river:

	Monterey Bay	Outside San Francisco Bay
1919	2,816,000	1,143,000
1918	2,893,000	1,929,000
1917	3,880,000	1,280,000
1916	5,231,000	263,000

	Troll fish	Sacramento River
1919	4,259,000	4,529,000
1918	4,822,000	5,938,000
1917	5,160,000	3,971,000
1916	5,494,000	3,451,000

It will be seen that the Monterey Bay catch has been falling off. Contrasted with this is the catch in the Fort Bragg region which has steadily increased due

to the recent development of the industry at that point. The catch near Fort Bragg was less than half a million pounds in 1917, in 1918 it exceeded one million pounds, in 1919 it was a little less than three million pounds, and this year the catch exceeded three million pounds.

This catching of the salmon in the open sea has added greatly to the difficulties of conserving these valuable fish. Our state laws provide for closed seasons on all of our salmon streams during which time salmon may not be caught. These closed seasons were mostly established before the development of sea trolling and were designed to allow at least one-third of the fish to pass up the rivers to the spawning beds unhindered by nets, under the belief that if this portion of the run, together with the number which escape the nets during the open season, could reach the spawning beds the run would be maintained. If these closed seasons let just enough salmon reach the spawning beds for the perpetuation of the species, then the additional catching of the fish by trolling in the sea before they enter the rivers will be subjecting them to just that much overfishing, for if one-half of the run, we will say, is caught in the sea before it enters the river, the river closed season, instead of protecting one-third of the run as intended, protects only one-sixth of it. It is our belief that the closed seasons on the Sacramento River were not sufficient for the purposes of propagation even before sea trolling came into general practice. The fall season, instead of closing before the latter third of the run has entered the upper bays, does not close until after the last salmon are well up the river and no portion of the run escapes running the gauntlet of nets. This insufficient closed season, coupled with the increase of trolling at Monterey and off San Francisco, has resulted in a decrease in abundance of the Sacramento salmon. This decrease in abundance is shown in the fact that the number of salmon which reach the egg-collecting stations of the United States Bureau of Fisheries on the upper Sacramento River averages less than one-half that of a few years ago. At the same time, in spite of more energetic fishing, the commercial catch has not increased, even if we consider all the salmon caught in Monterey Bay and off San Francisco as Sacramento fish. There is no question but that the Sacramento salmon need decidedly more protection if we are to save these fish from destruction. This need of added protection has been increased by a decision of the Superior Court of Contra Costa County which permits fishermen to net salmon on Suisun Bay and the lower Sacramento River during the summer closed season of June and July; and also by irrigation and power dams under construction and to be built which will shut off important salmon-spawning grounds lying above them.

Fishermen who fish with nets on the bays and rivers think that the sea trolling should be stopped or radically restricted, contending that the trollers are destroying the salmon by catching large numbers of immature fish. Salmon trollers, on the other hand, contend that the sea is the proper place to catch them and that after they have entered the river for the purpose of spawning they should not be caught. There is considerable merit to the arguments on both sides of this question. We are convinced that both methods of fishing need to be radically restricted, and that the time is now here when the laws should be made so as to best conserve the salmon and should not be compromised to suit different factions of fishermen on the plea that the state owes them a living. Salmon on the Sacramento need far more protection than they are getting under the present law, even if sea trolling is greatly restricted. Netting of salmon should not be permitted above the city of Sacramento, the summer closed season of June and July should be restored, and the fall closed season should close two weeks earlier.

It is true that a great many of the salmon caught by trolling are immature as is well shown in the paper on the "Relative Maturity of Salmon Caught by Trolling," in this issue, by Willis Rich. From investigations which have been made it is not clear that trolling is a more destructive method of fishing than is netting in the river. There are evidences which indicate that a salmon fishery may produce more pounds without depleting the supply if the fishing is carried on only in the sea. It is our belief,

however, that until our investigations throw more light on this subject, closed seasons should be established in the trolling districts during those times of the year when the majority of the immature fish are caught. These restrictions should not be so severe as to discourage the development of our sea fisheries, for the future expansion of our fisheries must be through sea fishing as our inland fisheries are now being taxed to their utmost capacity. Sea trolling for salmon, we believe, should be encouraged, for it is the most promising avenue through which sea fishing for other varieties of fish may be developed in the northern half of the state. The inauguration of salmon trolling a few years ago near Fort Bragg has resulted in fishing for other varieties of fish and it can be confidently predicted that within a few years we will have other fisheries there of more importance than the salmon.

EEL RIVER PROBLEMS

Just as the catching of salmon of the sea has been an added drain on the Sacramento salmon, so is the recent rapid growth of salmon trolling near Fort Bragg an added drain on the Eel River salmon, and fish of that river are in need of additional protection. This ocean catch is apparently having little effect on the run in the Klamath River, which is more than one hundred miles to the north.

It seems impossible to devise an open season for nets on Eel River which will satisfy the needs of the sportsmen, the commercial fishermen and the salmon culturist, and at the same time properly conserve the two species of salmon and the steelheads which spawn in the river. The Quinnat salmon begin entering the river early in September, and as there is rarely sufficient water before November to permit them to get above the pools near the mouth, these fish remain there in the fresh water and after a time become of little value for food, although they are still of value for propagation purposes. If the netting season is opened early and closed early so as to let the latter part of the run ascend the river unhindered to the spawning beds, and so as to take these early salmon while they are still fit for food, it meets with the violent opposition of the sportsmen, who contend that it would ruin their steelhead fishing which is carried on in the lower river before the winter rains. If the open season for nets is moved to a time sufficiently late to permit these salmon lying in the pools to ascend the river beyond the reach of the nets, too many spawning steelheads and silver salmon, which begin entering the river about the first of November, would be taken. The present netting season of October 8 to December 7, inclusive, was a compromise season designed to meet the conservation requirements of the two species of salmon and the steelhead, and to partially satisfy the sportsmen and commercial fishermen. This open season has not satisfied the sportsmen or the commercial fisherman, and it has not met the needs of the salmon culturists; and, on account of the development of outside trolling, it does not meet the conservation needs of the Quinnat salmon.

The season is not sufficiently early to take the first part of the run before the fish become inferior for food purposes and it closes too late to let a sufficient number of fish reach the spawning beds up the river. On account of the depletion of the Sacramento run, salmon eggs can no longer be taken from that river to be used in stocking Eel River. If salmon culture is to be carried on in Eel River, the river must furnish its own eggs. Salmon racks can not be maintained in those parts of the river which are suitable for taking salmon for propagation purposes after the river is in flood, and it appears that the only feasible way in which eggs can be taken for this purpose is to permit the first of the run to ascend to the salmon racks after the first rise in the river, which is usually not sufficient to wash out the racks. If the netting season is placed sufficiently late to come after the first rise in the river and closes sufficiently early to avoid taking too many of the late running silver salmon—which date should not be later than December 1—the season would hardly be long enough to make netting profitable. We see no good way of harmonizing these varied interests. Whatever is done it should be seen to that the conservation needs of the three species of fish involved get first consideration.

NOTES FROM THE STATE FISHERIES LABORATORY.*

WILL F. THOMPSON, Editor.

CHANGES IN THE PERSONNEL.

Since the appearance of the last number of this magazine there have been several changes in the staff engaged in fisheries research.

Mr. John W. Rich, who has acted as field assistant in the albacore work at San Diego and San Pedro during the summer of 1920, has returned to Pomona College to resume his studies.

Mr. O. E. Sette, who has been with the Commission for more than a year, has also returned to his college work, having left for Stanford on September 1. He was stationed at Monterey observing the sardine fishery during the fall and winter fishing seasons, leaving there to act as field assistant at San Pedro in the work on the albacore during the summer months. At Stanford he will take up the study of subjects bearing on fisheries research and will at the same time prepare for publication the sardine data which he has collected. The Commission is fortunate in being able to retain the interest and services of Mr. Sette, whose work has been of high order.

To take the places of Mr. Sette and Mr. Rich, Mr. W. L. Scofield and Mr. Harlan B. Holmes have been added to the personnel of the laboratory. Mr. Scofield had been previously employed in research on the salmon and has been transferred to that on the sardine. He will be stationed at the Hopkins Marine Station in Monterey during the coming season, to carry forward the work already done by Mr. Sette. He is known to the readers of CALIFORNIA FISH AND GAME for several contributions made in past issues. Mr. Holmes has been a student at the University of Oregon, at Eugene; comes highly recommended, and with good training in biological work. He will be stationed at San Pedro, and will be engaged in the sardine work in company with Mr. Higgins.

Mr. Thompson will remain in general charge of the work, with temporary headquarters at Monterey. Mr. Higgins will remain at San Pedro.

Professor Weymouth, who has been engaged for several months in research on the Pismo clam, leaves on December 15 for Stanford University, where he will resume his teaching in physiology. He has one paper now in the hands of the printer and another in the process of writing. His work on the Pismo clam will prove of considerable value because of the great interest taken by the public in the preservation of that species, and because his work will prove of fundamental importance in the study of other mollusks.

THE SARDINE SEASON.

The sardine season opens inauspiciously this year, and it seems to be a serious question whether enough material will be obtained to complete our program of investigation for this year. No sardines were being taken at San Pedro at the time this note was written—December 8—and there was little hope held out by the cannerymen that very extensive packing would be resumed at any near date. At Monterey a number of the canneries have ceased operations, but up to the present at least no difficulty has been experienced in obtaining sufficient fish for our purposes.

What will happen in the future is not at present clear. There is no lack of fish at Monterey, and there is no reason to believe that they would be lacking at San Pedro if sought for. The reasons for the failure of the canneries to operate are given as a lack of orders, due very largely to the slump in export trade, and to the expectation of a falling market for sardines.

The sardine investigation, however, will not suffer vitally, even though the program for this year be disrupted, as there are enough data on hand to take considerable time in handling and interpreting. This program has been dealt with in the last issue of CALIFORNIA FISH AND GAME (Volume 6, No. 4, page 180).

*California State Fisheries Laboratory, Contribution No. 23.

CONFERENCES ON THE SARDINE WORK.

In order that the various assistants engaged in work on the sardine may thoroughly understand the program, we have instituted a system of conferences, in which the men engaged at Monterey and San Pedro meet as often as necessary, or more often if possible. The last conference was on the twenty-sixth and twenty-seventh of November, when Mr. Thompson, Mr. Weymouth, Mr. Sette, Mr. W. L. Scofield and Mr. Holmes were present. The purpose in this as on preceding occasions was to correlate the programs and to give everyone a thorough knowledge of them.

These conferences are inevitable because of the necessity we are under of educating the new assistants as they come, and of giving them an understanding of the fundamental reasons for the program we have adopted, if for no other cause. It is our hope that these assistants will be able—after the lapse of several years—to each take over entirely certain phases of the sardine or other problems, and to do this a thorough schooling is necessary. It has become obvious that a merely mechanical execution of duties by a more or less disinterested subordinate will not solve any of our fishery problems, and therefore we hope to give each worker a show in the rewards and penalties which come to the research man.

The inevitable period of training must include work under the senior assistants, but as fast as it is possible to place every investigator on a separate problem to make his own report this will be done, for it is recognized that no man works as well for another as for himself, and that there is no incentive comparable to that of professional success for which full credit is received. But until a thorough knowledge of the fundamentals is obtained such a course would be disastrous to any assistant, and hence the necessity of education.

The more immediate aim is, however, to have a discussion of all that bears on our problems and to make sure that the investigations at Monterey and San Pedro supplement and parallel each other where necessary. These conferences already held have proved of the utmost value in formulating the programs of work, avoiding mistakes, and bringing to everyone's attention the observations made.—W. F. T.

THE PROGRESS OF THE NEW LABORATORY.

The building of the new laboratory at San Pedro has been definitely decided upon by the Commissioners, and the State Architect, Mr. McDougall, has the matter in hand. It is sincerely to be hoped that the building will be rushed, as we will face an embarrassing situation in the near future when the sardines begin to be taken at San Pedro, in that we will have to ask quarters from some cannery for our operations, the temperary laboratory being too far removed.

To those interested in the purposes of the new laboratory the statement concerning them in the last issue of CALIFORNIA FISH AND GAME, Volume 6, No. 4, page 177, will be of value.

THE HABITS OF SEA GULLS.

It is not an uncommon thing to have the presence of small fish in quantity regarded as the reason for the presence of great numbers of sea birds, especially sea gulls, at certain localities. Observation at Monterey has shown, however, that the great flocks of sea gulls frequently seen there during the winter occasionally appear on the days following a severe blow or other weather disturbance. This has not been investigated enough, however, to justify a positive statement, yet is highly suggestive in throwing light upon the belief mentioned as to their connection with the presence of young fish. The visits of the great flocks would seem to be due to the rough surf or wind on the outer coasts, when they are not present in both places in numbers during their migration.

That sea gulls are very sensitive to the condition of the water is strongly implied by an observation we have made upon them at Monterey. This observation has been repeated so often by laboratory members working there as to be beyond doubt. The water off such a lee shore as at Monterey is frequently streaked with light and dark areas, the light areas

being smoother and reflecting the sky more perfectly. These smooth light areas are always strictly avoided by the sea gulls (chiefly herring, western and glaucous-winged) for some reason, the flocks of gulls at rest on the water being invariably and sharply limited by the roughened dark water. This distribution of the flocks upon the water is for the purpose of resting, not feeding, and is invariable and exact. It is a most remarkable and strange fact. Whether the rough areas are caused by winds running counter to the currents or otherwise, the choice of such surfaces as resting places indicates unmistakably the sensitiveness of the gulls to the condition of the water, and thus throws some doubt upon the presence of food as the factor determining their presence.—W. F. T.

A FURTHER NOTE ON THE MONTEREY GULLS.

In the April, 1920, number (page 85) of CALIFORNIA FISH AND GAME, in an article on the "Gulls in Monterey Bay," it is pointed out that these birds, although diurnal in habit, were on one occasion observed to be feeding at night on sardines lost overboard while the lighters were being unloaded at the canneries. Such cases of night feeding are evidently not rare, for gulls in great numbers have been noticed recently on two occasions flying about the lighters in search of chance sardines dropped overboard. On one occasion the gulls were flying half an hour before daylight. The usual habit of the gulls is to spend the night on their roosting grounds, supposedly along the coast, and to appear suddenly at the canneries in large numbers with a regularity as to time that suggests an alarm clock, the time being just before daylight and considerably before sunrise. On the mornings when this sudden appearance was timed it was found to vary but a few minutes from the scheduled breakfasting hour for Monterey gulls. On one other occasion gulls were noticed in large numbers at 10:30 p.m. (November 28) in bright moonlight flying about the sardine lighters. Fishermen and cannerymen say that the gulls have learned that the chances for a square meal are good whenever the sardines are being delivered to the cannery, and that it is no uncommon sight on moonlight nights to see hundreds of gulls flying about on the outlook for stray sardines. Just what amount of fish a gull considers to be a square meal is a question. One gull has been observed to swallow four large sardines in rapid succession and then fly off with ease. If the supply of sardines holds out more are swallowed until the bird is so weighted down that he is unable to fly, and must perforce walk or swim away to some quiet spot where the meal may be digested undisturbed. If confronted with the necessity of flying out of danger, the gull must lighten ship by disgorging his meal before taking to the air. Occasionally the sardine fishermen leave a lighter full of fish uncovered and unguarded, in which case gulls gather in the boat and eat until they are helpless. On the return of the fishermen the overloaded gulls allow themselves to be picked up and thrown overboard rather than disgorge away part of the feast. On one such occasion 65 gulls filled to capacity were counted as they were thrown into the air from a lighter and came down with a splash into the water. After a few feeble attempts to rise from the water these contented gulls swam off sedately, all headed for a sheltered stretch of sunny beach.—W. L. S.

LIFE HISTORY NOTES.

OPOSSUM KILLED ON MOUNT HAMILTON.

Last night I killed a porch climber, in the shape of an opossum (*Didelphis virginiana*), here on Mount Hamilton. A few years ago a number of these animals were turned loose, or escaped, near San Jose, and they have since become established in the Santa Clara Valley. I was somewhat surprised, however, to find one at this distance from the original point of importation.

Mount Hamilton is at the summit of the range bounding the Santa Clara Valley on the east, and lies about thirteen miles, in an air line, from San Jose. It is separated from the Santa Clara Valley by two deeply cut watersheds: Halls Valley and Smith Creek. If the species keeps up its present rate of travel, it will be in the San Joaquin Valley within a few years, and from there will doubtless spread rapidly over the state. From the havoc this one created in the grapevine that marked the end of his particular trail, his relatives will not be very welcome guests to the vineyardists and other fruit men of the state.—W. H. WRIGHT, *Mount Hamilton, California.*

THREE MOUNTAIN LION KITTENS CAPTURED.

About September 1, 1920, reports came to the Fish and Game Commission that there were mountain lions in the vicinity of Cathey Ranch, near Jerseydale, Mariposa County. I was sent to hunt the lions. I arrived at Jerseydale on September 10, and learned then that the lions had been heard screaming near the Cathey Ranch.

Never having heard the so-called scream of the mountain lion, and, in fact, having found them to be an invariably silent animal, I was much disappointed with this report. However, I spent two days hunting in the vicinity of Jerseydale without finding any sign of lions.

In the meantime, I telephoned to Ranger Malcolm McLeod and learned that cattle men had reported that they had seen some lion tracks several times on Owl Creek, near Devil's Gulch, eight miles northeast of Jerseydale. On the evening of September 12, I moved my outfit to the Mariposa Ranger's Station and the next day, while Ranger McLeod packed my equipment to camp on Owl Creek, I hunted on the way over to the

FIG. 27. Mountain lion kittens captured by Jay Bruce, state mountain lion hunter, in Mariposa County, September, 1920. Photograph by H. C. Bryant.

camp, then down the ridge on the east side of Owl Creek, and then to the east up Devil's Gulch and back to camp. I found old tracks of a female lion near the mouth of Owl Creek and in Devil's Gulch, but the indications were that the lioness had not been working these for several days.

The next day, September 14, I started to hunt in the country west of Owl's Creek, and about 7 a.m. my dogs picked up the fresh trail of the lioness going east toward Owl Creek. After trailing about half a mile my silent trailer, Ely, who was about two hundred yards in the lead of Ranger, the hound, jumped the lioness, which was indicated by Ely's barking.

The lioness ran down Owl Creek, going north for about a quarter of a mile, then treed in a live oak. I noticed that when Ranger arrived at the place where Ely found the lioness, he became confused for a few moments before straightening out the trail, but I was taking a short cut to where Ely was barking "treed" so that at the time I did not learn the cause of Ranger's confusion.

After shooting the lioness, the first thing that I noticed was that she had just been nursing kittens, as her breasts were still wet.

I skinned the lioness and afterwards back-trailed her tracks over the course that the dogs had chased her. When I reached the place where Ely had found the lioness, I noticed her fresh tracks going on toward Owl Creek and returning again over the same course; this explained why the hound had gotten confused.

The next thing was to find the kittens. After searching the brush and rocks for several minutes without success, and having in mind the track I had noticed going east from here and returning the same way, I decided that the kittens were somewhere farther east. Evidently, while the mother lion was nursing the kittens she heard the hound baying on her trail, about a quarter of a mile away, and left the kittens and back-trailed herself to meet the dog, but she was surprised by the silent dog, who was in the lead of the hound. Then she turned at right angles and led the dogs down the creek and away from the kittens. I now followed her tracks for about five hundred feet east and across Owl Creek to a bluff of rocks, where the dogs scented the kittens, which were hiding in the small holes among the rocks. Two of the kittens were in one place and the other was about twenty-five feet from them in another hole. After considerable trouble I captured the kittens alive, and after taking off my shirt I carried them in it for about a mile to camp. From the camp I carried them in a barley sack for five miles to the Ranger's Station and then from there by auto to the office of the Fish and Game Commission in San Francisco.

The kittens were about six weeks old and were the size of an adult house cat. They weighed about eight pounds each and were twenty-six inches in length from tip to tip.

The home of the lions was on a ledge about seventy-five feet from the water of Owl Creek and near the top of a bluff of rock. This ledge, which was about sixty feet above the base of the bluff, was about five feet wide and extended about thirty feet along the north side and the same approximate distance along the west side of the bluff. Although there was no cave or den large enough to shelter the mother lion, this was apparently the place where the kittens were born and where they had lived until they were captured; as there were numerous beds, both on the north and west sides of the bluff, where the lioness had been lying on the ledge. The dry grass and moss all along the ledge was well worn and trampled, probably by the kittens while playing. The small holes among the loose rocks behind and above the ledge had evidently provided hiding places for the kittens when disturbed.—JAY C. BRUCE, *Oakland, California.*

HOW MANY EGGS DOES A SALMON LAY?

In the course of a study of King Salmon in Klamath River, it became desirable to learn how many eggs the female produces. Thinking that it may be of general interest, a table including the results of an examination of 30 individuals is given, the specimens being selected from a larger number as fairly representing the average.

Klamath salmon are somewhat smaller than those of the Sacramento, and it is

possible that the females produce fewer eggs. In a series of 3350 Klamath salmon the smallest female measured 20 inches and the largest 42. One either smaller or larger is rarely found.

The number of eggs here given were obtained not by actual count, but by weighing the ovaries, counting a small number of eggs, weighing the latter, and then calculating the entire number. Tests demonstrated that the method gave results accurate to 1 to 3 eggs in a 100. Ovaries from the same fish are not usually alike in size, the left being often somewhat larger than the right and containing as many as 200 or 300 more eggs. No very definite relation is seen between size, weight, or age and the number of eggs, although it will be noted that fish in the fifth year are found amongst those having most eggs.

Number of eggs	Length, inches	Weight, pounds	Age
2146	26½	8¼	4
2709	31	11¾	4
2745	31½	14¼	4
2847	30¼	12¼	4
2879	28¼	9¼	4
2949	30¼	13¼	4
3083	31½	15	4
3149	33¼	17½	4
3200	32¼	16½	4
3305	28	10½	4
3403	31	13½	4
3467	32	15	4
3579	27	9½	4
3586	29¾	12⅞	4
3614	32½	14	4
3630	32½	15⅞	—
3672	32½	13⅝	4
3676	32¾	15⅞	4
3731	33	17½	4
3781	32¼	14½	4
3886	30¾	13	4
3935	33	15½	5
4069	31½	14	4
4117	37½	26½	5
4192	32½	17½	4
4197	30½	13¾	4
4209	31¼	19⅝	5
4269	32¼	15⅞	4
4392	34¼	16⅜	5
4842	34¼	18	5

Average number of eggs per fish, 3572. —J. O. SNYDER, *Stanford University, California.*

FULVOUS TREE-DUCK SHOT NEAR COLUSA.

On October 16, 1920, while shooting ducks seven miles north of Colusa, the writer saw a flock of about twenty birds which came to the pond several times which were to him unknown. One of these birds was shot so that it might be identified, but when examined none of the party were able to name the bird. While discussing the specimen, Fish and Game Deputy Wm. N. Dirks happened by and identified it as a fulvous tree-duck, *Dendrocygna bicolor*. It was in fine plumage and is of particular interest because it is unusual for one to be seen so far north and at so late a date.—A. C. HANSEN, *Birds' Landing, California.*

BLACK FISH NEAR SANTA CATALINA ISLAND.

While doing patrol duty with the "Albacore," on November 18, 1920, I came upon a school of black fish (*Globiocephalus scamoni*) near Santa Catalina Island, about ten miles north of Lone Point. I estimated that there were about one hundred individuals ranging between thirty and forty feet in length. They were going slowly northward. Unfortunately, I was unable to secure a specimen.

This large, porpoise-like mammal was formerly abundant off the coast of lower California and in the Gulf of California, but in more recent years it is not often seen. An oil made from the head of the black fish is highly prized for use in watches and chronometers. This oil is said to improve with age.—H. B. NIDEVER, *San Pedro, California.*

CONSERVATION IN OTHER STATES.

SANCTUARY FOR WILD LIFE DEEDED TO LOUISIANA.

A tract of land embracing 224,000 acres in Louisiana has been set aside as a perpetual bird sanctuary, and secondarily as a refuge for game, thus bringing to fruition the project of Edward Avery McIlhenny.

On November 8, 1920, deeds were signed in the office of the State Conservation Commissioner which gave to the state in fee simple Marsh Island, 79,300 acres in extent, which was purchased and presented by Mrs. Russell Sage; the Grand Chenier tract, 85,000 acres, purchased and presented by the Rockefeller Foundation, and the Ward-McIlhenny tract, 60,000 acres.

Years ago the plan for this reservation was thought out by Mr. McIlhenny, who first discussed the proposition with a friend, Charles Willis Ward. Mr. Ward supported the idea and as a result the Ward-McIlhenny tract was set aside as a wild life refuge. Mr. McIlhenny, encouraged in his plan to secure an adequate sanctuary for native and migratory birds, found a willing helper in Mrs. Sage. Soon afterwards he secured the appropriation from the Rockefeller Foundation and now the reservation is definitely assured to the state.

The Marsh Island tract lies in the Gulf of Mexico, off the coast of Iberia, St. Mary and Vermillion parishes; its eastern shores are famous as migratory bird haunts. The Grand Chenier tract is on the mainland and adjoins the Ward-McIlhenny tract and is close to Marsh Island. The Marsh Island and Grand Chenier tracts have been under the care of Commissioner Alexander of the State of Louisiana for the past six years, and this supervision has been so successful that it was finally decided to turn them over in fee simple to the state, along with the Ward-McIlhenny tract.

In the event of the discovery of any valuable ore or mineral, it is to be removed with the least possible disturbance to the wild life and the profits accrued must be used to further the protection of it, and if more money is made from this source than is needed for its original purpose, it is to be devoted to education or public health in the state.

VERMONT ESTABLISHES SANCTUARY FOR WATERFOWL.

The Vermont Fish and Game Commission has secured an option upon a tract of 900 acres of marsh land at the mouth of the Lamoille River, on Lake Champlain, as a sanctuary for waterfowl in their trips north and south through this much traveled migration route. The area has been investigated as to its properties for feeding the birds by the U. S. Bureau of Biological Survey and is considered ideal. It is expected that enough revenue can be derived from the trapping privileges to pay the salary of a caretaker; for the region abounds in muskrats, skunks, and other fur-bearing animals. This step is the first of its kind taken in any of the northeastern states.—*The Conservationist*, June, 1920.

VALUE OF PENNSYLVANIA'S ANNUAL KILL OF GAME.

The State Game Commissioner of Pennsylvania, John M. Phillips, through the statistics of the State Commission, estimated that there were 6,000,000 pounds of meat bagged as game last year which, at 20 cents a pound, would have a value of $1,200,000. Three thousand buck deer were killed and 472 black bear. Mr. Phillips estimates that next year there will be 4000 deer killed and that the total weight of the game killed, including all smaller game, will be at least 8,000,000 pounds, which, at 20 cents, would be $1,600,000.—*Field and Stream*, September, 1920.

QUEBEC LICENSES FUR DEALERS.

Canada is following the United States in the effort to conserve fur-bearing mammals. Recently, the province of Quebec took over entire control of its fur trade. Fur traders must take out licenses and report monthly all furs bought. The government imposes a small royalty on all skins before they can be stamped, and no unstamped skin may be sold or shipped out of the province on penalty of confiscation and fine. Trapping out of season is to be controlled, for obviously no inspector will stamp a skin which shows evidence of having been taken out of season. All shipments of skins not plainly marked on the outside will be confiscated and the sender fined. Thus, the poacher will be unable to market his illegally taken fur.

AUTOMOBILES CONFISCATED IN WISCONSIN.

The state of Wisconsin has a law which imposes on hunting violators not only a $50 fine, but deprives these men of their guns, hunting licenses and automobiles. The confiscation of the automobile is a drastic and effective step, for it affords a stronger protection to the partridges and prairie chickens, which must be protected against the onslaughts of those who previously have been willing to "take a chance." They are more apt to think now what it will mean if they are caught.

THE SYSTEM OF CONSERVATION IN PENNSYLVANIA.

In an article published in the Bulletin of the American Game Protective Association, Mr. Holland states that the basis of the game protective system adopted by Pennsylvania is a combination of public shooting grounds and game refuges.

The first game preserve was established in Pennsylvania in 1905, and—quoting from Mr. Holland's report—"at the present time the state has twenty-four state game preserves, eighteen being on state owned forest lands and six on leased land that will eventually be owned by the state. These preserves are approximately nine miles in circumference and individually contain from 1700 to 3200 acres. Around each preserve are from 3000 to 7000 acres of land that is public shooting ground, on which any man may go and shoot, provided he complies with the laws of state and nation." According to the state laws, one-half of the total acreage of the state can be utilized in this way.

The game refuges have been placed as near as possible to the centers of population and in the center of state-owned forest lands, which during the open season constitute the public shooting ground. By this method the game is more readily protected when out of season. The preserves can not be mistaken, for a wire stretched waist high surrounds it, and often as many as six refuge posters can be seen from one point along the reserve. Too, fire protection clearings surround each area. The average cost of establishing a refuge is $2,175, and the yearly cost of maintaining the preserves total about $1,174.

Aside from the larger preserves, there are the auxiliary state game preserves, which "are tracts of land, generally of 250 acres or more. They are cared for by the state, but are owned by some individual or a group of several individuals who are willing to donate or lease the land to the state as a game preserve for a period of ten or more years. A part of each tract is posted and cared for by the state and the balance is used for public shooting. These reservations may consist of farm lands. The plan has been found very beneficial where small game such as quail and rabbit are concerned."

The system of protection practiced in Pennsylvania to assure to the sportsmen an abundant supply of game seems to be eminently successful, and by 1921 Pennsylvania plans to have increased the number of her game preserves to forty.

THE PLATFORM ADOPTED BY THE ILLINOIS SPORTSMEN'S LEAGUE.

The annual meeting of the Illinois Sportsmen's League was held at Belleville, Ill., on May 14, 1920, and quoting from the Illinois Sportsman, the official organ of the League, the program which they are to support follows. It will be noted that the organization still maintains that the Federal Migratory Bird Treaty Act does not give the middle West a fair deal so far as duck hunting is concerned:

First—We are for the enactment of just and equitable game and fish laws and the vigorous and impartial enforcement of the same.

Second—We favor a program which will result in a better understanding between the farmer and sportsman.

Third—We feel that the number of game and fish wardens is inadequate and stand for an increase, also insist that efficient service be given at all times.

Fourth—Since the revenue from the sale of hunting and fishing licenses receipts for fines, etc., more than pays the operating expenses of the Illinois Division of Game and Fish, we ask that this surplus be kept intact in a special fund to be used for the conservation of our wild life.

Fifth—We stand for such an increase in game and fish as will furnish legitimate sport for every citizen.

Sixth—We favor the establishment by the state of recreation grounds which will be open to the public at all times

for either hunting, fishing, camping or other outdoor life sports.

Seventh—We will give our support to the Illinois Natural History Survey and State Forester in the preliminary work now being done for the conservation of what is left of our natural forests.

Eighth—We stand for a system of game refuges, and resting places for waterfowl; that is, in case public shooting grounds are obtained by the state, certain portions thereof shall be set apart where game can breed and raise its young without being molested by hunters, following the Pennsylvania plan.

Ninth—We stand for an extension of the fish rescue work now being done by the state, and feel that this could be made much more effective by the purchase or lease of certain lakes to be used for placing the smaller fish taken from the shallow bodies of water. When larger these fish could then be taken out and distributed for stocking purposes.

Tenth—We stand for a reduction in the bag and possession limits on all of our game birds and animals, this to be determined after a free discussion of the subject through the medium of this organization.

Eleventh—We stand for a change in the open season for the taking of our fur-bearing animals, preferably from November 15 to February 15.

Twelfth—We stand for a change in the open season on rabbits, preferably from November 10 to January 31; and in addition thereto believe a possession limit should be fixed. By delaying the opening of the rabbit season and making it the first day of the open season for quail, there is a general feeling among the true sportsmen that many quail will be saved.

Thirteenth—Millions of dollars are being appropriated by the General Assembly at each session for the good of the people, therefore we are of the opinion that the question of establishing state parks should be given some consideration along this line. Next year we propose asking for a liberal appropriation, and request the cooperation of the people in general in obtaining the same.

Fourteenth—We consider roving dogs and cats one of the greatest existing menaces to our wild game animals and birds during the breeding season, therefore we favor the enactment of a law regulating the same.

Fifteenth—We stand for an amendment to the existing laws which will give the state additional powers in dealing with the pollution of the rivers and other streams of our state causing the destruction of our fish.

Sixteenth—The Migratory Bird Treaty Act has been upheld by the United States Supreme Court, therefore, it is the supreme law of the land, so the safe plan is to obey the same; however, we still maintain that the Middle West states are entitled to a late winter season during February and March for the shooting of waterfowl and hope to convince the United States Bureau of Biological Survey that this concession is due the sportsmen of this section of our country.

REPORTS.

VIOLATIONS OF FISH AND GAME LAWS.

July 1, 1920, to September 30, 1920.

Offense	Number of Arrests	Fines Imposed
Game.		
Hunting without license	23	$340 00
Hunting on posted grounds	5	95 00
Deer closed season killing or possession	23	805 00
Failure to produce deer horns or skin	11	425 00
Running deer with dogs closed season	1	25 00
Female deer spike bucks fawns killing or possession	51	2,725 00
Illegal deer hides	2	75 00
Brush rabbits closed season killing or possession	19	410 00
Tree squirrels closed season killing or possession	2	50 00
Quail closed season killing or possession	19	615 00
Doves closed season killing or possession	13	385 00
Ducks closed season killing or possession	27	925 00
Sage hens closed season killing or possesion	1	25 00
Nongame birds killing or possession	5	110 00
Protected shore birds killing or possession	4	200 00
Bear closed season	6	105 00
Night hunting	1	25 00
Total game violations	213	$7,340 00
Fish.		
Angling without license	9	$250 00
Fishing for profit without license	42	430 00
Fishing in restricted waters	2	120 00
Illegal nets in restricted districts	29	600 00
Salmon Saturday-Sunday fishing excess daily limit closed season taking or possession	2	200 00
Striped bass underweight excess daily limit and offering for sale closed season	28	505 00
Barracuda undersized taking or possession	1	25 00
Trout excess limit taking other than by hook and line	5	125 00
Clams undersized excess limit taking or possession	8	250 00
Crabs undersized excess limit taking or possession	7	95 00
Abalones undersized bringing to shore detached from shell	11	425 00
Dried shrimps possession	5	165 00
Total fish violations	149	$3,170 00
Grand total fish and game violations	362	$10,510 00

SEIZURES—FISH AND GAME AND ILLEGALLY USED FISHING APPARATUS.

July 1, 1920, to September 30, 1920.

Game.		Fish.	
Deer meat	1,230 lbs.	Striped bass	1,125 lbs.
Doves	11	Halibut	600 lbs.
Quail	18	Barracuda	885 lbs.
Ducks	71	Salmon	55 lbs.
Rabbits	23	Perch	100 lbs.
Sage hens	2	Trout	12 lbs.
Deer hides	2	Crabs	377
Bear hides	1	Abalones	204
		Pismo clams	117
		Cockle clams	425 lbs.
		Dried shrimps and meal	6,300 lbs.
		Illegal nets	5

Searches.

Illegal fish and game	17

STATEMENT OF EXPENDITURES.

Period July 1, 1920, to October 31, 1920.

Administration:		
Commissioners	$130 18	
Executive officers	8,262 62	
Printing	716 20	
Research and publicity	1,605 58	
Accident and death claims	776 40	
		$11,490 98
Commercial fish culture and conservation:		
Superintendence	$4,836 25	
Inspection and patrol	10,078 33	
Research	11,009 75	
Statistics	3,376 73	
Market fishing license commissions	144 50	
Propagation and distribution of salmon	9,600 12	
		39,045 68
Sporting fish culture and conservation:		
Superintendence	$5,272 57	
Printing	99 05	
Prosecutions and allowances	117 50	
Angling license commissions	5,043 10	
Fish exhibits	4,287 94	
General patrol, pro rata share—		
San Francisco District (40 per cent)	12,883 72	
Los Angeles District (40 per cent)	5,670 59	
Sacramento District (40 per cent)	10,135 44	
Propagation and distribution of trout	71,079 29	
		$114,589 20
Game conservation:		
Printing	$124 26	
Prosecutions and allowances	536 44	
Hunting license commissions	9,630 50	
Mountain lion hunting (and bounties)	2,566 40	
General patrol, pro rata share—		
San Francisco District (60 per cent)	19,222 11	
Los Angeles District (60 per cent)	8,505 93	
Sacramento District (60 per cent)	15,201 59	
		$55,787 23
Tahoe camping ground		402 11
Total expenditures		$221,315 20

CALIFORNIA FRESH FISHERY PRODUCTS, JULY, AUGUST AND SEPTEMBER, 1920.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Total	Mexican
Albacore										5 0	16,227,880	3,607	1,630,198	17 871,575	
Anchovies							78,345		185,767					264 112	
Barracuda	25						8,102	25,759	45,295	62,152	306,971	11,072	369,663	829,139	322,718
Bluefish								54						54	
Boccaccio		5					34,309	73 878	200,721					308,773	
Bonito								324	15	11,310	195,193	249	57,905	264,996	7,581
Carp				312	7,088	267								7,667	
Catfish				1,649	1,846	45								3,540	
Chilipepper							16,358	11,521	720					25,579	
Cultus cod	1,450	11,877	52				137,822	19,815	8,456					269,986	
Flounders		16					6,602	6,703	446	64	642			14,270	
Grayfish			20			759	3,630				5,267		139,225	148,901	
Hake							35,019	625	55					35,699	
Halibut	2,873	80,405	2,428				11,002	1,233	2,731	58,052	64,386	6,033	303,227	561,370	627,989
Hardhead						470								470	
Kingfish							365	5,111	2,647	751	11,025		285	19,941	
Mackerel								9,678	193,644	20,460	462,232	20,027	120,198	826,239	7,142
Mullet												226	1,211	1,437	90
Perch	178						11,254	103	132		3,327	1,859		16,863	
Pike				23	50	6								79	
Pompano							25	118			1,243	21	120	1,527	
Rock bass										1,689	16,844	6,213	32,430	87,176	485
Rockfish	6 172	651	49				285,006	80,260	85,435	9,660	30,059	1,336	125,316	624,274	2,630
Sablefish							72 912	314	21 931					95,157	
Salmon	948,289	2,388,179	3,711	1,200,972	282,895	1,075,196	1,413,002	31,225	6 149					7,380,919	
Sand dabs							76,378	77 250	2,771				470	156,649	
Sardines							29 425	2,833 620	26,233,905		9,278		754,802	29,861,620	
Sculpin											1,951	100		2,051	
Sea bass—black										145	7,671	392	8,726	16,934	6,288
Sea bass—white			18,291				5 530	98 521	5,778	71,838	630,705	5,516	72,178	908,387	158,156
Sea trout							382				754	20		956	
Shad				284	181	508								973	
Shad—buck						280								280	

Shad—roe				4											4	
Sheepshead											603		14	140	757	165
Skates							849	8,062					19		8,930	
Skipjack								63	3		4,218,843	2,544	2,401,095		6,622,548	4,245
Smelt	11,225		9,842				6,744	30,882	90,568	19,018	26,194	11,213	1,204		206,890	671
Sole	186	4					851,163	182,944	3,139	1,600	1,628	170			1,040,834	195
Splittail				23											23	
Striped bass			252	4,171	1,002	40,066	42,200								87,781	
Stingaree			14,000	103									59,121		73,224	
Swordfish											7,877		1,208		9,085	
Tomcod	111						2,909								3,020	
Trout—steelhead	5,900														5,900	
Tuna										410	1,181,572	1,232	3,210,419		4,393,633	200,415
Tuna—bluefin											10,519,862				10,519,862	
Tuna—yellowfin											446,073				446,073	
Turbot			34												34	
Whitefish											90				90	
Yellowtail										287	191,770	1,398	213,659		407,114	31,737
Miscellaneous	303			52	7		3,399	3,735	1,133	7,471	20,957	1,672	425		39,154	
Total fish	995,512	2,517,187	46,679	1,207,503	293,539	1,117,527	3,127,792	3,501,316	27,151,085	265,846	34,827,034	75,033	9,512,525		84,414,662	1,370,537
Crustaceans—																
Crabs, (doz.)	253						2)	2	2						286	
Shrimps							309,759								309,759	
Spiny lobsters																22,443
Mollusks—																
Abalones									210,831	103,881					314,711	35,296
Clams—ecekle			217									820			1,037	
Clams—mixed	2,898		3,202												6,100	
Clams—Pismo										94,494					94,494	
Clams—softshell		649	9,129			57,021	11,493								78,286	
Cuttlefish							6,225	1,627	1,747						9,599	
Limpets												7,800			7,800	
Mussels						588				70		2,400			10,458	
Oysters—																
Eastern (No.)			236,336				688,175								924,511	
Native			16,826												16,826	
Squid								26	31,161						31,187	
Miscellaneous—																
Turtles																36,239

All amounts shown in pounds unless otherwise specified.

CALIFORNIA STATE PRINTING OFFICE
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CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

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CONTENTS.

A BRIEF HISTORY OF THE CALIFORNIA FISH AND GAME COMMISSION.

By Harold C. Bryant.

INTRODUCTION.

The California Fish and Game Commission having completed fifty years of service to the state in the administration and conservation of wild life resources, it seems fitting that a review of the problems of the past and their solution, together with an outline of the distinctive accomplishments of one of the oldest state commissions, be published, to the end that the work of this Commission may be better understood and

appreciated and that future activities may be governed by the successes or failures of the past.

Under the administration of Governor H. H. Haight, the legislature of 1870 established a Board of Fish Commissioners under "An act to provide for the restoration and preservation of fish in the waters of this state." The bill was approved on April 2, 1870, and Messrs. B. B. Redding, S. R. Throckmorton and J. D. Farwell were appointed as commissioners. The former commissioner served the state for more than ten years.

The United States Commission of Fish and Fisheries was not established until a year later. California thus had an organized fish commission nearly a year before the federal government took up similar work. The appropriation of $5,000 was largely used in importing new varieties of fish and in preserving those native fish which were recognized as valuable food fish. It was not until 1878 that the Commission was granted jurisdiction over game as well as fish.

"The first hatchery owned and operated by the state was situated on the grounds of the State University, in Berkeley. The California Acclimatization Society under the supervision of Mr. J. G. Woodbury had been experimenting, and had made several successful hatches of eggs introduced from the eastern states. Mr. Woodbury afterward became an assistant to Dr. Livingston Stone, at the Baird Hatchery, on the McCloud River, in 1872, when the first attempt was made to propagate the quinnat salmon in California.

INTRODUCTION OF FOOD AND GAME FISHES.

"The California Fish Commission during the first decade of its existence introduced into the waters of this state a number of varieties of food and game fishes and the attending results are regarded as being among the greatest achievements in fisheulture and acclimatization."*

In the year 1872, an attempt was made to import from eastern states on a special aquarium car the following: black bass, glass-eyed perch, yellow perch, catfish, tautogs, brook trout, salt water eels, lobsters and oysters. Unfortunately, this large shipment never reached California owing to a train wreck which was described in the official report as follows:

"After leaving Omaha we stowed away as well as we could the immense amount of ice we had on the car, and having regulated the temperature of all the tanks, and aerated the water all round, we made our tea and were sitting down to dinner, when suddenly there came a terrible crash, and tanks, ice, and everything in the car seemed to strike us in every direction. We were, every one of us, at once wedged in by the heavy weights upon us, so that we could not move or stir. A moment after, the car began to fill rapidly with water, the heavy weights upon us began to loosen, and, in some unaccountable way, we were washed out into the river. Swimming around our car, we climbed up on one end of it, which was still out of water, and looked around to see where we were. We found our car detached from the train, both couplings having parted. The tender was out of sight, and the upper end of our car resting on it. The engine was three-fourths under water, and one man in the engine

*Shebley, W. H.: History of the Introduction of Food and Game Fishes into the Waters of California. California Blue Book, 1911, pages 513–527.

cab crushed to death. Two men were floating down the swift current in a drowning condition, and the balance of the train still stood on the track, with the forward car within a very few inches of the water's edge. The Westinghouse air-brake had saved the train. If we had been without it, the destruction would have been fearful.

"One look was sufficient to show that the contents of the aquarium car were a total loss. No care or labor had been spared in bringing the fish to this point, and now, almost on the verge of success, everything was lost." (Bienn. Rept. Fish Comm., 1872-1873.)

Undiscouraged by this loss the Commission asked Mr. Stone, who was in charge of the aquarium car, to return East and obtain a new shipment. With the help of the United States Bureau of Fisheries, 40,000 shad were secured in the Hudson River. These fish arrived safely and were planted in the Sacramento River at Tehama.

FIG. 28. Fisherman unloading catch of shad. Over a million and a half pounds of shad are taken annually in California. They were first introduced into the waters of the state by the State Fish Commission in 1871 and a second plant was made in 1873.

In the fall of 1872, a shipment of white fish eggs was secured in the East. These were hatched with success and 25,000 young white fish were planted in Clear Lake. During this period, Tahoe trout were introduced into several coastal lakes and streams. This constituted the first transplantation experiments.

On June 12, 1874, another importation which included black bass, glass-eyed perch, Schuylkill catfish, horn-pouts, silver eels, eastern salmon, rock bass, tautogs, lobsters and salt water eels, were distributed to different lakes and streams of the state. The tautogs were placed in San Francisco Bay and the white fish in Tulare Lake.

During the years 1876–1877 an attempt was made to acclimatize the awa, a fish from Hawaii. Apparently, there were no results from the

plant made near Bridgeport, Solano County. Efforts to better establish the white fish, shad, and other fishes were continued and additional importations were made. The striped bass was introduced in 1879 and the carp in 1880.

The first published report on the edible fishes of the Pacific Coast appeared in 1881.

In 1898, six fish hatcheries were in operation, as well as several egg-collecting stations, and the Sisson Hatchery had been enlarged to handle 16,000,000 eggs at one time.

In 1903–1904 additional attempts were made to introduce the greyling and the land-locked salmon. Although fish were planted, no results were obtained. At the same time four dozen elegant quail imported from Mexico were liberated, but soon disappeared. Chinese quail were the subject of still another acclimatization failure.

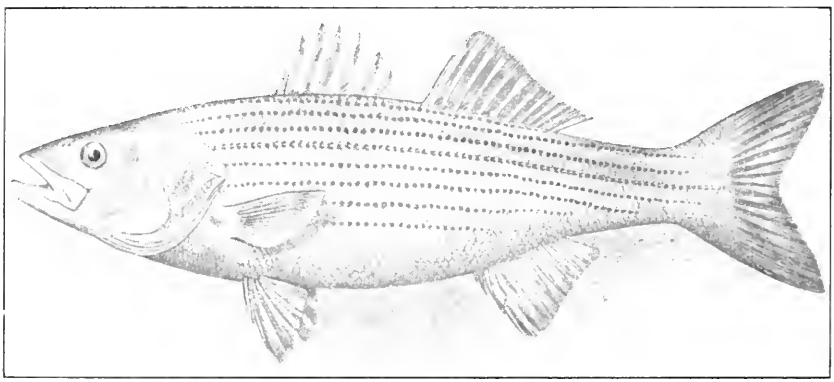

FIG. 29. Striped bass, *Roccus lineatus*, the successful introduction of which was accomplished in the year 1879, when 135 were planted near Martinez. A second plant was made in June, 1882, when about 300 were planted in Suisun Bay. The increase has been remarkable.

Continued interest in the introduction of new food fishes led to the importation and planting in 1908 of crappie, blue-gilled sunfish, yellow perch and ring perch, making about thirty different exotic species given a trial in the waters of the state. The above species have increased and are well established in the Sacramento and San Joaquin rivers. Attempted introduction of the ayu from Japan in 1920 met with failure.

Enthusiasm over the golden trout of the southern High Sierra led to many transplantations of this fish beginning in 1909 and 1910. As a result this species is now found 150 miles to the north of its original home in the head waters of the Kern River.

Transplantations of striped bass were also attempted in more recent years.

OUTSTANDING PROBLEMS AND ACHIEVEMENTS.

The first outstanding problem confronting the Commission was that of the pollution of coastal streams by sawdust from the mills. It was found that the fish life in those streams into which the refuse from mills was poured soon became barren and demand was made for legislation to prevent further pollution.

The need for fishways was apparent to the first board appointed and within a few years the building of them was made compulsory. The following quotation from the 1870–71 Biennial Report is of interest:

"At one dam on a tributary of the Truckee a mill owner consented to put in a fishway, at the earnest solicitation of one of the commissioners, and to prevent the expenses of a suit. He said the law was an infringement of his rights, and when the legislature passed an act to compel him to spend money in such foolish business they should have appointed a schoolmaster to teach the trout how to use the contrivance; he did not believe a fish could be coaxed to go near it. The next evening after the fishway was placed in position the fish were passing it every few minutes; the mill owner became a convert to the practical use of fishways. He soon tore away the cheap and temporary affair built to comply with the law under compulsion, and has erected in its place a substantial ladder that will last for years."

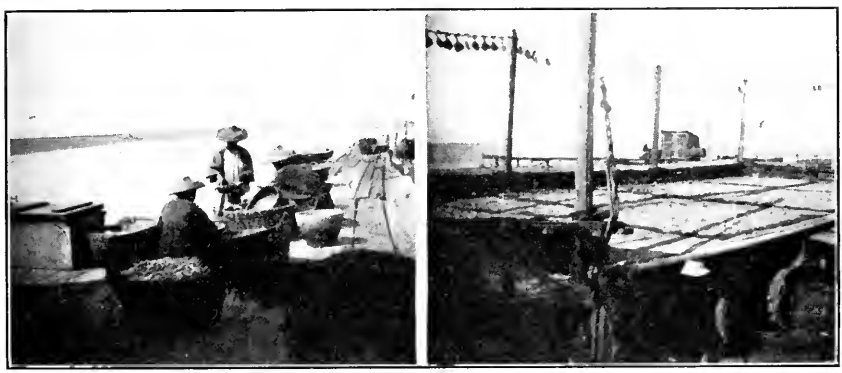

FIG. 30. Chinese shrimp fishermen and small fish, caught in the shrimp nets, being dried. The danger to young fish as a result of the shrimp fisheries early became an important problem of the Fish and Game Commission. Photographs by N. B. Scofield.

The most important problem confronting the Commission in the years 1876 and 1877 was the decreasing run of salmon in the Sacramento and San Joaquin rivers. A demand for a closed season to limit the catch was made as a result of investigation. Interest in the salmon situation continued for several years and statistics on canning operations and output were secured.

Decimation of immature fish as a result of the practices of the Chinese shrimp fishermen, and the destruction of the sturgeon by the use of Chinese set lines next attracted the attention of the Commission and in 1885 a strengthening of the patrol service was ordered as was also the building of a patrol launch. By this time shad had become so numerous that a repeal of the closed season was recommended. Interest in salmon centered around the complaint that sea lions destroyed large numbers as they entered the Bay, and the building of the first large state salmon hatchery which was located on Hat Creek.

An interesting political situation hindered the work of the Board during the years 1886 and 1888: "The work of the Commission was progressing very satisfactorily, until disturbed by the attempt on your part (the report was made to Hon. R. W. Waterman, then Governor of

the State of California) to reorganize the Commission by placing thereon persons of your own selection. This attempted removal of the members of the Commission (Routier and Harvey) discredited the acts of the Commission, destroyed public confidence in the legality of their official acts, and defeated all efforts to an efficient discharge of their duties. That the legal status of the Board might be determined, Mr. J. D. Redding, who had been appointed by you to succeed Commissioner Routier, obtained the permission of the Attorney General to bring an action in the name of the people to oust Mr. Routier, but after suffering the action to remain in the courts for several months, he caused it to be dismissed. Subsequently, the State Board of Examiners, moved by the clamor of claimants who had furnished supplies, or rendered services to the state, agreed that the question as to who were entitled to act as the

FIG. 31. A view of the Mount Shasta Hatchery taken about the year 1905. There are now six large hatchery buildings on the grounds.

State Board of Fish Commissioners should be submitted to the Attorney General, and that the opinion of that officer should be binding upon the Board of Examiners until overruled by the courts."*

The licensing of market fishermen as a means of controlling the salmon situation was begun on March 21, 1887.

Although appointed solely in the interest of preserving and increasing a fish supply, the Fish Commission early recognized the need for conserving game, notably deer, as is evidenced by the following excerpt:

"We recommend that the killing of deer be prohibited absolutely for the next two years, and also the having in possession of the skin of any deer for the same time. This is rendered necessary because of the great

*Biennial Report of the State Board of Fish Commissioners of the State of California, for the years 1886–1888.

loss of these animals during the extremely severe weather of the last two winters, as well as their indiscriminate slaughter in some localities by hunters who defy the law with impunity. With these men, nothing save the heavy hand of the law can be made effective." (Biennial Report 1888–1890.)

An appropriation of $2,000 first gave the impetus to the introduction of foreign game birds. In 1889 attempts were made to secure Oregon pheasants but actual stocking of the state did not begin until several years later.

The screening of irrigation ditches now attracted attention for the first time and steps were taken to improve the existing situation. It was at this time also that various conflicting county laws relative to the mesh of salmon nets made the enforcement of the salmon laws very difficult.

The sale of fish and game in San Francisco during the closed season became an important problem in the years 1891 and 1892. Under a system of cold storage it was possible for markets to hold fish and game, taken at a time when it was lawful, and to sell it during the closed season. It became apparent that unless some limitations were imposed the closed seasons for fish and game would cease to accomplish any purpose, and recommendations were made accordingly. Demand was also made for an investigation of the marine fishes and the spawning and hatching of the same.

By 1893, with an appropriation of about $20,000 and an income from fishermen's licenses of about $4,000, the Commission was able to employ an attorney, and twenty-seven deputies who served without pay. Furthermore, the first compilation of the game laws of the state was made and printed. Sportsmen's clubs which had by this time begun to appear were encouraged.

Of particular interest were the game statistics secured and published in the 1895–1896 Biennial Report. A table shows the receipts of game birds in the San Francisco and Los Angeles markets. The totals show 332,630 pounds of ducks, 175,444 pounds of geese and 37,880 pounds of California doves, pigeons and other game birds. The total valuation of the birds in the San Francisco and Los Angeles markets was $62,362.01.

In 1897, attention was again directed toward the introduction of ring-necked pheasants and 323 were purchased in Oregon and liberated in five-pair lots. Satisfactory increase was reported. A year or two later about 250 more pheasants were purchased in Hongkong for seventy-five cents each and liberated in several different places in the state.

Interest in commercial fisheries now developed to such a point that there was urgent demand for the abatement of the destruction to young fish by Chinese shrimp fishermen on which agitation had begun as early as 1885. This came as a result of investigations made by an expert which consumed several months' time. Statistics showing the amounts of the different varieties of fish sold in the San Francisco markets were prepared in order to show the need for protective legislation. The sturgeon, once of no market value, was found to be the highest priced fish on the market and with the supply insufficient to meet the demands, in spite of protective laws.

"As the hunting license law produced ample funds, and believing that the establishment of a State Game Farm where game birds could

be raised in captivity and operated along the same lines as fish hatcheries, would be in entire accord with the spirit of the law, which authorizes expenditures for the propagation and restoration of game, and being encouraged by the example of other states, it was decided to undertake the establishment of one in California. Negotiations for services were entered into with several men who had had experience on game farms in eastern states, also with Mr. J. R. Argabrite, a resident of California, who was a successful raiser of pheasants in Ventura County. This resulted in engaging the services of Mr. Argabrite in September, 1908. He was immediately detailed to examine and report on a number of different locations that had been offered for the estab-

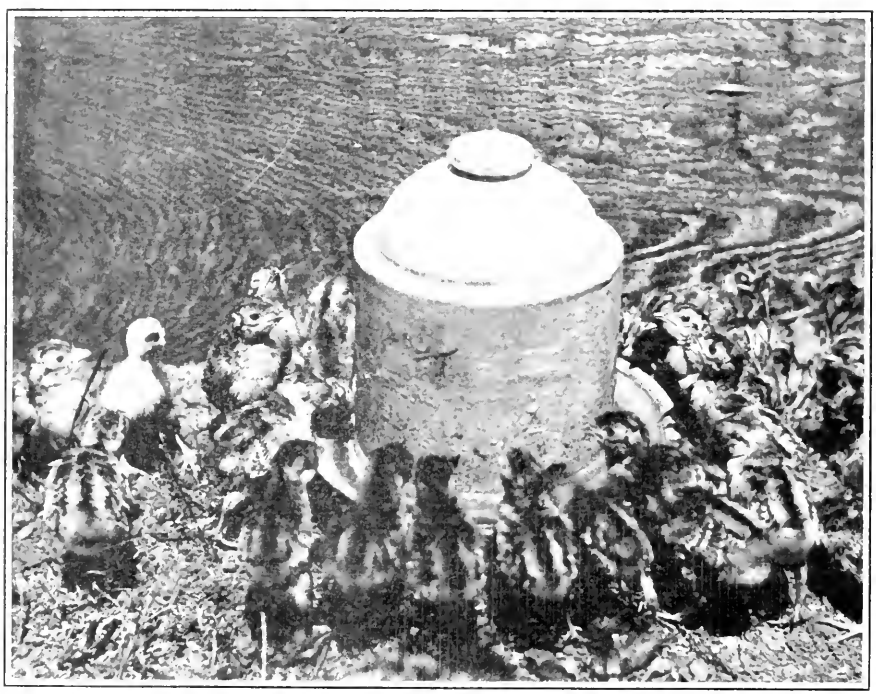

FIG. 32. Pheasant chicks at the State Game Farm. Many pheasants and quail were reared on the farm between 1908 and 1918. Photograph by H. C. Bryant.

lishment of such an institution." (Bienn. Rpt. 1910.) A location was finally selected one mile south of Hayward, Alameda County, and a lease executed in November, 1908. A stock of pheasants was immediately secured together with four dozen Hungarian partridges. During the ten years of its existence the game farm reared and distributed several thousand pheasants, many quail and some wild turkeys. The expense of the farm seemed to be so out of proportion to the results obtained and the location so unfavorable for game propagation that the farm was finally abandoned in the fall of 1918. In the last years of its existence it was used more largely as an experiment station to determine the possibility of breeding different species of game birds and mammals.

When the game farm was first established there were a number of experiments made in the transplanting of native species. In 1908 and 1909, about three thousand quail were trapped and distributed in various sections of the state. About one thousand five hundred of this number were quail trapped in Lower California and liberated near Los Angeles. The incentive for these plants had its source in the mistaken idea that quail were decreasing because of inbreeding.

During the period 1910–1912, due to the concerted effort of Commissioner Newbert, public interest in fish and game conservation was aroused by directing and otherwise aiding in the formation of a representative protective organization, with a membership of over 16,000 sportsmen scattered through every county in the state. Each county sent representatives to Sacramento in order to aid in the formulation of the game laws so that the laws would be as fair to the people of the state as it was possible to make them. The organization, however, was short lived.

In 1912, Charles L. Gilmore was appointed by the Commission to make a stream survey, all of the available data to be recorded on maps together with fish distribution in proper position with reference to the locality of the actual plant. The best available sources of information and of statistical data were consulted and an intensive study made.

Beginning in 1913, the Fish and Game Commission started emphasizing scientific investigation of the many problems relating to fish and game. For these investigations experts from the State University and from Stanford University were secured. Professor Charles H. Gilbert undertook an inquiry into the life history of salmon and trout. Study of the life, abundance and conditions most favorable to the maintenance of our edible crabs was undertaken by Professor Frank W. Weymouth. A study of the clams of California was made by Harold Heath and one on abalones by Chas. L. Edwards. Complaint of the devastation caused by meadowlarks and other nongame birds led to the study of the relation of birds to agriculture by H. C. Bryant. At this time also, Miss Gretchen Libby was secured to conduct an educational campaign regarding wild life and wild life conservation in the schools of the state. Frank C. Clarke undertook an investigation of the deer problem and published a report.

On August 10, 1913, the employees of the Commission were included in the classified list of state employees under civil service. In this year also administrative divisions were established under the charge of branch offices at Sacramento, Los Angeles and Fresno.

Beginning in 1914, emphasis was placed on education and publicity, a separate department being inaugurated. Conservation work in the schools and in the summer resorts was undertaken, as well as the publication of a quarterly, CALIFORNIA FISH AND GAME, with the motto, "Conservation Through Education."

In 1917, in anticipation of an income from a newly established fisheries tax, scientific investigation of problems connected with the rapidly growing fisheries of the state were begun with the ultimate establishment of a State Fisheries Laboratory at San Pedro under the direction of Mr. W. F. Thompson. A patrol boat suitable for use in scientific work was built in 1918. A system of recording the catch of fish in order to furnish statistics of fluctuation and overfishing was also begun.

The game refuge as a means of game conservation came to the fore about 1909 but it was 1915 before extensive areas were set aside. In 1917, sixteen large areas were added making a total when the national parks and monuments are added of about 3,000,000 acres.

Fig. 33. The old Tahoe Hatchery as it appeared in 1906.

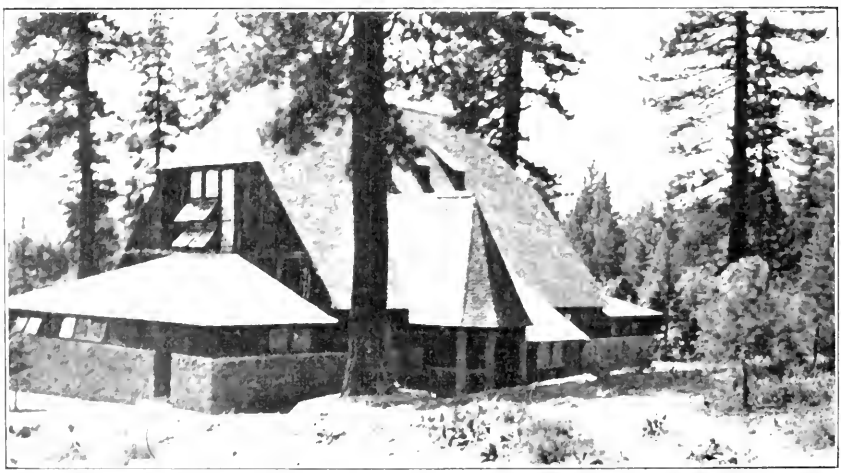

Fig. 34. The new Tahoe Hatchery completed August, 1920. Photograph by M. K. Spaulding.

In 1920, the Commission was operating sixteen fish hatcheries and six egg-collecting stations. The output in trout for the two-year period ending June 30, 1920, amounted to 34,000,000. In addition 29,000,000 Chinook salmon were hatched and distributed. Thus we find at the end of the fifty-year period that continued emphasis is being placed on fish propagation with attendant spectacular results.

PERSONNEL.

A succession of interested and discerning commissioners backed by a long list of faithful employees have combined to make a splendid working organization. The policy pursued by each newly appointed Commission of retaining employees instead of using political power to oust them has allowed certain policies to be continued through a term of years, without change and with correspondingly favorable results. The present head of the Fishculture Department, W. H. Shebley, and his assistant, E. W. Hunt, have served the Commisison continuously for thirty-five and thirty-two years respectively. The list of chief deputies and executive officers is very short considering the political changes during fifty years. The list on page 84 will furnish some idea of the men appointed by various Governors, as Fish and Game Commissioners.

Chief Deputies and Executive Officers.

John P. Babcock	December, 1892–October 15, 1901
Chas. A. Vogelsang	October 15, 1901–August 15, 1910
John P. Babcock	August 15, 1910–November 29, 1911
Ernest Schaeffle	November 29, 1911–September, 1916
Carl Westerfeld	December 8, 1916–April 28, 1920
Chas. A. Vogelsang	April 28, 1920—

CONSTRUCTIVE LEGISLATION AND COURT DECISIONS.

A number of court decisions have formed the ground work for the successful administration of fish and game laws, not only in California but in other states. The more outstanding cases have had to do with pollution, transportation and sale of fish and game. Brief statements regarding the more important ones follow:

It was in 1893 that the Supreme Court handed down a very important decision relative to the sale of venison. In the case of Simon Maier, the law making the possession of venison illegal during the closed season was upheld even though the deer might have been killed without the state.

Hide hunters were most active about 1880 when thousands of deer hides were shipped annually from Sacramento Valley towns, but a final cleanup of offenders did not come until 1893, when arrests were made in San Francisco and an important case won. Thereafter, violations of the deer law were less flagrant.

Several important game cases helped put a stop to illegal sale of game in the markets. A test case of the law fixing a limit on the number of quail, ducks, doves and other game birds that one person may possess during one calendar day was decided in favor of the people, and market men of San Francisco were forced to limit their supply to a single bag limit. Similar cases carried to the Supreme Court were decided favorably. Also the law prohibiting the sale of quail was upheld in the Supreme Court. Inspection of express shipments was begun in an effort to stop illicit shipping of game.

LIST OF FISH AND GAME COMMISSIONERS, 1870–1920.

Commissioner	Term of office	Home	Occupation	Recreation	Attainments in office
Hon. B. B. Redding	1870–1885	San Francisco	Lawyer	Angler	Introduction of fishes; striped bass.
Hon. S. R. Throckmorton	1870–1885	Sausalito	Capitalist	Naturalist	Introduction of fishes.
Hon. J. D. Farwell	1870–1885	San Francisco	Capitalist	Angler and sportsman	Introduction of fishes.
Hon. R. H. Buckingham	1885–1886	Broderick	Market fisherman; hotel man	Commercial fishing	Introduced carp.
Hon. A. B. Dibble	1885–1886	Grass Valley	Lawyer	All round sportsman	Restocking depleted streams.
Hon. T. J. Sherwood	1885–1886	Marysville	Newspaper man	Field sportsman	Developed interest in fish and game.
Hon. Joseph Routier	1886–1891	Routier	Fruit grower	Conservationist and field sportsman	Motto: "More fish"; conservation of game.
Hon. J. Downey Harvey	1886–1891	Los Angeles	Capitalist	All round sportsman	
Hon. Charles Josselyn	1886–1891	San Francisco	Ship chandler	Angler and sportsman	Propagation.
Hon. Joseph D. Redding	1891–Feb. 25, 1895	San Francisco	Lawyer	Angler and sportsman	Propagation.
Hon. Ramon E. Wilson	1891–Sept. 22, 1891	Napa	Lawyer	Angler and sportsman	Propagation.
Hon. Joseph Morizio	1891–Dec., 1892	Oakland	Commercial fisherman	All round sportsman	Commercial fisheries; propagation.
Hon. Hugh L. Macneil	Nov., 1892–Jan., 1895	Los Angeles	Capitalist; fruit grower		
Hon. William C. Murdock	Dec. 22, 1892–Sept., 1896	San Francisco	Capitalist	Sportsman and angler	Authority on fish and game.
Hon. H. F. Emeric	Feb.8, 1895–Sept., 1897	San Francisco	Rancher	Angler	Originated the "Emeric spinner."
Hon. J. M. Morrison	Mar. 12, 1895–Jun, 1899	Sacramento	Restaurant man	Trap shooter	County game warden law; law enforcement; introduction of game.
Hon. Alex. T. Vogelsang	Nov., 1896–April, 1901	San Francisco	Lawyer	Angler	Propagation of salmon and trout.
Hon. C. B. Gould	Sept., 1897–April, 1901	Oakland	Business man	Angler and sportsman	Fish propagation.
Hon. Henry W. Keller	June 20, 1899–April 24, 1903	Santa Monica	Capitalist	Sportsman	Conservation; urged bag limits and non-sale of game.
Hon. W. W. Van Arsdale	April 5, 1901–May, 1907	Ridgewood	Rancher; lumberman	Sportsman	Conservation.
Hon. W. E. Gerber	April 5, 1901–May, 1907	Sacramento	Rancher; banker	Trap shooter; sportsman	Introduction of game.
Hon. John Bermingham, Jr.	Mar. 23, 1905–July, 1908	Pinole	Superintendent powder works	Bass angler	Fish propagation and fish patrol.
Hon. George Stone	May 14, 1907–May, 1910	San Francisco	Capitalist		
Hon. F. W. Van Sicklen	June 25, 1907–Nov. 3, 1910	Alameda	Business man	Ang'er and sportsman	Game propagation and game farm.
Hon. M. J. Connell	July 15, 1908	Los Angeles	Capitalist	Angler and sportsman	Golden trout propagation and distribution.
Hon. Lendal N. Gray	Nov. 3,1910–Dec., 1910 Deceased	San Mateo	Shipping man	Angler and sportsman	
Hon. David Starr Jordan	Nov. 4, 1910–Aug. 4, 1911	Stanford University	College president	Ichthyologist	Conservation.
Hon. F. G. Sanborn	Jan. 21, 1911–Jan. 2, 1912	San Francisco	Business man	Angler	Fish and game propagation.
Hon. F. M. Newbert	Aug. 4, 1911	Sacramento	Merchant	Trap shooter; sportsman	Fish propagation; game protective association; untrammeled fishing rights.
Hon. Carl Westerfeld	Jan. 2, 1912–Dec. 8, 1916	San Francisco	Lawyer	Sportsman	Law enforcement; educational work.
Hon. E. L. Bosqui	Dec. 8, 1916	San Francisco	Printer	Angler	Commercial fisheries.

For several years the desire to curb the use of explosives in the capture of fish led to the offer of a reward of $25 for the arrest of any person killing fish by the use of powder or dynamite. For the two years ending September 1, 1898, nineteen cases where explosives had been used were prosecuted.

Owing to the efforts of the Commission a hunting license law was enacted in 1907, but the angler's license law was not enacted until 1913. The hunting license law met the approval of all those interested in the preservation of game and provided funds for a $20 bounty on mountain lions, after November, 1907.

In 1897, a case of importance which was brought before the courts was that against the Truckee Lumber Company for dumping sawdust in the Truckee River. The company maintained that the state had a right to protect fish only in navigable waters and that in all other waters the right is exclusively in the riparian proprietor. The Supreme Court ruled that the right to take fish extends to all waters and that therefore the title remains in the government. Also that the waters of the state furnish passageway for the fish and that they can not be subjected to private ownership. Further that the owner does not control all of the fish in the stream except as he reduces them to actual possession and that he can not kill or obstruct the free passage of those not taken.

Proper control of the transportation of game was attained by winning two important cases, one of which put the game transfer companies out of business and the other sustained the law prohibiting the use of parcel post in the shipment of game.

"For a number of years prior to 1913, there was an organized effort on the part of certain commission merchants in San Francisco to evade the limit law on ducks and to that end transfer companies were formed, which, while endeavoring to act as such, were, in fact, subterfuges of the several commission houses; for the reason that a transfer company is allowed to have in its possession more than the limit of ducks in one day, for the purpose of transportation only. When the Commission discovered this fact, all the ducks in the possession of the so-called transfer companies were seized. Thereafter, an action was brought in the Superior Court to restrain the Commission from seizing the ducks, so shipped, and for $5,000 damages. Judgment was rendered in favor of the Commission and against the plaintiff, for costs. Since the rendering of this decree, these so-called transfer companies have entirely gone out of business and it has reduced the unlawful distribution of ducks to less than one-half." (Bienn. Rept. 1914.)

The first legislation regarding the nonsale of game was brought before the people of California in 1893, when the market sale of deer was prohibited. In 1901, quail were taken from the market. But a crisis was reached when, in 1913, along with many other bills relating to fish and game, there was introduced into the legislature what has since been known as the "Flint-Cary bill," prohibiting the sale of wild ducks and wild pigeons, in addition to the wild game the sale of which had been previously forbidden.

This bill was passed by both houses and signed by the Governor, but those who had failed to prevent its passage, namely, the Northern California Hotel Men's Association and others, got up a referendum petition, which led to the setting aside of the bill until the general election, November 3, 1914. The law failed of passage in the November election, but a few years afterwards the federal law was passed which prohibits the market sale of any migratory game which accomplished the desired result.

In July 1914, on account of the decision that the Districting Act of 1913 was faulty, it became necessary to revise the act and to change many of the laws on the statutes. This was done at the 1915 session of the legislature.

On September 11, 1917, Frank Phoedovius was arrested in San Mateo County for shipping deer meat by parcel post. He was tried and convicted and sentenced to pay a fine of $25 or be imprisoned in the county jail until said sentence was satisfied, in proportion to one day's imprisonment for every dollar of said fine. The fact that the postal laws prevented inspection of any packages shipped by parcel post had been taken advantage of by the market hunters and fishermen. The decision in this case took from them the last avenue through which the game and fish of the state could be unlawfully exploited.

CONCLUSION.

These features of the work of the Commission have been selected more or less at random and doubtless there are many other accomplishments which deserve recognition. Such have been left out for the sake of brevity.

The above achievements have of course been accompanied with many discouragements and some failures, but the latter are overshadowed by these notable successes.

With such achievements as a background the future should yield a rich harvest of new attainments.

PUBLICATIONS OF THE CALIFORNIA FISH AND GAME COMMISSION, 1870-1920.

Compiled by HAROLD C. BRYANT.

INTRODUCTION.

A test of the efficiency of any organization whose function it is to administer natural resources is to be found in the actual published results of scientific research. Certainly, a Fish and Game Commission is not functioning correctly if legislation and current activities are not based on the carefully ascertained facts secured as a result of scientific inquiry. That the California Fish and Game Commission has not been remiss in this regard is evidenced by the following list of publications. Although compiled largely as an aid to those making use of published articles on the fish and game of this state, the list should bring forcefully to the minds of all readers the outstanding features in the work and accomplishments of the Commission during the fifty years of its existence.

The list is as near complete as it was possible to make it. As the files of the Commission were destroyed in the San Francisco fire of 1906, reference has been made to the files of the State Library and the University of California Library, as well as to files of the Fisheultural Department.

All of the publications listed with but one or two exceptions have been published by the State Department of Printing at Sacramento.

In some instances new series of bulletins have been started under different administrations without due regard to previous series. These have accordingly been designated as new series, to avoid duplication of bulletin numbers, although this designation does not appear on the bulletins themselves.

The serial publications of the Commission have been: (1) biennial reports (a report to the Governor required by law); (2) California fish and game laws (a compilation of the laws relating to fish and game for the use of deputies); (3) abstracts of California fish and game laws (cards giving a summary of the open seasons, bag limits and other regulations); (4) fish bulletins (publications giving the results of scientific investigations); (5) game bulletins (publications giving the results of scientific investigations); (6) teachers' bulletins (a series designed for the use of teachers in the public schools); (7) miscellaneous bulletins (miscellaneous reports on the work and accomplishments of the Commission and publications appearing irregularly); (8) CALIFORNIA FISH AND GAME (a quarterly magazine with the motto "Conservation Through Education"); (9) reprints and separates.

BIENNIAL REPORTS.

Report of the Commissioners of Fisheries of the State of California for the years 1870 and 1871. 1872; 24 pp.

Report of the Commissioners of Fisheries of the State of California for the years 1872 and 1873. 1874; 28 pp.

Report of the Commissioners of Fisheries of the State of California for the years 1874 and 1875. 1875; 36 pp.

Report of the Commissioners of Fisheries of the State of California for the years 1876 and 1877. 1877; 30 pp.

Report of the Commissioners of Fisheries of the State of California for the years 1878 and 1879. 1879; 63 pp.

a. Report upon the food fishes of San Francisco. By W. N. Lockington, pp. 17–58.

Report of the Commissioners of Fisheries of the State of California for the year 1880. 1880; 70 pp.

a. Report on the edible fishes of the Pacific Coast, U. S. A. By W. N. Lockington, pp. 16–66.

Biennial Report of the Commissioners of Fisheries of the State of California for 1881–1882. 1882; 23 pp.

Biennial Report of the Commissioners of Fisheries of the State of California for the years 1883–1884. 1884; 33 pp.

Biennial Report of the Commissioners of Fisheries of the State of California for the years 1885–1886. 1886; 31 pp.

Biennial Report of the State Board of Fish Commissioners of the State of California for the years 1886–1888. 1888; 45 pp.

Biennial Report of the State Board of Fish Commissioners of the State of California for the years 1888–1890. 1890; 67 pp. 4 pls.

a. Food fishes of the California fresh waters. By Carl H. Eigenmann, pp. 53–65.

b. Why salmon are scarce. By H. W. Harkness, pp. 66–67.

Biennial Report of the State Board of Fish Commissioners of the State of California, 1891–1892. 1892; 65 pp., 3 pl.

a. Salmon and trout of the Pacific Coast. By David Starr Jordan, pp. 44–58.

b. Description of a new species of trout (Salmo kamloops). By David Starr Jordan, pp. 60–61, 1 pl.

c. Description of the Golden trout of Kern River. By David Starr Jordan, pp. 62–65, 1 pl.

Thirteenth Biennial Report of the State Board of Fish Commissioners of the State of California, 1893–1894. 1894; 143 pp., 18 pl.

a. Report of observations respecting the oyster resources and oyster fishery of the Pacific Coast of the United States. By Charles H. Townsend, pp. 92–108.

b. Salmon and trout of the Pacific Coast. By David Starr Jordan, pp. 125–141, 7 pls.

c. Descriptions of new varieties of trout. By David Starr Jordan, pp. 142–143, 3 pls.

Fourteenth Biennial Report of the State Board of Fish Commissioners of the State of California, for the years 1895–1896. 1896; 108 pp., 28 pl.

Fifteenth Biennial Report of the State Board of Fish Commissioners of the State of California, for the years 1897–1898. 1900; 75 pp., 3 pls., 3 figs.

a. Report on the planting of quinnat salmon fry in the short coast streams of Marin County, California. By N. B. Scofield, pp. 49–62, 3 pls.

b. Notes on the movements of the young of the steelhead trout in Marin County streams. By N. B. Scofield, pp. 63–65.

c. Notes on an investigation of the movement and rate of growth of the quinnat salmon fry in the Sacramento River. By N. B. Scofield, pp. 66–71.

Sixteenth Biennial Report of the State Board of Fish Commissioners of the State of California, for the years 1899–1900. 1900; 45 pp.

Seventeenth Biennial Report of the State Board of Fish Commissioners of the State of California, for the years 1901–1902. 1902; 76 pp., 3 pls., 7 figs.

a. The equity of the game laws. By a "convert," pp. 58–63.

b. Studies in the natural history of the Sacramento salmon. By Cloudsley Rutter, pp. 64–76, 1 pl.

Eighteenth Biennial Report of the State Board of Fish Commissioners of the State of California, for the years 1903–1904. 1904; 112 pp., 16 figs.

a. Pacific species of salmon and trout. By David Starr Jordan, pp. 75–97.

b. The parent-stream theory of the return of salmon. By David Starr Jordan, pp. 98–102.

c. Artificial propagation of salmon in the Sacramento River. By Cloudsley Rutter, with addenda by Commissioners, pp. 103–107, 1 fig.

Nineteenth Biennial Report of the State Board of Fish Commissioners of the State of California for the years 1904–1906. 1907; 112 pp., 3 colored pls., 29 figs.

a. The trout and salmon of the Pacific Coast. By David Starr Jordan, pp. 77–92, 11 figs.

b. Do quinnat salmon return to the native streams? By Cloudsley Rutter, pp. 93–97.

c. The golden trout of the southern High Sierras. By Barton Warren Evermann, pp. 98–112, 1 pl.

Twentieth Biennial Report and Financial Statement of the State Board of Fish Commissioners for the years 1907–1908. (Not printed for distribution but appearing in the Appendix of the Twenty-first Biennial Report, pp. 75–79.)

*Twenty-first Biennial Report of the Board of Fish Commissioners of the State of California, for the years 1909–1910. 1910; 127 pp., 8 colored pls., 16 figs.

a. Notes on the striped bass in California. By N. B. Scofield, pp. 104–109, 1 pl.

b. Notes on spawning and hatching of striped bass eggs at Bouldin Island Hatchery. By N. B. Scofield and G. A. Coleman, pp. 109–117, 3 figs.

c. Pheasant raising. By Chas. A. Vogelsang, pp. 118–124, 1 pl., 1 fig.

d. Diseases of pheasants. By George B. Morse, M.D., V.S., pp. 124–127.

*Twenty-second Biennial Report of the Fish and Game Commission of the State of California, for the years 1910–1912. 1913; 80 pp., 5 figs.

*Twenty-third Biennial Report of the Fish and Game Commission of the State of California, for the years 1912–1914. 1914; 166 pp., 34 figs.

a. Arid California and its animal life. By Frank Stevens, pp. 127–135, 2 figs.

b. The California fish industry from a commercial point of view. By F. E. Booth, pp. 136–140, 1 fig.

c. The National Forests in California. By W. C. Hodge, pp. 141–150, 3 figs.

d. The American army of hunters. By Ernest Schaeffle, pp. 151–152.

NOTE.—Beginning with the Twenty-fourth, the Biennial Report consists of the report only, such papers as had been included heretofore being henceforth published as bulletins or in the quarterly CALIFORNIA FISH AND GAME.

*Twenty-fourth Biennial Report of the Fish and Game Commission of the State of California, for the years 1914–1916; 248 pp., 88 figs., 1 colored pl.

*Twenty-fifth Biennial Report of the Fish and Game Commission of the State of California, for the years 1916–1918; 98 pp., 11 figs.

*Twenty-sixth Biennial Report of the Fish and Game Commission of the State of California, for the years 1918–1920. 1921; 149 pp., 28 figs.

CALIFORNIA FISH AND GAME LAWS.

1885 The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners; 1st ed., 77 pp.

1886 (No record available of 2d edition.)

1887 The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners; 3d ed., 80 pp.

1889 The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners; 4th ed., 86 pp.

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1893 The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners, compiled by F. P. Deering, attorney for the Board; 6th ed., 142 pp.

1895 The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners, compiled by Arthur G. Fletcher, clerk of the Board; 7th ed., 55 pp.

1897 The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners, compiled by Arthur G. Fletcher, clerk of the Board; 8th ed., 55 pp.

1899 The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners; 9th ed., 32 pp.

1901 The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners; 10th ed., 48 pp.

1903 The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners, compiled by Chas. A. Vogelsang; 11th ed., 48 pp.

1905 The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners, compiled by Chas. A. Vogelsang; 12th ed., 52 pp.

1907 The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners, compiled by Chas. A. Vogelsang; 13th ed., 64 pp.

1909 The Fish and Game laws of the State of California; published by authority of the State Board of Fish and Game Commissioners, compiled by Chas. A. Vogelsang; 14th ed., 80 pp.

1911–12 State of California Fish and Game Laws; compiled and published by order of the State Board of Fish and Game Commissioners; 15th ed., 118 pp.

1913–14 State of California Fish and Game Laws; compiled and published by order of the State Board of Fish and Game Commissioners, arranged by Ernest Schaeffle, Assistant Commissioner; 16th ed., 123 pp.

1914–15 State of California Fish and Game Laws; published by the Board of Fish and Game Commissioners, arranged by Ernest Schaeffle, Assistant Commissioner; 17th ed., 130 pp.

1915–17 State of California Fish and Game Laws; published by the Board of Fish and Game Commissioners, arranged by John P. Fisher, game expert; 18th ed., 144 pp.

1915–17 State of California Fish and Game Laws; published by the Board of Fish and Game Commissioners, arranged by John P. Fisher, in charge license department; 19th ed., 144 pp.

1917–19 State of California Laws relating to Fish and Game; published by the Board of Fish and Game Commissioners, arranged by J. S. Hunter, assistant executive officer; 20th ed., 180 pp.

1919–21 *State of California Laws relating to Fish and Game; published by the Board of Fish and Game Commissioners, arranged by J. S. Hunter, assistant executive officer; 21st ed., 201 pp.

ABSTRACT OF FISH AND GAME LAWS.

Abstract of California Fish and Game Laws; first published in 1903 (?); biennially to 1920. (Two sizes, one for mailing, the other as a poster.)

Abstract of Laws pertaining to Commercial Fisheries.
1915–1917.
1917–1919.
1919–1921.

FISH BULLETINS.

1. Report on fish conditions; 1913; 48 pp., 3 figs. Contains:
   a. The abalone industry in California. By Charles Lincoln Edwards.
   b. The towing of salmon and steelhead fry from Sacramento to the sea in a "live car." By N. B. Scofield.
   c. The problem of the spiny lobster. By Bennet M. Allen.
   d. Investigation of the clams of California. By Harold Heath.

*Publications still available for distribution are marked with an asterisk.

e. Investigation of the life history of the edible crab (*Cancer magister*). By F. W. Weymouth.
f. A general report on a quinnat salmon investigation carried on during the spring and summer of 1911. By N. B. Scofield.
g. Trout and black bass planting and transplanting in the San Joaquin and Southern Sierra districts. By. A. D. Ferguson.

2. *The scientific investigation of marine fisheries as related to the work of the Fish and Game Commission in Southern California. By Will F. Thompson. 1919; 27 pp., 4 figs.
3. *The spawning of the grunion (*Leuresthes tenuis*). By Will F. Thompson, assisted by Julia Bell Thompson. July 15, 1919; 29 pp., 9 figs.
4. *The edible clams, mussels and scallops of California. By Frank W. Weymouth. January 10, 1921; 74 pp., 19 pls., 26 figs. (In press.)
5. *A key to the families of marine fishes of the west coast. By Edwin C. Starks. March 3, 1921; 16 pp., 4 figs. (In press.)

GAME BULLETINS.

1. *Report on game conditions; 1913; 67 pp., 8 figs. Contains:
   a. Investigation of the large game situation in California with special reference to deer. By Frank C. Clarke.
   b. Present and future status of the California valley quail. By Harold C. Bryant.
   c. Introduction of foreign game birds into the southern San Joaquin and tributary sections. By A. D. Ferguson.
   d. Educating the young people as to the need and value of wild life conservation. By Gretchen L. Libby.
   e. Investigation of the economic status of nongame birds. By H. C. Bryant.

TEACHERS' BULLETINS.

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2. *Birds as rodent destroyers. [By Gretchen L. Libby.] 1912; 4 pp.
3. *Owls. [By Gretchen L. Libby.] 1912; 4 pp.
4. Game conservation and its importance. [By Gretchen L. Libby.] 1913; 4 pp.
5. *Game conservation and its importance. [By Gretchen L. Libby] (continued from No. 4). 1913; 4 pp.
6. *Bats as desirable citizens. By Joseph Grinnell. 1916; 4 pp.
7. *The European house sparrow and its control in California. By Harold C. Bryant. 1916; 8 pp., 6 figs.

GENERAL.

MISCELLANEOUS BULLETINS.

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No. 1. Short report on classification of certain fish found in the Eel River, as steelhead trout, in salt water during month of September. By David Starr Jordan. October 12, 1891.
No. 2. Short report on classification of certain fish found in Webber Lake as *Salmo mykiss henshawi* (cut-throat). By David Starr Jordan. October 12, 1891.
No. 3. Short report on classification of certain fish found in Klamath River as steelhead trout, *Salmo gairdneri*. By David Starr Jordan. October 24, 1891.
No. 4. Salmon and trout of the Pacific Coast. By David Starr Jordan. February 15, 1892; 19 pp.
No. 5. Enforcement of game ordinance of city and county of San Francisco. March 15, 1892.
No. 6. Classification of the trout caught in Mount Whitney Creek. July 12, 1892.

SERIES B.

No. 1. Pheasant raising. By Chas. A. Vogelsang. 1910; 12 pp., 1 fig. Contains also: Diseases of pheasants. By Geo. B. Morse; pp. 9–12.

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SERIES C.

No. 1. Statement by Commissioners. 1911; 23 pp. (Relative to activities of the Commission.)
a. Excerpt from report on crab investigation. By F. W. Weymouth.
b. Bird investigation. Letter written by H. C. Bryant to the editor of the San Bernardino "Sun."
No. 2. Bird study in the schools. By Gretchen L. Libby. 1912; 19 pp., 1 fig.

SERIES D.

No. 100. *Deer in relation to young orchards. By A. D. Ferguson: Farmers' Bulletin. January, 1914; 4 pp.

EXTRA SERIES (not numbered).

How to liberate game birds; date (?); 1 p.
Receipts, disbursements and transactions for period from July 1, 1910 to June 30, 1912. December 23, 1912; 4 pp. (printed on one side only).
Statement from the Fish and Game Commission. 1912; 1 p.
*Your Fish and Game—Swat the market hunter and give the boy a chance. 1913 (?); 14 pp. illus.
Statement from the Fish and Game Commission. 1913 (?); 4 pp., 1 map inclosed. (In reference to nonsale of game.)
*Conservation through education. 1915 (?); 14 pp., illustrations in color.

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A publication devoted to the conservation of wild life and published quarterly by the California Fish and Game Commission.

VOL. I. 1914–1915.
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No. 2. January 30.
No. 3. April 10.
No. 4. July 15.
No. 5. October 15.

VOL. II. 1916.
No. 1. January 15.
No. 2. April 15. (Shad number.)
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VOL. IV. 1918.
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VOL. VI. 1920.
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No. 4. October 28.

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VOL. I.

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No. 2. *The wood duck in California. By Joseph Grinnell and H. C. Bryant. January 30, 1915; 1 pp.
No. 3. *The Tennessee possum has arrived in California. By Joseph Grinnell. April 10, 1915; 3 pp., 1 fig.
No. 3. *An attempt to save California elk. By B. W. Evermann. April 10, 1915; 11 pp., 8 figs.
No. 3. *California's fur-bearing mammals. By Harold C. Bryant. April 10, 1915; 12 pp., 2 figs.
No. 4. *Books and pamphlets relating to California birds. By H. C. Bryant. July 15, 1915; 3 pp.
No. 1. *Two kinds of conservationists. By W. P. Taylor. July 15, 1915; 3 pp.
No. 5. *Some hints on making photographs for illustrations. By Tracy I. Storer. October 15, 1915; 4 pp.

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No. 1. *History of the introduction of food and game fishes into the waters of California. By W. H. Shebley. January 20, 1917; 10 pp., 2 figs.

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No. 4. *Temperature and the albacore. By W. F. Thompson. October 27, 1917; 7 pp.

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No. 2. *The herrings and herring-like fishes of California. By Edwin C. Starks. April 15, 1918; 8 pp., 9 figs.

No. 3. *The mackerel and mackerel-like fishes of California. By E. C. Starks. July 15, 1918; 13 pp., 12 figs.

No. 3. *The mussels of the Pacific Coast. By Edward P. Rankin. July 15, 1918; 5 pp., 4 figs.

No. 3. *Discretionary powers and game conservation. By Harold C. Bryant. July 15, 1918; 5 pp.

No. 4. *The flat fishes of California. By Edwin C. Starks. October 25, 1918; 19 pp., 22 figs.

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No. 1. *The fishes of the croaker family (*Sciaenidæ*) of California. By E. C. Starks. February 3, 1919; 8 pp., 8 figs.

No. 2. *The basses and bass-like fishes of California (families *Serranidæ*, *Hæmulidæ* and *Kyphosidæ*). By E. C. Starks. April 21, 1919; 10 pp., 9 figs.

No. 2. *The conservation of our fisheries. By W. F. Thompson. April 21, 1919; 11 pp., 4 figs.

No. 3. *California trout. By Barton Warren Evermann and Harold C. Bryant. July 15, 1919; 30 pp., 12 figs.

No. 4. *Some notes on dry-fly fishing, No. 1. By R. L. M., California. October 21, 1919; 2 pp.

VOL. VI.

No. 1. *Notes on dry-fly fishing, No. 2. By R. L. M., California. January 15, 1920; 5 pp.

No. 1. *California's game sanctuaries. January 15, 1920; 1 p.

No. 1. *The young of the black sea-bass. By Elmer Higgins. January 15, 1920; 2 pp., 2 figs.

No. 1. *The Pacific edible crab and its near relatives. By Frank Walter Weymouth. January 15, 1920; 3 pp., 4 figs.

No. 1. The proposed investigation of the sardine. By Will F. Thompson. January 15, 1920; 2 pp.

No. 2. *The abalones of northern California. By Will F. Thompson. April 19, 1920; 5 pp., 3 figs.

No. 2. *Some notes on dry-fly fishing, No. 3. By R. L. M. April 19, 1920; 10 pp., 4 figs.

No. 3. *Notes on dry-fly fishing, No. 3. By R. L. M. July 26, 1920; 10 pp., 4 figs.

No. 4. *Notes on dry-fly fishing, No. 5. By R. L. M. October 28, 1920; 8 pp., 3 figs.

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REPRINTS—BIENNIAL REPORTS.

*Report of Superintendent of Game Farm. By W. N. Dirks; 12 pp., 2 figs. (From Biennial Report of 1911.)

Arid California and its animal life. By Frank Stephens; 9 pp., 2 figs. (From Biennial Report of 1911.)

The California fish industry from a commercial point of view. By F. E. Booth; 5 pp. (From Biennial Report of 1911.)

The national forests in California. By W. C. Hodge; 8 pp., 1 figs. (From Biennial Report of 1911.)

REPRINTS—GAME BULLETINS.

*Investigation of the economic status of nongame birds. By H. C. Bryant. 1912; 19 pp., 8 figs. (Reprint from Game Bull. No. 1.)

SEPARATES—CALIFORNIA FISH AND GAME LAWS.

*Act authorizing and regulating rearing and selling of domesticated fish. (Enacted 1911.) (Separate California Game Laws 1911 13, pp. 75-80.)

*Bowman Law (game farming). (Enacted 1913.) (Separate from California game laws 1913 1915, pp. 67-73.)

FINDING LIST OF SUBJECTS.

Abbreviations used:

B—Biennial Report.
F B—Fish Bulletin.
G B—Game Bulletin.
T B—Teachers' Bulletin.
M B—Miscellaneous Bulletin (A, B, C, D, E series).
R—Reprint, California Fish and Game.
R B—Reprint, Biennial Report.
R G B—Reprint, Game Bulletin.
L—Laws.
M—Maps.
C F and G—California Fish and Game.
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NOTE—The last number of each year (October number) of CALIFORNIA FISH AND GAME contains a subject index of all material appearing in that magazine.

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MAPS.

Outline map of California. By Chas. L. Gilmore. 1914.

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Abbreviations used:

B—Biennial Report (up to 1891 designated by year; thereafter by number).
F B—Fish Bulletin.
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R—Reprint, California Fish and Game.
R B—Reprint, Biennial Reports.
R G B—Reprint, Game Bulletin.
L—Laws.
C F and G—California Fish and Game.

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Higgins, Elmer ..... R VI 1
Hodge, W. C. ..... B 1912–14; R B 1912–14
Hunter, J. S. ..... L 1917–19; L 1919–21

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Vogelsang, Charles A. ..... B 1909–10; M B (B) 1; L 1903; L 1905; L 1907; L 1909

W

Weymouth, Frank Walter ..... F B 1; R VI 1; M B (C) 1

THE CONTROL OF THE MOUNTAIN LION IN CALIFORNIA.

By J. S. Hunter.

The one predatory animal for which practically no good can be said is the mountain lion. This animal without doubt kills more deer in California than are killed by all of the hunters. They also destroy a great many domestic animals. The actual meat value of the game and domestic animals destroyed by lions is impossible to estimate but it is safe to say that it runs into thousands of dollars.

During the many years that the Fish and Game Commission has been paying a bounty for every lion killed, hundreds have been taken, and up to January 1, 1920, $65,550 had been paid out in bounties.

In August, 1917, the amount paid for the killing of a female lion was increased from $20 to $30. Between that date and January, 1920, females to the number of 218 were sent in. Many requests have been made to the Commission that the bounty be still further increased. It is doubtful whether there would be any increase in the number killed even though the bounty were doubled. Most lions are killed either for the sport or on account of their destroying stock. The bounty is not the chief factor, but only an incident. In general as soon as a lion is reported there is a small army of hunters scouring the country, all anxious to boast of having killed a lion.

Contrary to the general opinion lions are not abundant in any part of the state. From the accompanying table it will be noted that Humboldt County leads with a total of 564 killed during twelve years time. The animal has been so reduced in that county that the kill has dropped from 113 in 1908 to 8 in 1919. In Shasta County, the next on the list, the kill has been less than one-half, 261 killed during the same period. Here, however, the animals have apparently not been reduced to the same extent as the kill in 1919 was approximately the same as in 1908.

In Trinity County 260 have been killed; last year only 14 as against 18 in 1908. In Siskiyou County none were killed last year; but in 1908 the number totaled 31 and in the twelve-year period 241. From this it would seem that lions in Siskiyou County are greatly reduced if not practically exterminated. Only one other county, Mendocino, reports more than 200 the first twelve years. In that county 219 have been killed; the number (22) taken in 1919 is just one-half those killed in 1908. Tehama County killed three during 1919, as against 31 in 1908, making a total of 159 in twelve years.

It is evident from the above figures that California lions are being slowly reduced in number and that the animals killed approximately if not entirely exceed the natural increase. If this is true we can form a very good idea as to the number of lions in the state. Forty-two per cent of the lions sent in for bounty are females. The female lion does not bring forth a litter every year but only every other year. Sometimes three kittens are born but the usual number is two. This would make the kill of 243 in 1919 the offspring of 243 females or 42 per cent of the total number of lions in the state. This calculation would give a lion population in California of about 575, which we believe is somewhere near the actual number.

This number of lions can do an enormous amount of damage to the deer. The minimum estimate of the number of deer killed by a single lion each year has been placed at fifty-two. Five hundred seventy-five lions will kill at least 30,000 deer during the year if deer are available and deer are common in every part of the state where lions are found.

The California Fish and Game Commission has determined to make every effort to still further reduce the number of lions. Knowing the increase of hunters and the ease with which hunters can reach what were formerly the most inaccessible places it will be necessary to stop

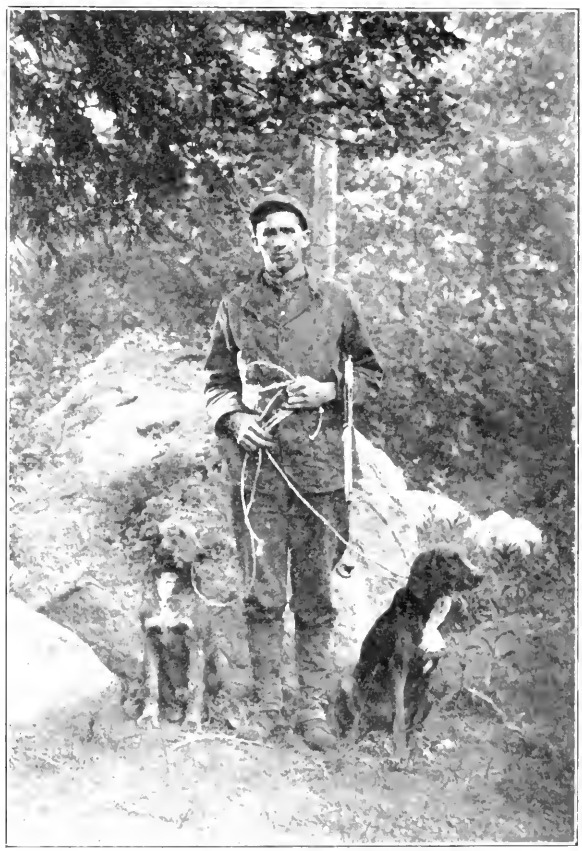

FIG. 35. Jay Bruce, state lion hunter, and his dogs. The Fish and Game Commission hires Mr. Bruce to cut down the number of mountain lions in the state game refuges.

the heavy natural drain on the deer supply caused by this animal. On this account an expert lion hunter has been employed. This man, Jay C. Bruce, is one of the best lion hunters in the country. In fact, the attention of the Commission was called to Mr. Bruce because of the many lions which he sent in for bounty from Mariposa County.

Mr. Bruce was born in Mariposa County and spent a great deal of his time in the mountains becoming thoroughly familiar with the habits of the animals of the forest. On account of an injury to his left hand

while working in a lumber mill he was forced to secure other employment and turned to that line of work for which his life long training had fitted him. On account of the bounty paid for the killing of lions he devoted considerable time to trailing them with dogs and was very successful.

His success as a lion hunter is due to the fact that he has made a study of the habits of the California lion and knows their habits thoroughly; also to the fact that he is an expert dog trainer and has his dogs trained so that they will follow only the tracks of either a bobcat or a lion and of no other animal. On account of this he can work without difficulty where deer are abundant. These dogs will never take the trail of a deer.

Since Mr. Bruce has been employed by the Commission he has worked chiefly in the game refuges and has made an excellent record. His greatest kill during any one month has been eight lions. Because of the success of the attempt to control the mountain lion it is the intention of the Commission to keep Mr. Bruce employed and later, perhaps, to employ other lion hunters.

Mountain Lion Bounties, 1907 to 1919—By Counties.

County	1907 to 1917	1918	1919	County	1907 to 1917	1918	1919
Humboldt	564	22	8	Santa Clara	19	3	2
Shasta	261	26	30	Colusa	17	3	---
Trinity	269	12	14	Calaveras	13	---	2
Siskiyou	241	1	---	Amador	9	---	---
Mendocino	219	18	22	Orange	9	2	1
Tehama	159	6	3	Plumas	9	---	---
Kern	134	10	15	Stan'slaus	9	1	1
Lake	106	11	9	Inyo	7	---	1
Monterey	105	12	19	Lassen	7	---	1
Santa Barbara	99	6	19	Mono	7	---	---
Del Norte	97	2	5	Nevada	7	2	---
Tulare	95	11	17	Sierra	6	---	---
Mariposa	77	12	5	Modoc	4	1	---
San Luis Obispo	76	3	6	Yuba	4	---	1
Tuolumne	75	9	12	Napa	3	---	---
Los Angeles	49	8	9	San Joaquin	2	---	---
El Dorado	48	1	8	Santa Cruz	2	---	1
Glenn	43	3	3	Sutter	2	---	1
San Diego	41	4	5	Alameda	1	---	---
Ventura	40	2	2	Alpine	1	---	---
Madera	39	5	1	Imperial	1	---	---
Placer	37	2	3	Merced	1	---	---
Butte	33	---	2	Sacramento	1	---	1
San Benito	33	2	1	San Mateo	1	---	---
Riverside	29	4	5	Kings	1	---	---
San Bernardino	23	5	3				
Fresno	22	3	4	Totals	3,170	243	214
Sonoma	22	2	1	Grand total			3,627

HUNTING THE WILD BOAR IN CENTRAL FRANCE.

By W. L. Scofield.

We were at the dinner table when a Frenchman rushed in waving his arms and talking at the top of his voice a stream like a high pressure fire hose. Lunch was finished in an uproar. Finally I found there had been no murder but that a wild boar had been seen at the edge of town. Flambo, the reliable old hunting hound, was out calling on his friends so the gray haired patrone of the hotel stepped to the door and wound several blasts on a cow-horn. Flambo arrived on the lope and I supposed we were ready to start, but not so. We talked about it for another hour and had other glasses of wine all round. By this time other cow-horns were tooting and other mighty hunters arrived at the hotel with shotguns and game bags large enough to carry the tail of a good sized boar.

Finally eight of us were ready to start with seven shotguns, four game bags, one hound and five cow-horns. So we had another glass of wine, talked some more and started for the communal forest about a mile from town. We followed a trail through thick growth along a stream where boars might besport themselves on sunny afternoons, the dog on a string that choked him till his tongue hung out, high tension jabber from all the men and every few minutes some imbecile would let out a blast on his horn for the purpose of adding to the general hilarity and scaring all the game for miles around. Wooden shoes clattered and animated conversation continued till the dog took the trail and then the racket increased instead of subsiding.

We trailed the boar to a thicket and separated to surround him. Guns were unlimbered, conversation increased if possible, the dog was loosed so he could breathe again and chase the boar out of the thicket but we found the boar was not in the thicket. Instead of sitting down and waiting to be surrounded when he heard the uproar the fool boar had wandered off somewhere else so after a half hour's conversation about it we trailed him to the next thicket and repeated the same performance.

This continued all afternoon and furnished ammunition for the most exciting conversation but no boar. I came to realize that conversation was the chief object of the occasion. If we quietly surrounded the boar someone might kill him and then there would be no boar to hunt and talk about another day. My trouble was that I had gone out on a talking expedition without sufficient knowledge of the language so I took a walk alone to look over the country. Toward evening I had no difficulty in finding the hunters for I could hear the din for a couple of miles. We returned to the hotel having been without wine for more than three hours. Half the village gathered in the hotel kitchen to talk about the hunt. At odd times we had some supper and I retired at eleven o'clock with the talk still running at fever heat.

THE ABUNDANCE OF YOUNG PISMO CLAMS.*

By Frank W. Weymouth, Stanford University.

While collecting data for the study of the life history of the Pismo clam some interesting facts regarding the abundance and fluctuations in number of the young have come to light.

During the spring and summer of 1919 the young of the preceding summer (1918) were difficult to obtain. In the fall of 1919 the young of that summer were first observed and have been noted in almost incredible numbers up to the present time. During the present fall (1920) a special search for the young of the current year has been made but only a few specimens have been obtained, indicating an even poorer spawning year than that of 1918.

Before comparing in more detail the relative success of the three spawning seasons it may be well to give some idea of the habits of the young and the methods used in estimating their numbers. The young of the Pismo clam is found for the first three years chiefly between tides where it is easly studied. At low tide on the long Pismo-Oceano beach the firm wet sand which proves so good a road for automobiles is the zone of their greatest abundance and many can be turned up by digging down an inch or so with the fingers. A more striking idea of their numbers may sometimes be gained after an unusually low tide when this area has been left dry for some time. A tiny hole then often appears above the siphon or "neck" of each clam and at times due, apparently, to their movements a little mound is raised above each animal. A view of the beach at such a time is shown in Figure 36 and gives a vivid idea of the abundance of the young clams.

An actual count of the numbers of young clams has been made at intervals in the following way: A shallow trench the width of a clam fork (9½ inches) was dug across the entire wet beach and into the water at low tide (see Fig 37). All the clams found were sorted into age groups, as is easily done by differences of size in the young, and the number of each age counted. They were found chiefly in a narrow zone some 20 to 30 yards wide corresponding to the roughened areas shown in the photograph; above and below this scattering clams were found, but more than nine-tenths of the young were concentrated here. The actual counts made over a period of about a year and a half range from 1294 to 774.

The young spawned in 1919 are, in all collections since their appearance, the most numerous, forming never less than 98 per cent of the total. Those of the previous year (1918) form from 0.88 per cent to 1.32 per cent, while in the two last counts in which the young of the current year (1920) are represented they form only one-fourth of one per cent. Other years, when the young were as abundant as in 1919, are reported by the diggers but seem to come several seasons apart.

The total numbers of young occurring in the entire beach as the result of a successful season such as 1919 is amazing. The productive area of the Pismo-Oceano beach is some eight miles in length; of this the northern third is by far the most thickly populated. The count was not made at the northern end, but near the middle of the beach

*California State Fisheries Laboratory, contribution No. 23.

where the conditions more nearly represent a fair average. A conservative estimate of the total number might be gained by considering six miles of beach with the numbers found in the region examined. Taking an average of the more recent counts when 800 young of 1919 were present in a cross section of the beach 9½ inches wide, a mile would contain 5,150,000 and six miles 30,900,000 clams. Other earlier counts would bring the total to 45,000,000. To this must be added the beach at Morro which, though not examined for this purpose, probably would double the present estimate.

FIG. 36. View taken on Pismo beach at low tide. Note pits and raised areas mentioned in the text; every pit or mound indicates a clam and there are other clams that show neither. Photograph by F. W. Weymouth.

Several important lessons should be drawn from this. When conditions are favorable the young of the Pismo clam are produced and given a foothold in such enormous numbers that the supply of adults should be secure if the young have a fair show. But the "if" should not be forgotten. Large numbers die from natural causes over which we have no control. But there are losses which could be prevented. In order to protect the Pismo clam, laws setting a size limit of $4\frac{3}{4}$ inches and a bag limit of 36 have been enacted. Many tourists and summer visitors, however, thoughtlessly dig these young that are so easily found

between tides and because they are so small take hundreds to furnish a single meal. The digging of an equal number of those of legal size would violate the bag limit but in realty would do less harm, as most of those which have reached a length of $4\frac{3}{4}$ inches have spawned, thus leaving behind them clams to fill their places. It is unfortunately true that other people including residents with undoubted knowledge of the law also take these young in large numbers. Unless these violations of a wise and necessary law are stopped by the cooperation of all interested people, their disastrous effects must soon be felt. All local residents that value the Pismo clam as a peculiar and distinctive local product should take every means possible to protect the young and to inform tourists and visitors of the need for its protection. With proper protection there is no reason why the Pismo clam should not remain a local

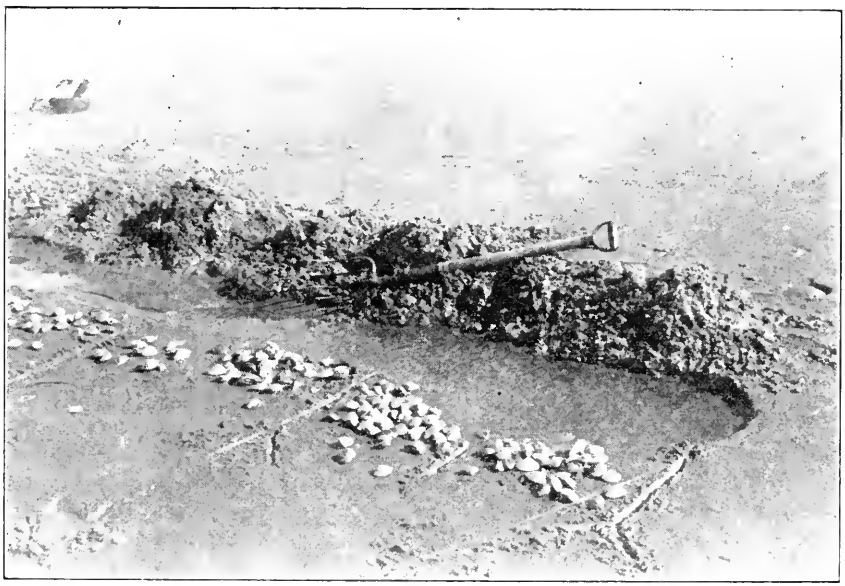

FIG. 37. Portion of trench made in counting young Pismo clams. All the clams shown came from a strip the width of the clam fork shown in the photograph ($9\frac{1}{2}$ inches). Photograph by F. W. Weymouth.

asset—with continued destruction of young before they have spawned as well as the taking of the adults of legal size, it will only be a question of time when this fine clam will be practically exterminated.

Another phase of the scientific work of the Fish and Game Commission is apparent here. The effect of an unusually good spawning year upon a fishery such as the sardine was discussed in the January issue.* Because of the ease with which the young of this clam may be studied we have here an even more striking example of such a successful spawning year in the season of 1919 which exceeds that of 1918 by seventy-five to one hundred times and that of 1920 by about four hundred times. According to reports the last season producing comparable numbers was four or five years ago. Evidently, for a number of years the clams

*See "The Future of the Sardine," by Will F. Thompson, CALIFORNIA FISH AND GAME, Vol. 7, pages 38–41.

spawned in 1919 will form the dominant class and when they reach legal size there will be an unusually good yield of clams. With a complete knowledge of the age reached and the rate of growth of the Pismo clam it would be possible to predict the future yield quite accurately from a yearly examination of the young such as here described.

Present indications are that the effect of this spawning year will be felt in 1925 and 1926, provided that proper protection is afforded the young in the meantime.

QUARTER-OILS OR HALF-POUND OVALS.*

By WILL F. THOMPSON.

(California State Fisheries Laboratory, contribution No. 24.)

One of the great problems which presents itself to the student of fisheries, that of the effect of occasional successful spawning years, was considered in relation to the sardine, in the last issue of CALIFORNIA FISH AND GAME. It was shown that the presence or absence of such great changes can be ascertained, and that such knowledge is most necessary to the proper understanding and prosperity of our greatest fishery. Moreover, the fascinating possibility that such a great change might be prophesied was held forth. In this article another problem, equally great and equally interesting is dealt with, and its close relationship to the great problems of biology is remarked upon.

Our sardine fishery, important as it is, has for the most part arisen within the last few years. At first an adjunct to that very recent one for the albacore, it has now reversed this relationship, and whereas once in Southern California the sardine was canned between albacore seasons, now the albacore and tuna are canned between sardine seasons. Such a limited experience has not until the present brought into question some of the fundamental facts upon which canning operations must rest. One of these is the subject of this paper; namely, the size of sardine which a cannery at Monterey, or a cannery at San Diego may expect to pack in the future. Will it can "quarter-oils," or "half-pound ovals"—the small fish or the large?

Experience thus far seems to indicate that the small fish will predominate to the south, the large fish to the north, that San Diego will be best for "quarter-oils" and Monterey for the larger sizes. This is an important fact—if fact it is—and if brief experience indicates the truth. Such a condition is highly probable, as any fisheries expert should know, for there are several fisheries in which such a distribution of sizes holds permanently. The cousin of the sardine—the Atlantic herring—has just such a distribution in the North Sea and along the Norwegian coast, and the Pacific herring may have the same along our own shores. The albacore of California has a similar difference in size between its southern and northern representatives. Yet we have had such a brief experience with the sardine of our waters that the seeming difference may be due merely to the passing at different times of dominating age classes such as we dealt with in the last article. Not until we know the real cause, or positive facts which will limit our

*"Quarter-oils" are the sardines packed in small square cans in oil. "Half-pound" ovals are the larger size of fish packed in oval cans containing a half pound each.

conjectures, may we be reasonably sure of the truth. So little attention has been given to the basic laws of fishery science that what we have to say about the question is necessarily speculative—but will, we hope, demonstrate the possibilities and the fascination of its solution.

Inevitably the theory most popular and most readily advanced to explain the differences in sizes is that of *migration*. According to this the sardines move towards the north as they grow older, and then the eggs are carried to the south by currents, so that there is a manner of eddy in existence. Perhaps some people would unhesitatingly assert that sardines hatch from the egg near San Diego and reach the State of Washington before they die. The more moderate minded would possibly confine themselves to a migration of the distance between San Diego and San Pedro. But it is worthy of note that either is a pure assumption, which must bear critical examination no matter what the degree of limitation imposed upon the theory.

It presupposes, indeed, that the sardine population is a homogeneous one, necessarily of the same race or breed from north to south. The proof of the existence of peculiarities in the fish from San Diego which are not present in the fish from San Pedro or Monterey, even though these peculiarities are not racial nor inheritable, would decidedly limit the theory of migration, if it did not eliminate it. The existence of such local "races" of herrings has been conclusively shown, to the great damage of the theory in the case, but it persists in modified form—that the herring of each local race migrate in the same way as all were supposed to do. And so it will doubtless be in the case of the sardine, the proof of the existence of local races will simply confine within smaller limits the ever-present theory. Nevertheless, it is of the greatest importance to distinguish local races of the sardine if possible.

But aside from this attempt to confine within logical bounds a theory tending to be adopted in a most unscientific way, there should also be examined certain fundamental facts which may bear on the question. Thus he supposed migration must vary enormously from year to year to account for the great schools which appear off Alaska, if indeed it could be shown that such schools could be drawn from the south without producing there a great temporary lack easily noticeable. And, again, it is an open question whether there is anything approaching the requisite permanent lack of adults in the south or the lack of young in the north. It may be totally unnecessary to postulate a migration, as a matter of fact, for sufficient adults or young may be present everywhere throughout the range of the species. Moreover, when one considers the vast numbers of eggs laid by fishes, like to the seeds of trees, and the few which must come to maturity from all that horde, it would seem perfectly obvious that even a slight difference in the surrounding conditions would cause great changes in the numbers which reach the various sizes, or stages of growth. And in this last possibility, we come to the second—perhaps more logical theory—that differences in proportion of adults and young may be due to the *differences in living conditions*.

For living conditions must play among fish much the same part that they do among the human kind. Scientists have shown that in barbaric races of man the prevalence of disease, hunger, and war tend to reduce

the chances of survival and render the older inhabitants relatively fewer than in quieter communities. So we might expect among fishes, that if other animals preyed on the earlier ages, the proportion of adults would be much reduced. And it is perhaps a significant fact that the sardines farthest south live in waters which are populated with many active and predacious enemies, particularly of the mackerel type, such as the tuna and the albacore. The contrast between north and south is, indeed, obvious to anyone who has fished in both waters. What more natural, then, than the failure of the young fish in southern waters to survive in numbers to adulthood, despite those favorable conditions for hatching the eggs which these waters may afford?

And it is equally logical that in the far north the chances of survival after once hatching are much better. A great percentage may grow to maturity and increase very greatly the numbers of adult fish, and with them the average of the size. Naturalists have often commented on the fact that the species in colder waters although fewer in number each consist of vastly more individuals, than in warmer waters. Perhaps the difference in rate of mortality explains this—certainly it appears to harmonize with conditions in the sardine.

But if the colder northern waters with fewer enemies allow fish to survive after hatching, are the natural conditions as friendly to the floating egg? One might venture to surmise not, judging from what facts are known. For it has been in northern waters that the vast variation in the success of spawning seasons has been noticed. A favorable year may allow myriads of eggs to hatch, while five, ten or more years may elapse without a recurrence of such favorable conditions. So the phenomenon of a dominating year class arises, concerning which we wrote in the last article in CALIFORNIA FISH AND GAME cited above. This phenomenon has been noticed only in northern waters in such species as the herring and the cod. It seems to occur in our northern sardine, as witness the appearance of the great schools in British Columbia during the last few years. So perhaps we may find that the abundance of large sardines in our northern waters depends, first on the only occasional success of a spawning season, and then on the growth of a large part of the resulting young to maturity. Such an hypothesis seems to fit the facts, and explain the sudden great extension to the north of a commercial abundance of sardines.

If, however, we go far enough to the south, say to Monterey, we may find a region where there is both a reasonable chance of spawning successfully, and a comparatively low rate of mortality still. Then—like nations under similar conditions—the average age of the population would be high, and the young somewhat scarce among the many adults. But even there we might find in a modified degree the phenomenon of dominating age classes, making the sardine appear to be smaller or larger in average size at times. So some such conditions may yet be found at Monterey.

Thus this second theory must be borne in mind, that conditions of existence may lead to varying kinds of populations. To the south, as at San Diego, the numerous young fish may find it hard to survive to maturity, to the extreme north the eggs may not develop save under favorable conditions recurring but seldom, and midway the adults may be more abundant because the young are able to survive the less numer-

ous enemies. The hypothesis certainly harmonizes with the facts as we imperfectly know them. Yet other theories may fit these facts nearly as well.

For if surrounding conditions can modify the actual numbers of fish of various sizes, it is equally probable that they can modify their appearance in the commercial catch. There is no greater fallacy extant, it seems to us, than the assumption that the fishermen catch a fair, or even a passably fair, representation of what actually exists in the ocean. It remains to be proved in every case that a fisherman with his gear, or—what is far more dubious—a scientist with his apparatus, can take a fair sample of any species or of any group of species. So for the third theory we may have one that is perhaps somewhat comforting to the commercially interested man: namely, that the *difference in sizes is really an illusion.*

It is common knowledge that in the method of fishing many things vary from day to day. To some fisheries more or less smooth water is necessary for successful operations. Or market conditions may change and shift the demand from one class of fish to another. Or on one part of the coast fish are taken by one method and on another a different one is used, perhaps merely because of the nationality of the fishermen. So, great caution is necessary that careful investigation of the fisherman and his methods is made at the same time that the fish is studied.

These things are comparatively easily discounted, but there is another category of circumstances not as readily investigated, namely, the effect of physical conditions, such as temperature or currents, upon the accessibility of the fish. There may be, for instance, many adult sardines at San Diego, but oceanic conditions may be such that they are simply never seen, never appear to the fishermen. And the great run of large fish in the far north may not be due to the unusual abundance of some year's spawning, but simply to the prevalence of unusual conditions which may serve to bring the fish in. Or an adult fish may react differently to temperature conditions, as is true of the albacore in a certain degree, and the change in temperature, however slight, may have a decisive effect in preventing the appearance of the large fish or of any particular class, save under the most favorable conditions. Or perhaps the varying salinity of the superficial layers of water may have a decisive influence, as is supposed to be the case in some parts of the North Sea. So there are many things which might be surmised to have an effect on the abundance of fish, so many and in truth so obvious, that fishermen are very prone to adopt this theory. Yet it is very easy to underestimate the ability of the fisherman to take the fish, and very easy to overestimate the sensitiveness of the fish to such changes as occur. Careful observation should be able to decide as to the probability of such occurrences as are mentioned in this paragraph, and to test the real presence or absence of the fish.

To the average casual reader these theories must be confusing, and decision between them very difficult. But there is, indeed, every logical reason to believe that the phenomena which must result from any of these possibilities would vary in a manner clearly distinguishing them according to their origin. Thus the appearance of the large fish far to the north may be due to the dominance of one year class

resulting from one spawning, or it may be due to favorable conditions bringing in the schools toward shore. But nothing should be easier to the scientist with a knowledge of methods of reading age from the scales than to decide whether the fish that come in are really made up of one great year class. That is simply an illustration of one of the possible methods of scientific attack, resultant from close observation and knowledge. So many are they that we may reasonably hope to solve most of the tangled problems that lie before us.

These are problems which are not merely of importance commercially but bear intimately on some of the greater problems of biological science. The true distribution of a species, for instance, may be seen to be in question, and the inadequacy of delimiting such distributions from collections of isolated individuals should be plain. We are in truth studying the factors which limit the distribution of a species, a subject still unknown, despite its importance to the student of the origin of species, or the nature of species. There seems to be no more favorable method of approaching these great problems of biology than through the study of the vast mass of data which the commercial fisheries place at our disposal. They are problems which involve a knowledge of great numbers of individuals and of the actual effect which conditions have on those numbers. The study is statistical if you please, is of commercial value, too; but still is scientific, and biological.

WHALES AND SARDINES.

By Will F. Thompson.

It has recently been the writer's fate to meet several times the argument advanced in all seriousness that the killing off of the whales and the albacore leave a surplus of sardines which might as well be used as fertilizer. This argument for the presence of a surplus is untenable, as is well known by fisheries scientists. Many arguments more valid may be cited leading to an opposite conclusion.

In the first place such animals as the whale, the albacore or tuna perhaps consume more enemies of the sardine than they do of the sardine itself. These fish, such as the anchovies, the mackerels, red cod, etc., probably feed on the young, as well as on the adult sardine. The anchovy, for instance, has a beautiful straining apparatus in its gills with which it might remove the eggs and larvæ from the water to swallow them. And the sardine eggs and young float freely in the open sea for such fish to take. These small things are so delicate that they must be destroyed immediately and no method of ascertaining the amount consumed is at hand. It is, on the other hand, easy to satisfy one's self about the sardines such fish as mackerel consume. So the existence of the whale and albacore may be actually a benefit to the sardine fishery, and their destruction a disaster to the industry.

A classic case could be found in Alaska, where the numbers of herring should supposedly be increased by the practical extinction of the halibut, which consumes the herring in quantities. But careful investigation of the halibut food showed conclusively that it ate more enemies of the herring than it did of the herring. It ate gray cod,

long-jaw flounders, dog-fish, rat fish, red cod and black cod, each as often as it did herring—and every one of those species is a bitter enemy of the herring.

Similar cases of mistaken conclusions as to the harmfulness of birds may be found. For many birds eat injurious insects to an extent that far overbalances any harm the birds themselves do to crops. The same is perhaps true of the whale and the albacore.

In so far as the albacore is concerned, an endeavor on the part of the writer to investigate its food met with disaster. For it was soon found that the fishermen were using sardines, anchovies and other fish for bait, or to chum the fish, and that the albacore which were caught had naturally a great many such bait fish in their stomachs. The same applies to the salmon. But, indeed, even ignoring this fact, it was found that such things as squids, small crustacea, and fish of other species formed a large part, at times all of the food of the albacore, tunas and salmons.

Another argument just as valid as that in support of the theory of the surplus of sardines is available. For it is common knowledge that the whale eats even more anchovies than it does sardines, and the anchovies may make serious inroads on the food supply of the sardine, being nearly the same type of feeder. Therefore the destruction of the anchovies must be advantageous, and the whale a benefactor, indeed.

The point to what has been said, we would emphasize, is the positive fact that nature is exceedingly complex, and that those who come to ready and easy conclusions are inevitably wrong. We do not wish to assert in an unqualified way that we are correct in saying that the destruction of any such animals as the whale, the albacore, the tuna and such animals is a disaster to the sardine, but we do wish to assert that the balance is just as likely to go that way as the other, and probably does. And that would be the case were all the suppositions advanced above untrue.

And as a matter of fact, if such great numbers of albacore, of of tuna and of whales have been taken, it may be high time to propose some protection for them.

The argument that there is now a surplus of sardines is a strange one to meet at this time. If we had three vessels at sea in a storm and two of them were sunk, would we talk confidently about the safety of the other? Yet that is just what is happening. The great salmon fisheries of the Alaskan and British Columbian coasts are on the verge of extinction, as everyone now knows, despite the fact that years ago statements that the supply was inexhaustible were quoted just as freely as they are now about the sardine. And the same is true of the halibut fisheries to a still greater extent. As in those two fisheries, once the two greatest on our coast, disaster has come, so may we well watch vigilantly lest disaster come to another great fishery, that for the sardine. Abstract speculation on intricate things such as the effect of killing off the enemies of the sardine is worse than useless in the face of real experience.

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All material for publication should be sent to H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.

MAY 6, 1921.

PEOPLE AND THE LAW.

People obey the laws because they believe them wise and just—not merely because the laws happen to be.

That fish, or that game law serves best its purpose which is based on real conditions, exact needs and which operates without undue injury to any person or class.—Adapted from *Pascal*.

THE 1918-1920 BIENNIAL REPORT.

The usual biennial review of the work of the Fish and Game Commission has appeared in a striking green cover with a colored reproduction of the Loch Leven trout. The report, which contains 150 pages, deals with the work of the various departments and is abundantly illustrated with photographs showing the work and accomplishments of the Commission. A comparison of this volume with the first report issued in 1870 furnishes an interesting contrast and proves that during fifty years of service to the state there has been great improvement in organization and in results.

In the introductory pages a tribute is paid to the men who so creditably served their country during the world war and a page is devoted to six employees who have died during the past two years.

Outstanding features of the biennial period have been the rearing and planting of 34,000,000 trout fry, the greatest number ever planted by the Commission in its history in a like period. In addition approximately 29,000,000 Chinook salmon were distributed in the Sacramento, Klamath and Eel rivers. The new Tahoe Hatchery with four times the capacity of the old one is described and figured.

The number of arrests and amount of fines assessed on offenders during the biennial period is the greatest in the history of the Commission—1,891 arrests and $19,426 in fines.

The Commercial Fisheries Department reports wonderful progress in connection with the gathering of fisheries statistics and the solving of many problems relating to the fisheries. Several graphs vividly show the growth of the different fishing industries and the output of the canneries.

Among the legislative recommendations in the report are a shortened trout season and a one buck limit on deer.

The educational and publicity campaign beginning in 1914 has been successfully continued. Particularly noticeable results have been obtained in the schools and in the summer resorts of the state.

NEW FISH BULLETINS.

There are now ready for distribution two new fish bulletins. Bulletin No. 4 is entitled, "The edible clams, mussels and scallops of California," and is the result of research made by Professor F. W. Weymouth, of Stanford University. The bulletin contains seventy-five pages, nineteen plates and twenty-six figures. The author notes that there were two purposes in issuing it. "First, it is an attempt to estimate the economic importance to the state of the bivalves here treated by putting on record the extent and position of the available mollusk producing grounds, the number and abundance of the edible species, and, by contributing to a knowledge of their life histories, lay the foundation for such protective legislation as may in the future be found necessary. Secondly, it proposes to make available to the camper and amateur naturalist a means of identifying the more common and important bivalves." Perhaps the most attractive feature of the bulletin is a key well illustrated which should be usable by the amateur in identifying any of the species of mollusks found in the state.

Fish Bulletin No. 5 is entitled, "A key to the families of marine fishes of the West Coast," and appears under the authorship of Professor E. C. Starks, of Stanford University. The key has been tested out by the students of Stanford University and should be of value to any one in the identification of fish which fall into their hands.

FISHCULTURAL METHODS UPHELD.

A recent newspaper attack on the methods and accomplishments of the fish-cultural department has brought forth many protests. Resolutions and letters in large quantity have been received from sportsmen's clubs, chambers of commerce, forest supervisors, boards of supervisors, and private individuals pointing out the successes attained in planting trout. Among the sportsmen's clubs defending the present methods are the Sierra Rod and Gun Club, the Grass Valley Sportsmen's Club, Lindsay Fish and Game Protective Association, El Dorado County Rod and Gun Club, Caspar Rod and Gun Club, Fresno Sportsmen's Club, Yuba County Fish and Game Association, and the Alturas Sportsmen's Club.

All unite in pointing out that in order to keep up the supply of trout where there is heavy fishing, it is essential to stock the streams annually. Many point out that had not annual plants been made the streams would now be barren of fish life. Fortunately, the opposite condition exists, owing to fishcultural operations.

Mr. C. J. Walters, of Independence, states that streams that are extensively fished have increased wonderfully since the planting of fry began. According to Robert E. Eddy, Secretary of the Lindsay Fish and Game Protective Association, it is the unanimous testimony of our members who know the streams and of ranchers in the mountains, "that fish are now being taken from places formerly barren, since planting began regularly in this section." George A. Green, President of the El Dorado Rod and Gun Club, writes: "Prior to 1910 no eastern brook trout had ever been taken from the American River, the fish life being entirely limited to the rainbow trout. In 1910, our club received from the Fish and Game Commission some eastern brook trout fry. These were planted in the American River near Kyburz. We have received and planted some eastern brook fry every season since. Today fifty per cent of the trout taken from the American River between Riverton and Phillips Station are eastern brook trout. The same holds good in regard to all other streams in our country."

All of the communications report satisfactory results and state that the fry are received in uniformly good condition. The one complaint evidenced is that individuals and organizations are unable to secure as many fish as they desire for planting purposes.

IN MEMORIAM—FRANK SHOOK.

It is to be regretted that deputy Frank Shook, one of the oldest and most loyal deputies in the employ of the Commission, died on January 16, 1921, at his home in Salinas.

From the time of his appointment as deputy, on November 15, 1907, Frank Shook was one of the most sincere workers of this Commission. He was always on duty and always gave the best service possible. He not only knew the violator and his ways, but he knew thoroughly Monterey County, the country which he patrolled, and it is because of the fact that he possessed all of the many qualities that are so necessary in one entrusted with the enforcement of the law that he was so valued and trusted as an employee of the Commission. That his loyal service was appreciated by the Fish and Game Commission goes without saying.—J. S. H.

THE NATIONAL GAME CONFERENCE.

The annual National Game Conference under the auspices of the American Game Protective Association was held in New York City on January 24 and 25. For the first time, the California Fish and Game Commission was represented at this conference. Dr. H. C. Bryant was able to attend, owing to a lecture program regarding nature guide work which was made possible by Mr. Stephen T. Mather, Director of the National Parks. Dr. Bryant gave an illustrated lecture on the subject, "Education as part of the conservation program," in which the work of the California Fish and Game Commission was outlined; emphasis being placed on the work in the schools and in the summer resorts. At the banquet, the last night of the conference, motion pictures showing wildfowl on Lake Merritt, California's first game refuge, were shown and received very favorable comment.

Outstanding features of the program were the discussions on a federal license,

to take the form of a stamp which can be pasted on the state license, and on the need for a treaty with neighboring countries relative to migratory fishes to supplement the one relative to birds, which is already in existence.

Considerable interest was also displayed in the report of the Virginia Fish and Game Commissioner regarding a law to control the vagrant dog. The law which is administered by the Fish and Game Commission has been effective in the destruction of 30,000 vagrant dogs since its enactment. That any state should have a dog problem, as well as a cat problem, was a surprise to those attending the conference.

A large number of resolutions relative to the conservation of game were passed.

THE STEELHEAD, A DISTINCT SPECIES.

The exact status of the steelhead trout has long been a mooted question. Although for many years considered specifically distinct, it has in more recent years been considered a sea run form of the rainbow. The United States Bureau of Fisheries now announces (Bureau of Fisheries Document No. 896, pp. 6-7) that Dr. W. C. Kendall, scientific assistant and ichthyologist, is bringing to completion a report which it is believed will settle the much discussed question of the specific identity or distinctness of the rainbow and steelhead trouts.

"After a careful study of the fish from taxonomical, anatomical, and distributional evidence the conclusion is reached that there are at least two wild forms which have been confused under the names of rainbow and steelhead trouts. One is predominantly migratory (ascending fresh waters from the sea), the other predominantly a permanent fresh water inhabitant. The name *Salmo iridcus* was originally bestowed upon a small steelhead form, as was also *Salmo rivularis*. There is absolutely no doubt concerning the proper application of *Salmo gairdnerii* to the steelhead, as Richardson's description is that of a large Columbia River fish and not a small blueback salmon (*Oncorhynchus nerka*), as one writer has stated. Contrary to current descriptions, the steelhead has larger (fewer) scales than the rainbow, and there appear to be other though inconspicuous and concealed structural differences.

There is probably more than one species or race of rainbow trout, and possibly also of steelhead. However, the rainbow trout of fish culture is largely from McCloud River (California) stock and should bear the name, not *Salmo iridcus*, but *Salmo shasta*. The fishcultural rainbow stock has been more or less affected by admixture of another form principally from Klamath River, which may be another form or species of rainbow or perhaps a steelhead. This admixture is clearly perceived in the appearance and structure of many specimens of the rainbow stock of some of the hatcheries. The steelhead stock has always, so far as known, been unadulterated *Salmo gairdnerii*, although in the distribution from hatcheries it is known that in some instances the two forms have been regarded as identical and distributed as rainbow trout. Pure *Salmo shasta* is distinguished from pure *Salmo gairdnerii* by the smaller scales of the former."

SALMON DESTROYED ON SPAWNING BEDS.

Because of the law which allows of the taking of three salmon by means of a spear, in districts one and two, between September 25 and November 15, many salmon are being destroyed on the spawning beds in Shasta and Siskiyou counties. Aliens, as in other cases, are the greatest violators. They often build a sort of trap across a stream and working at night spear the fish as they move through a narrow entrance to the trap. As many of the fish are unfit for food, because on the spawning grounds, these violators sometimes kill as many as from fifteen to twenty fish and save but the three that they are allowed by law. The deputies of the Commission have difficulty in apprehending these violators because they work at night and because they are not to be found with more than the legal limit in their possession. Fortunately, sentiment in these counties is changing and many now see the danger in allowing salmon to be taken by means of a spear during the spawning season. It is to be hoped that there will be sufficient sentiment to make possible a change in the law during the present session of the legislature.

BLUE JAY HUNT IN SAN BENITO COUNTY.

Several years ago blue jay hunts were in vogue, but more recently little attention has been paid to the bird accused by the sportsmen of destroying quail's eggs. Of late, however, a well organized blue jay hunt was held at Hollister, California. Sixty sportsmen were divided into two rival teams and a week chosen for the hunt. When the final count of birds was made at the end of the week the total showed 1531 blue jays. One team outdistanced the other by 210 birds and this winning team were the guests at a big barbecue held by the other team. One hunter bagged 233, and the second best was 139.

FIG. 38. The result of a blue jay hunt at Hollister, California. An organized blue jay hunt by sportsmen of the region netted 1531 blue jays in one week.

Whether such organized blue jay hunts are beneficial to the interests of game and other birds is still doubtful. That the blue jay deserves to be placed on the black list few will deny, but that blue jays good and bad, and there are good blue jays, should be killed off in large numbers is a question. Whether blue jays are actually as destructive to quail as to tree nesting birds is also something that still has to be proved. Doubtless, many arguments can be given on both sides, and the thing which is needed is more evidence. When those engaged in such a hunt spend as much energy in trying to determine the food of the blue jay as they do in making a large kill of birds a solution of the problem will be forthcoming.

MORE FINES FOR HUNTING OUT OF SEASON.

Apprehended for shooting four pintail ducks out of season, a Missouri hunter on March 7, 1921, was fined $200 and costs by Federal Judge Van Valkenburg, sitting at St. Joseph, Missouri. This sentence follows closely upon the conviction of a hunter in New Jersey before a federal judge by whom he was fined $200 and costs and sentenced to jail for ten days.

The spring flight of migratory birds is at its height during April, and the Biological Survey of the United States Department of Agriculture is putting forth every effort to see that they are permitted to go north to their nesting grounds unmolested. Due to the active cooperation of federal game wardens and state authorities, fewer violations of the federal law are occurring this spring than formerly. Nevertheless, some unscrupulous hunters are taking a chance; arrests for shooting out of season are being made by the game wardens and convictions are being obtained in nearly all cases.

MORE AND BETTER FUR.

"The demand for fur is far greater than can be met. Evidently the time is at hand when steps should be taken to increase and improve the fur supply. Trappers, dealers, manufacturers, and wearers, possessing in the aggregate a tremendous moral and financial influence, want more and better fur.

"Among the bad practices which have reduced the number of fur bearers are: (1) Using poison, which kills many animals that are not found before their skins are spoiled; (2) smoking animals out of their dens, which often suffocates them instead of forcing them out; (3) destroying dens, which either leaves the animals without suitable places in which to rear their young or drives them out of the neighborhood altogether; (4) trapping early in fall, which catches animals having small, unprime pelts before they are old enough to be suspicious of traps; and (5) trapping late in spring, which destroys breeding females with young.

"If no early or late trapping were done there would be fewer animals taken, but on the other hand the value of the catch and the number of animals left to breed another season would be far greater. Skins are prime for about two months after the molt is completed, and during this time they have no dark spots on the flesh side. They are worth much more when prime (. . . .) than when unprime (. . . .). Muskrat and beaver pelts are best in February and March, while those of other fur bearers are best from late in November till about the end of January."—Yrbk. U. S. Dept. Agri. 1919, Separate 823.

RAINBOW TROUT IN HAWAII.

In the Fisheries Service Bulletin, No. 69, issued February 1, 1921, Mr. H. L. Kelly, a former assistant of the Bureau of Fisheries and now the executive officer of the Fish and Game Commission of the Territory of Hawaii, gives an interesting report on the rainbow trout resulting from eggs supplied by the Bureau of Fisheries in 1919. Before making an application for another shipment of eggs to be hatched and planted on government reserves, Mr. Kelly went to Kauai to determine how the trout planted in the streams of the island were thriving. He found the people enthusiastic over the species and in the streams which had been stocked many trout were seen. Some of the fish were caught. The largest measured 7¾ inches and others 5¾ inches. These were taken exactly six months after planting. Requests were made for plantings in the mountain streams of the islands of Molokai and Maui. Their beautiful coloration and rapid rate of growth are prime factors in the success of the importation experiment to the sportsman and the fisheulturist alike of Hawaii.

A DECLINE IN THE CONSUMPTION OF FISH.

"How are we to meet the decline in the consumption of fish and the resultant hardship on the fishing industry of the United States?"—is the question of the United States Bureau of Fisheries. During the period of the war the consumption of fishery products grew to considerable extent, which resulted in an expansion of facilities for the capture, preservation and marketing of these products. Despite the more adequate facilities for supply and the general advancing costs of materials and labor, there was a decline in the fishing industry.

Not only on the eastern coast is this the case but it would appear to be true to a certain extent in the west as well, as is demonstrated by a graph published in the 1920 Biennial Report of the California Fish and Game Commission giving a comparison of fish of all kinds packed in northern and southern California. A slight decline in the total number of cases of fish packed is shown by the following figures:

	1918	1919
Southern	1,385,202	1,166,435
Northern	729,100	905,206
Total	2,114,302	2,071,641

1918	2,114,302
1919	2,071,641
	42,661

However, in California, the salmon, and particularly the sardine catch, has steadily increased, as stated for the period 1917-1919, yet the estimated 1920 pack of canned salmon in the United States,

including Alaska, is about 3½ million cases less than in 1917 and includes about 2½ million cases of the cheaper grades (pink and chum), which it is reported are being offered for sale for less than the cost of production and can be sold with profit by the retailer at a low price. The canners of sardines and the cheaper grades of tuna are confronted with similar difficulties.

The problem is indeed one of importance, for aside from the fact that fish is our cheapest and best source of natural food supply the fishermen are, most of them, small, individual producers with little or no training for a change of livelihood and these men will suffer, if the industry is allowed thus to decline.

accidents during the open season, as well as being a conservation measure. In 1917, twenty-eight fatal hunting accidents occurred in Michigan and Wisconsin. Out of this total, twenty-two occurred in Michigan as against only six in Wisconsin. The reason for the disparity was again laid to the fact that bucks only were allowed to be killed by deer hunters in Wisconsin, while in Michigan the big game hunters were allowed to kill without waiting to see the horns.

And so it continues to be demonstrated that the buck law in California and other states is largely responsible for the reduction in the number of hunting accidents.

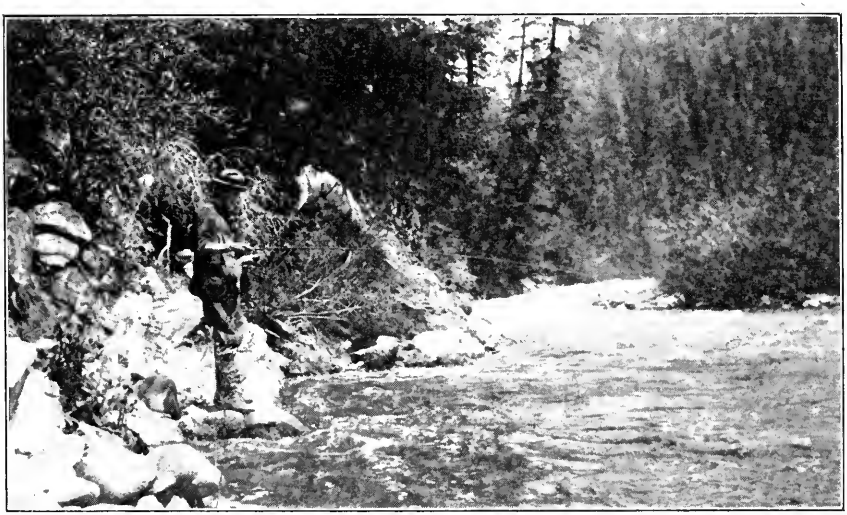


FIG. 39. Fishing on the north fork of the Feather River. The trout season opened April 1, as usual. Photograph by F. A. Farnum.

BUCK LAW DECREASES HUNTING ACCIDENTS IN NEW YORK.

Quoting from the Conservationist for December, 1920: "The deer hunting season of 1920 closed with only one fatality due to a man being shot in mistake for a deer. Last year there were nine deaths from this cause, during a season when both bucks and does could be legally shot. Restoration of the buck law, and the requirement that a hunter look for horns before he shoots, is unquestionably to be thanked for the low mortality this year."

The buck law is one of the prime factors in reducing the number of hunting

A CONSERVATION READER FOR CALIFORNIA PUBLIC SCHOOLS.

"The wave of enthusiasm for the conservation of our natural resources must reach the children or it will expend much of its force uselessly." With this end in view, H. W. Fairbanks of Berkeley, California, who is the author of many text books on geography, has written a Conservation Reader.* The book brings out in a simple and interesting manner the principles of conservation. After introductory chapters giving a contrast be-

*Fairbanks, H. W., 1920. Conservation Reader (World Book Co., N. Y.) VI, 216 pages, illustrated.

tween the past and the present, the conservation of soils, water, trees, forests, wild flowers, coal, oil, gas, aquatic animals, and birds, is outlined. The book is illustrated with two colored plates furnished by the National Association of Audubon Societies and with various reproductions of photographs.

"The movement for the preservation of natural resources can succeed only with the establishment of an enlightened public sentiment on the subject. To create and maintain such a sentiment is the proper work of the schools." The use of this conservation reader in the schools should help greatly in developing the right attitude toward natural resources and the consequent attainment of proper conservation of them.

PRESIDENT HARDING IN SYMPATHY WITH WILD LIFE CONSERVATION.

Mr. T. G. Pearson, President of the National Association of Audubon Societies, in answer to a telegram, received the following telegram from President Harding, who was at the time President-elect.

"I am fully in favor of a policy which will guard the integrity of our national parks and our bird reservations. I favor the enforcement of our treaty with Canada for the protection of valuable migratory birds. Please accept my greetings to your Association." (Signed)

WARREN G. HARDING.

Those who are interested in our national parks and in the conservation of our wild life take great satisfaction in the expressed attitude of President Harding.

FUR-BEARERS PROTECTED IN TRINITY REFUGE.

Game Refuge No. 1-D has been closed to trapping except for coyotes, mountain lions and bobcats. This restriction will bring about the same object with reference to fur-bearers as that attained for deer. The refuge is an ideal one for this purpose and if the law can be enforced and the predatory animals exterminated, it is absolutely certain that these species will be preserved forever, and that to a large degree the overflow can be legitimately trapped. Similar provisions for preserving fur-bearers should be applied to other refuges.—E. V. Jotter, Weaverville, California.

THE FUR SUPPLY AND ITS MAINTENANCE.

Mr. Ned Dearborn, Assistant Biologist, Bureau of Biological Survey, has recently written a pamphlet entitled "Maintenance of the Fur Supply."* In introducing the subject of his paper he says, "to direct attention to the great commercial importance of fur; to emphasize the need of maintaining the supply, which lately has been declining at an alarming rate; and to point out ways by which this supply may not only be maintained as to quantity but improved as to quality, is the purpose of this circular.

"The subject is discussed from the viewpoint of the farmer, to whom fur-bearing animals, if rightly managed, will be a source of interest and profit."

"The commercial history of America begins with fur, and from the early days down to the present this has been an important article in our domestic and foreign trade."

The World War has changed the center of the world fur trade from Europe to the United States, and the center of manufacture in the United States is New York City or the near vicinity. The United States has learned the art of dressing and dyeing the skins, as is demonstrated by the drop of forty per cent in the ratio of dressed and raw skins imported into the country. In 1914, dressed skins imported were worth $3,500,000, while raw skins imported were worth $7,500,000. In 1919, $4,000,000 worth of dressed skins were imported, as against $69,000,000 worth of raw skins.

"A concrete example of the rise in fur prices is afforded by the actual record of one man's fur-lined overcoat. This coat, lined with mink, in 1913 cost $500. After wearing the coat two years the owner sold the mink lining for $1,000 and replaced it with nutria at a cost of $150. Two years later, in 1917, he had the nutria lining removed and sold it for $250. A muskrat lining was then put in the coat at a cost of $55, which, in 1919, was in turn removed and sold for $300. The original purchaser still has the shell."

Although the price of furs is bound to drop to a certain extent, the fur dealers are not uneasy. The use of fur is being

*U. S. Dept. Agric., Dept. Circ. 135, Nov., 1920.

widely exploited—is being advertised for summer use as well as for winter—yet, there are two important factors to be reckoned with: (1) About one-half of the skins disposed of at American auction sales are of foreign origin. (2) The supply of furs is waning to the extent that if the present condition should continue for a few years the supply in settled districts would come to an end.

The following remedies for the situation are pointed out by Mr. Dearborn:

(1) All trappers should be licensed at a nominal fee and at the end of the trapping season should turn in a complete report of the skins taken. This report to be published for the benefit of the public.

(2) Farmers should be made to appreciate the possibilities of this source of income. They should know that although most of the important small fur-bearers are carniverous, few of them are destroyers of poultry. "Among fur animals, as among men, the proportion of criminals is small." Skunk-proof poultry yards should be installed, and the subsequent value of enticing the skunk to the farmer's land to destroy the rodents advocated.

Further emphasis should be placed on this natural source of income to the farmer, from animals which he neither has to feed nor shelter, so long as he recognizes the value of preserving their dens and killing them with discretion.

(3) The wisdom of killing fur-bearers only when the peltries are prime is forcefully brought out to the farmer by the associative argument, namely, that it is just as short-sighted for the farmer or trapper to kill fur-bearers before the peltries are prime as it is to harvest crops before they are ripe or when they are overripe. Hence, the value of limiting the trapping to a two months open season which is believed to be the most effective and efficient means of obtaining results.

(4) The importance of having fur animal preserves and of domesticating the animals is of moment. Now that the characters of North American animals and their geographical distribution are well known, the production of superior fur should be much more possible.

(5) Animal dens should be protected, and the knowledge of the local attachment of animals used to good advantage. The use of poison, smoke, gas, or fumes in taking fur-bearing animals should be prohibited.

Mr. Dearborn's paper is of importance to Californians for he points out that in this state the asset value of wild fur-bearers to the people of the state has been estimated at $7,125,000. The annual catch of fur in the state brings about four per cent of this huge sum. "By proper conservation it might readily be doubled." Therefore, the value of encouraging and promoting the fur industry along the right channels at this embryonic period in its development would seem most advantageous.

CAMP SANITATION.

Are you going camping this summer? The mountains of California constitute one of the most delightful of recreation areas, and an outing there may be most healthful and enjoyable if proper use is made of the opportunities offered. Proper use means, in a very important degree, good sanitation. If you take an outing you will find that your pleasure is marred when you discover evidences of careless habits of other campers. Remember that you are one of many thousands of campers that go to the mountains during a season, and that all have a right to expect you to avoid defiling the pleasure ground that is theirs as well as yours. Remember ,too, that these mountains are the catchment areas for drinking water supplies of many thousands of people and that the purity of these supplies depends very largely upon the efforts of yourself and other campers to practice intelligent sanitation.

The principles of good mountain sanitation are simple and their practice is not more burdensome than maintaining customary cleanliness around home. At home the person of common decency does not tolerate an accumulation in his yard of cans, bottles, papers, garbage and fecal matter, yet why is it that one may frequently see an otherwise attractive spot in the mountains littered with these things? Is it because the camp ground

is only a temporary stopping place and campers lack the neighborliness to clean up their own refuse out of kindness for those who follow? Is it that same return-to-nature, otherwise carelessness, that on a camping expedition contents a man to go a week or two without a shave? It is thoughtlessness, and carelessness, perhaps laziness, but no part of nature.

The principles of good mountain sanitation are simple. Burn or bury all refuse and use care not to contaminate streams. There you have a complete program for keeping our recreation areas clean. Take a small shovel and some matches with you on your camping trip and use them with prudence. They will be useful for other than sanitary purposes.

When you build your camp fire burn your waste paper and when the meal is finished burn your garbage. Bury these materials if you do not have a camp fire; don't leave them for the next fellow to dispose of. Bury also your unburnable refuse, such as cans and bottles, or throw them into the underbrush well out of sight. Practice the ordinary principles of good housekeeping.

"Leave your camp as you would like to find it. Keep the pleasure grounds of America clean."—California State Board of Health.

NEW YORK'S ANNUAL GAME DIVIDEND.

Beginning in 1919 all owners of hunting licenses in the State of New York were required to report the game killed for the preceding year. The statistics compiled show that there were reported 165,590 cottontail rabbits; ducks taking a fifth place in the kill showing a total of 109,663; male deer totaled 8,293. The grand total of game taken in 1918 was 1,526,960.

The game and fur-bearing animals of New York State, if capitalized, are worth not less than $53,000,000; they return an annual dividend of more than $3,200,000; and they cost the state for their protection and increase the nominal sum of $182,000. This cost of protection and increase is thus less than six per cent of the annual dividend.

FACTS OF CURRENT INTEREST.

In 1920, Trinity County spent $1,323 in controlling the coyote. A bounty of $3 each was paid on 441 coyotes on which the reward was claimed.

Salmon have appeared early this season, 150 pounds having been taken by trawling near the Farallones on March 3, 1921. In 1919 and 1920 the first salmon were caught after the middle of March.

Although some of the ayu eggs imported from Japan hatched, they were so weakened by fungus that none of them survived.

Deputies Carpenter and Britton arrested two men at Arbuckle during March who had in their machine 184 ducks. They were presumably on their way to San Francisco to dispose of this illegal game. Both men were taken before Justice Jones at Williams, who sentenced them to sixty and ninety days, respectively, in the county jail.

A bill before the legislature provides for a limit of ten abalones per day. This would effectively prohibit the commercialization of this sea food.

Large shipments of edible crabs have been arriving in San Francisco. On March 12, 1921, a shipment amounting to four truckloads was received.

No less than three bills which would abolish the present Fish and Game Commission have been introduced in the legislature. Two of them would make fish and game work depend upon appropriations by the legislature.

HATCHERY NOTES.

W. H. SHERLEY, Editor.

SEASON PROSPECTS.

As outlined in the January number of CALIFORNIA FISH AND GAME, the past season was a very successful one from the standpoint of the number of trout fry reared, the quality of the fish planted and the systematic manner in which they were distributed, when the difficulties encountered in the prosecution of the work, due to the extreme drought, are taken into consideration.

Plans are under way for still further improvements in the fish distribution work during the coming season. Within the next two weeks all applicants, who received trout fry last season, will be sent application blanks and will be requested to file their applications prior to the thirtieth day of April. Judging from recent correspondence with many of last season's applicants, there is going to be an unprecedented demand for trout fry this coming season. This is due to several reasons. There were very few losses of fish last season. The success of fish planting during the past few seasons due to our closer cooperation with the applicants and to sending of special messengers, trained in fish planting work, to assist and instruct in the best methods of handling and planting the fry is beginning to show more satisfactory results and the public is coming more generally to realize that it is only by extensive restocking of their fishing streams and lakes each year, that they may prevent depletion due to excessive fishing.

Public association of anglers, resort owners and individuals, who are interested in one way or another in fishing, are taking more interest in the work, as the efficiency of our methods is demonstrated to them. Then to, Boards of Supervisors, Chambers of Commerce and public officials, having the business interests of their communities at heart, are coming to realize that fish and game are among the best assets to a community, and that it is only by keeping the streams stocked with trout fry from the state hatcheries that the depletion of the fish in the streams and lakes can be avoided. They therefore consider, from a business standpoint, that appropriations of adequate amounts from their funds to provide for proper distribution of the fish allotted to them by the Commission is money well spent.

During the past several years of drought, it has been extremely difficult for us to obtain a sufficient number of trout eggs to supply all of the fry required to adequately stock the waters of the state, despite the rapid increase in the extent of our operations. This season we hope to materially increase our output of trout fry. No effort has been spared to make the coming season the most productive of results that we have ever had. The older egg-collecting stations have been enlarged and improved to handle a greater output and hatcheries have been equipped to take care of all of the eggs which it is possible to secure.

The new Lake Tahoe Hatchery, as previously mentioned, has been finished and is ready for occupancy. The Mount Tallac Hatchery will be opened as usual about the middle of March and in addition to the egg-collecting operations, which have been carried on in past years at the mouth of Taylor Creek, a new egg-collecting station will be operated on the upper Truckee River.

Arrangements are being made to establish an experimental hatchery near Blairsden, in Plumas County, to take care of the requirements of the Feather River district, as well as the North Yuba River district near Sierra City. If this station can be successfully established, it will eliminate to a very great extent, the necessity of transporting trout fry for stocking the streams in Plumas County from the Mount Shasta Hatchery. This long haul is very hard on the fish and is very expensive. If rainbow trout can be successfully reared at the Feather River, near Blairsden, which is centrally located, they can be distributed to far better advantage and with much less expense than to ship them from so great a distance as Sisson.

By the establishment of this hatchery that section of the Yuba River in the vicinity of Sierra City can be handled to better advantage, as the long haul from Sisson to Nevada City and thence by auto

truck over the heavy grades along the Yuba River will be eliminated.

Operations at the Mount Shasta Hatchery and the various egg-collecting stations along the Klamath River are in full swing. While it is too early in the season to state definitely the number of eggs, which we can expect from the Klamath River stations, we have every reason to believe that the take will be very satisfactory. The first of the rainbow trout are "running" in Bogus Creek, Camp Creek and Fall Creek and something over a million of eggs have been taken to date. The run of fish in Cottonwood Creek is somewhat later, but indications are for a successful take of eggs at the Hornbrook Station. The salmon fry which are being hatched at Mount Shasta and Fall Creek hatcheries are doing nicely and will furnish a fine lot of fry for distribution this spring and for placing in the large salmon rearing lakes where they are held throughout the summer months and then liberated in the upper reaches of the Sacramento and Klamath rivers next fall.

Steelhead egg-collecting operations are under way at the Scott Creek and Snow Mountain collecting stations and indications are that a successful take of eggs at both places will be secured.

Ukiah Hatchery is in readiness for the reception of the steelhead eggs from the Snow Mountain Station.

Brookdale Hatchery is also open and prepared for operations. Extensive re-

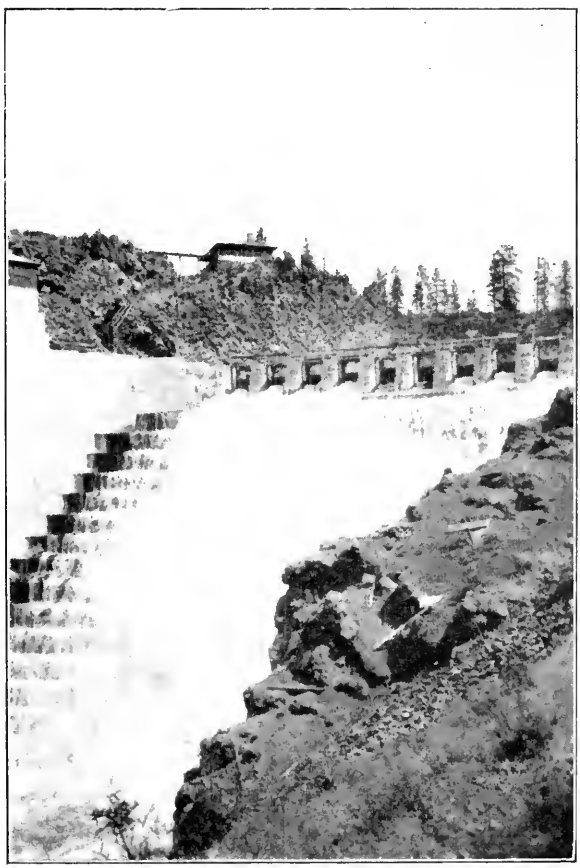


FIG. 40. Copco Dam on the Klamath River. This dam is so high that a fish ladder was not feasible. Consequently, the California-Oregon Power Company was compelled to build a fish hatchery in lieu of a fishway. Photograph by C. Westerfeld.

pairs to the water supply system have been made and the station generally is in first class condition. Over three-quarters of a million of steelhead eggs have been taken at the Scott Creek Station to-date and are being cared for at Brookdale. A half million salmon fry are being reared at the Fort Seward Hatchery for distribution this spring in Eel River, Mad River and tributaries of Humboldt Bay. The hatchery is all ready for the reception of steelhead trout eggs from Ukiah Hatchery.

Domingo Springs, Almanor and Clear Creek hatcheries will be open for operations during the middle and latter part of March.

A crew of fishculturists will be sent into the Big Bear Lake district within the next two weeks and operations will be commenced as soon as the fish start "running" at the North Creek Station.

The Kaweah Hatchery will open for operations shortly after the first of April.

Wawona Hatchery will, as usual, be opened sometime during April.

The San Joaquin River Experimental Station is still in operation. The weather has been extremely cold, the water being close to the freezing point for days at a time and development of the salmon eggs has been very greatly retarded.

Three hundred thousand Loch Leven trout eggs were shipped during the latter part of December to the Mount Whitney Hatchery and the resulting fry are doing nicely. Everything at this station is in readiness for the commencement of the season's operations. The seasonal work on the grounds has been progressing nicely and the gardens promise to be in even better shape than they were last season.

COMMERCIAL FISHERY NOTES.

N. B. Scofield, Editor.

SHALL WE USE FOOD FISH FOR FERTILIZER?

With a poor market for canned fishery products and a strong market for fertilizer and poultry foods, a difficult problem confronts the Fish and Game Commission and the state legislature. Canneries at Monterey and in southern California are asking for permits to catch sardines in quantity for use at reduction plants rather than for use in the canneries. So great is the demand made by the canneries that a bill has been introduced into the legislature which would allow the use of food fishes for fertilizer and poultry products. Up to this time, only ten to twenty per cent of the catch, which was considered as "overcatch," has been utilized in the reduction plants. It is feared that the sardine has already suffered from over fishing, owing to the great demand of the past few years, and that a further toll levied would deplete the supply. Present plans to continue fishing obviates the chance of the species to recuperate and assure an abundance of fish in the future.

In order to test the present law which allows only the spoiled fish and the overcatch to be utilized in the reduction plants, cannery men of southern California have instituted a test case which is now before the courts.

FISHERIES, 1920.

During the year 1920 there were 208,342,816 pounds of fresh fish and 6,423,911 pounds of mollusks and crustaceans, making a grand total of 214,766,727 pounds of fishery products, taken in the waters of this state. The catch for 1920 shows considerable decrease in the totals in comparison with the catch for 1919 which was 262,258,511 pounds. The sardine catch showed the greatest decrease, which was approximately 35,000,000 pounds less than during 1919. Salmon, yellowtail, sole, squid and clams also declined, while the catch of albacore showed an increase of about 5,000,000 pounds.

The decreased catch of sardines was on account of the poor demand for the canned and salted products and canneries did not operate their plants to full capacity during the year and many of those plants operating closed down early in the fall. During the spring of 1919 there were great quantities of sardines used in reduction plants for fish meal. In the summer of 1919, a law went into effect preventing the use of edible fish in reduction plants and during 1920 there was no straight fishing for sardines for reduction purposes.

The salmon catch in the state shows a decrease of approximately two million pounds, the total catch for the year being 11,138,693 pounds. Along the coast north of San Francisco the catch was about the same as the previous year, some particular localities showing slight increase, while other districts show a small decrease. The decrease in the catch was on Monterey Bay and the Sacramento River. The Monterey Bay catch was 1,300,000 pounds less than in 1919, which was by no means a good year for that district. The Sacramento River catch declined about 700,000 pounds. The water was very low in the Sacramento River during August and September and no doubt this fact, together with the poor quality of salmon and low price, had considerable effect on the catch as a number of the fishermen laid up their boats and stopped fishing some time before the season closed on September 24.

During 1920 there were 1,941,984 cases of fish canned. Of this amount, 1,062,996 cases were sardines and 835,645 cases were tuna, these two varieties of fish being the principal fish used for canning purposes in this state. The tuna pack for 1920 was greater than during the previous year, while the sardine pack was lighter. The total pack of all varieties canned in 1920 was about 130,000 cases less than during 1919.

Complete statistics of the fisheries for the year 1920 will be published at a later date and should show some very interesting data.—S. H. D.

SACRAMENTO RIVER SALMON MARKING, 1920.

When salmon hatching on a large scale began on this coast it was the custom to liberate the fry in the streams as soon as the yolk sacks had been absorbed. Of late years the fry have been held for longer periods of time at the hatcheries on the belief that larger fish are better able to take care of themselves when liberated in the streams. The small fry in the hatchery troughs are of necessity crowded and are accustomed to being fed at regular intervals. It is thought that planting these small fry in a stream is too sudden a change and that too many fall a prey to enemies before they learn to avoid dangers and forage for themselves. To overcome this difficulty the small fry are transferred from the crowded hatchery trough to a large pond or lake where they have more room and are often able to find some natural food. From the pond the fry may be transferred to the stream when they are considered to be of sufficient size or when the height of water in the stream is considered most favorable.

Proof of the relative success of different times of liberating has been lacking, partially due to the difficulty of securing data. One method of securing this proof is to mark some of the young fish from two or more lots of fry liberated at different times. A comparison of the number from each lot recovered when they return to spawn would throw some light on the success of the different methods of liberating. The great difficulty in all such marking experiments is that so few marked fish are recovered. In the cleaning sheds large numbers of fish must be prepared for market in a short time and the fish are handled so rapidly that the missing fins of marked fish are either not noticed or are neglected, so that time is not taken to measure the fish, to take a sample of the scales and send the data to the office of the Fish and Game Commission. It is impractical to have a representative of the Commission at all of the fish sheds while fish are being received.

Another difficulty is the possible objection to marking fish by the removal of fins or with metal tags in that one is never sure that the behavior of such marked fish is typical of the behavior of unmarked fish of the same brood. Nevertheless some valuable data may be secured from such marking experiments. No other method has yet been devised for securing knowledge of the migrations of salmon in the ocean. In this connection, the first article in the January, 1921, number of this magazine is of special interest in showing that marked fish liberated in the Sacramento River were recovered not only in the Sacramento gill nets but also by trolling at such widely separated points as Monterey and Shelter Cove.

At a conference (September 8, 1920) between representatives of the California Fish and Game Commission it was de-

cided to try another King salmon marking experiment using Sacramento River eggs and liberating in the Sacramento. The object of the experiment was threefold, first, to contribute to the knowledge of ocean migrations and, second, to throw some light on scale readings by comparing the hatchery lake growth with the normal stream growth. The third and chief object was the comparison of three methods of liberating fry; liberating (1) large fry in the fall, (2) yearlings in the spring, and (3) small fry in the spring. To accomplish this it was planned to mark three batches of fish corresponding to the three enumerated above. Of the first two batches of fry from November, 1919, eggs, the first was to be marked and liberated in September, 1920, and the second in the spring of 1921. The third, from the fall of 1920 eggs, to be marked and liberated in the spring of 1921.

The first batch was marked as planned but the remainder of the experiment was unexpectedly upset by the behavior of the Sacramento River. These marked fish were to have been liberated sometime in November of 1920, but the fall floods of the Sacramento broke levees and it was feared that too great a loss of young fry would result if the liberation were made during the time of floods, so it was necessary to hold the fish over winter. However, the marking already completed should contribute something toward determining ocean migrations and possibly scale growth characteristics. The following is an account of the marking of the first batch of salmon fry.

Scurce of Eggs and Hatching.

The King or Chinook salmon eggs were taken by the United States Bureau of Fisheries at its substation on Mill Creek, a tributary of the Sacramento River, Tehama County, California. The eggs were taken the latter part of November, 1919, eyed at Mill Creek and sent in a shipment of 1,258,000 to Sisson, California, where they were received February 10, 1920. They were hatched the latter part of February at the Mount Shasta Hatchery, a state hatchery at Sisson. After several weeks in the troughs the fry were transferred on May 27, 1920, to Klink's Lake, one of the three lakes at the hatchery used for holding fry before the final planting in the stream. Here they remained till the end of September when part of them were returned to the hatchery for the purpose of marking.

Size of Fry.

These fry in the latter part of September, 1920, were ten months old reckoning from the time the eggs were collected or seven months from the time of hatching and had spent four months in Klink's Lake. A sample of 120 of these fish taken at random on September 27 showed an average length of 7.9 centimeters, or 3.1 inches. The greatest extremes in length of fish from this sample were 5.8 to 10.8 centimeters, or 2.3 to 4.25 inches. Other extreme cases were found where the range was from 4.5 to 13.0 centimeters, or 1.8 to 5.1 inches. The measurements were made from the tip of the nose to the tip of the central rays of the tail fin.

Mark and Number Marked.

The mark used was the removal of the adipose fin and the posterior half of the dorsal fin by clipping with cuticle nippers. Twenty thousand fry were marked, the marking being started on September 25 and finished on October 4, 1920. The marking was done by C. L. Frame of the Department of Fish Culture and W. L. Scofield of the Departmentof Commercial Fisheries.—W. L. Scofield.

A NEW SPECIES OF FISH FROM SANTA CATALINA ISLAND.

A specimen secured from the Avalon Aquarium has been described as a new species by Carl L. Hubbs, of the Museum of Zoology, of the University of Michigan.* This new fish is of particular interest because it has been named for Mr. William Francis Thompson, in charge of the State Fisheries Laboratory, of the California Fish and Game Commission, who is the author of many important works on marine fishes.

Sciaena thompsoni is most similar to three Panamaic species, but has fewer dorsal fin-rays and longer caudal peduncle, as well as other differences.

*Hubbs, Carl L. 1921. Description of a new Scienoid fish from Santa Catalina Island, California. Occ. papers Museum of Zoology. No. 92, pp. 1–3, 1 pl.

BARBLESS FISH HOOKS.

Certain sportsmen's angling clubs are advocating the use of barbless hooks for catching fish, arguing that it is more sportsmanlike for it gives the fish a chance for its life. Besides its being a more creditable performance, they say, to catch fish with a barbless hook, the undersized fish when returned to the water will be more apt to survive as they are hurt very little.

It is interesting to note here that the commercial fishermen in fishing for long-finned tuna, skipjack and bonito in southern California use principally barbless hooks. The motive in their case is not to give the fish a better chance for their life, but to enable them to catch them faster, for the barbless hook is more quickly extracted and time is thus saved when the fish are coming fast.

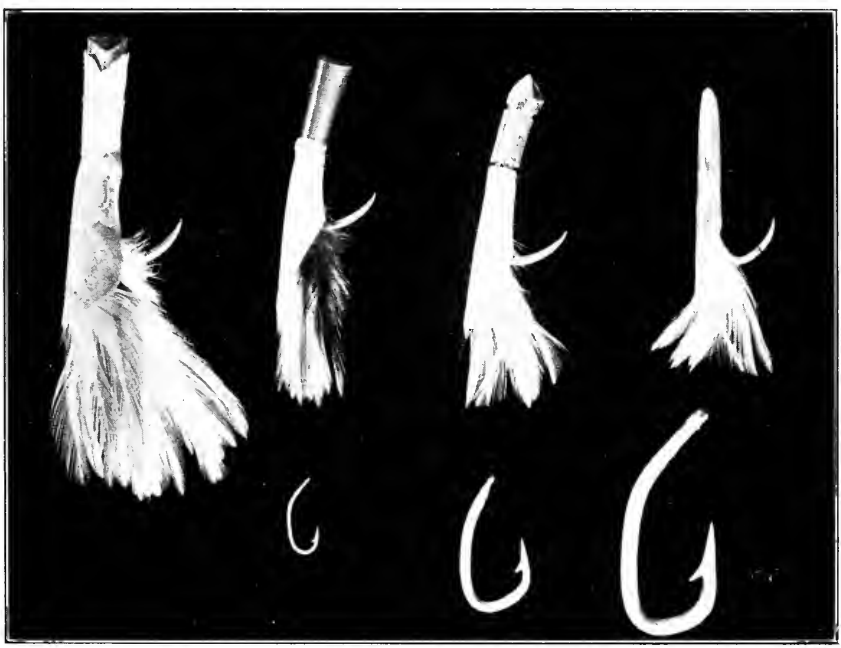


FIG. 41. Barbless hooks used in the capture of tuna. Photograph by H. C. Bryant.

LIFE HISTORY NOTES.

THE PORCUPINE AS FOOD.

An animal, purely a vegetarian, that plays great havoc with gardens all through this country, is the porcupine. Sometimes, all of the garden stuff on outlying ranches in this section is completely destroyed by this pest. One of our rangers trapped a good many porcupines in his garden at a ranger station last summer, and he and his family used them to a considerable extent as food. I have eaten porcupine meat on several occasions during the past summer and found it to be quite palatable. Only for the fact that the meat is coarser in texture, one could imagine he was eating beef—provided of course, that the porcupine is young. An old porcupine is the toughest chewing imaginable—WM. S. BROWN, *Alturas, California.*

TREE SQUIRRELS INFESTED WITH SCABIES.

A dead California gray squirrel (*Sciurus griseus griseus*) was recently sent to the University of California by Deputy Ewell Gray from Placerville, California, for post mortem, as it was afflicted with a disease which has been killing off great numbers of gray squirrels in the El Dorado National Forest. The disease was first noticed among the squirrels on the Georgetown Ridge in 1917. The gray squirrels were practically exterminated in this district. Since then, the disease has spread from this vicinity and is now most noticeable in the southeastern part of the county.

The first evidence of the disease is to be seen in a scaly or mangy appearance around the head and neck. This is followed by sores over the rest of the body and the hair falls off. Dead squirrels are to be found at the bases of trees and in streams of water.

Examination, by the veterinary and entomological departments of the University of California of the specimen sent in showed the disease to be a form of scabies. According to Professor Stanley B. Freeborn, the cause is to be found in a mite belonging to the genus *Notoedres*. These mites live in little tunnels dug in the skin and they eventually cause bad sores which weaken the animal to such an extent that death finally ensues. A closely related species found on the cat has recently been transmitted to the rabbit, horse, dog and man, always with difficulty and with no serious effect. Laboratory rabbits infested with a similar species of mite invariably die a more or less lingering death, if left untreated. Thorough washing followed by applications of sulphur ointment repeated three or four times, at intervals of five or six days, generally produces satisfactory cures in these animals, if taken early.

It is to be hoped that this epidemic will disappear, as do most epidemics of this kind.—H. C. Bryant, *Berkeley, Calif.*

ANTELOPE SHOW INCREASE.

Prong-horn antelope (*Antilocapra americana*) near Mount Dome in Butte Creek Valley appear to be on the increase. Mr. Crawford, of Yreka, recently counted 108 animals near Mount Dome. This is an increase of sixteen head over the last count of these antelope. This increase is apparently due to the careful enforcement of the law which gives total protection to the antelope—J. O. Miller, *Yreka, California.*

REPORTS.

SEIZURES—FISH AND GAME; ILLEGALLY USED FISHING APPARATUS.

Game.

Deer meat	141	pounds
Quail	253	
Ducks	797	
Doves—pigeons	9	
Rabbits—squirrels	2	
Pheasants	3	
Swan	1	
Mudhens	18	
Miscellaneous birds	80	
Deer hides	1	

Fish.

Striped bass	617	pounds
Halibut	1,000	pounds
Salmon	3,031	pounds
Young smelt	415	pounds
Trout	8	
Crabs	2,164	
Crab meat	30	pounds
Abalones	37	
Clams—Pismo	101	
Clams—cockle	232	pounds
Lobsters	811	
Illegal nets	9	

Searches.

Illegal fish and game	9

VIOLATIONS OF FISH AND GAME LAWS.

October 1, 1920, to December 31, 1920.

Game.

Offense	Number of arrests	Fines imposed
Hunting without license	47	$853 00
Hunting on posted grounds	4	130 00
Trapping without license	2	35 00
Deer—closed season—killing or possession	13	625 00
Does—spike bucks—fawns—killing or possession	4	225 00
Illegal deer hides	2	30 00
Brush rabbits—squirrels—closed season—killing or possession	5	150 00
Quail—closed season—excess limit—killing or possession	35	1,048 00
Doves—closed season—killing or possession	1	25 00
Ducks—excess limit—closed season—killing or possession	14	480 00
Mudhens—closed season—killing or possession	3	75 00
Wild pheasants—swan—closed season—killing or possession	6	275 00
Non-game birds—killing or possession	33	660 00
Protected shore birds—killing or possession	15	400 00
Bear—closed season—killing or possession	2	20 00
Shooting from power boat	8	35 00
Night hunting	17	550 00
Destroying state evidence	1	30 00
Total game violations	212	$5,646 00

Fish.

Angling without license	6	$150 00
Fishing for profit without license	2	20 00
Clams—undersized—excess limit—taking or possession	16	375 00
Crabs—undersized—taking or possession	4	95 00
Abalones—undersized—excess limit—taking or possession	4	100 00
Lobsters—undersized—excess limit—taking or possession	10	170 00
Striped bass—under weight—offering for sale closed season—excess limit	6	140 00
Halibut—excess limit	1	50 00
Selling steelhead not properly tagged	1	75 00
Young fish—taking or possession	3	60 00
Fishing in restricted waters	1	
Illegal nets in restricted districts	6	200 00
Total fish violations	60	$1,435 00
Grand total fish and game violations	272	$7,081 00

CALIFORNIA FRESH FISHERY PRODUCTS FOR MONTHS OF OCTOBER, NOVEMBER, DECEMBER, 1920.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Total	Mexican
Albacore											96,633		993	97,626	
Anchovies			60				20,370		96,681				14,170	130,661	
Barracuda								3,573	22,610	78,716	298,008	251	32,943	436,101	1,530,931
Bluefish								36	15,531					15,567	
Boccaccio							10,186	72,326	291,278					373,790	
Bonito								41	36	11,924	287,260		20,060	319,321	54,584
Carp				147	1,206	6,986								8,129	
Catfish		7,881		3,985		5,950								17,817	
Chilipepper								33,458	150,813					184,251	
Cultus cod	30						51,005	11,199	63,878					126,112	
Eels												180		180	
Flounders	406		41	583		3,451	15,877	875	640		554			22,430	
Grayfish						65	29,950	1,375	710		15,389	234	89,507	128,230	
Hake							58,057							58,057	
Halibut							1,242	38	285	27,463	175,427	2,026	38,564	245,055	574,468
Hardhead					197	270								467	
Herring	739		17,239			2,420	28,040							48,038	
Kingfish							671	18,814	11,500		57,257	672	1,520	90,434	48
Mackerel								2,175	123,404	6,405	683,247	7,248	12,713	835,193	10,824
Perch	4,302		15,648			3	22,653	1,000	1,005	41	10,708	1,119	1,995	58,474	4,950
Pike				42	433	1,994								2,469	
Pompano							459		51		7,705			8,215	
Rock bass										9	35,618	1,254	10,518	47,399	1,980
Rockfish	1,016						102,982	85,493	178,517	5,172	235,294	4,394	242,090	854,808	10,932
Sablefish							181,692							181,692	
Salmon	331,459		94	17,542		12,877	21		38					362,031	
Sand dabs							46,580	12,441	90		1,781			60,905	
Sardines						200	424,985	3,122,554	20,415,121		69,116		158,981	24,190,957	
Sculpin											12,629	95	2,195	14,919	
Sea bass—black										743	14,453		3,823	19,019	24,112
Sea bass—white			15,892				3,253	11,360	629	28,778	60,228	1,134	2,733	124,007	31,740
Sea trout							24						42	66	

Shad				78		755								833	
Shad—buck						88								88	
Sheepshead										85	1,772		2,037	3,894	
Skates							19,095		140		87			19,322	
Skipjack								84			730,775	77	588,469	1,319,345	
Smelt	7,467		3,527			320	3,842	1,391	26,895	6,444	50,603	93,293	7,895	201,677	13,002
Sole	33						594,119	237,756	1,161		16,764		947	844,780	530
Splittail					798	644								1,442	
Striped bass			24	9,782		91,609	1,873							103,288	
Stingaree													1,485	1,485	
Suckers					551									551	
Swordfish											2,598		370	2,968	
Tomcod							4,450	480						4,930	
Trout—steelhead	1,089													1,089	
Tuna											243,267	35	585,911	829,213	25,903
Tuna—bluefin											6,070			6,070	
Tuna—yellowfin											1,031,522			1,031,522	
Turbot			334											334	
Whitebait			542											542	
Whitefish											2,607	150	1,165	3,922	435
Yellowtail										991	994,762	1,663	182,790	1,180,206	96,935
Miscellaneous	851		6				10,234	31,448	4,194	46,297	8,433	581		102,044	
Total fish	347,392	7,881	53,410	32,160	3 275	126,932	1,622,650	3,647,810	21,404,607	213,069	5,144,567	114,416	2,003,856	34,722,025	2,381,374
Crustaceans—															
Crabs (doz.)	39		169				11,692	7						11,907	
Shrimps							73,697				681			74,378	
Spiny lobsters										29,584	93,079	3,077	33,565	159,305	281,878
Mollusks—															
Abalones									182,852	40,435				223,287	28,355
Clams—cockle	140		1,812											1,952	
Clams—mixed	5,355	36	6,719			804								12,914	
Clams—Pismo								75		52,139				52,214	
Clams—softshell			4,440			54,697	17,065							76,112	
Cuttlefish							1,572	130	6,483		17			8,202	
Mussels						76	288	125						489	
Oysters—															
Eastern (No.)			255,537				1,390,947							1,646,484	
Native			1,905											1,905	
Snails											60			60	
Squid									440		110			550	

All amounts shown in pounds unless otherwise specified.

STATEMENT OF EXPENDITURES.

Period from July 1, 1920, to January 31, 1921.

Administration:		
Commissioners	$ 310 68	
Executive offices	14,870 58	
Printing	3,259 87	
Research and publicity	3,533 79	
Accident and death claims	1,179 53	
		$23,151 45
Commercial fish culture and conservation:		
Superintendence	8,737 52	
Inspection and patrol	17,803 38	
Research	18,096 36	
Statistics	5,778 17	
Market fishing license commissions	299 50	
Propagation and distribution of salmon	16,748 52	
		$67,463 45
Sporting fish culture and conservation:		
Superintendence	9,137 87	
Printing	172 04	
Prosecutions and allowances	212 50	
Angling license commissions	11,731 60	
Fish exhibits	4,293 19	
General patrol—pro rata share:		
San Francisco District (40 per cent)	22,457 19	
Los Angeles District (40 per cent)	9,566 74	
Sacramento District (40 per cent)	16,842 10	
Propagation and distribution of trout	94,031 27	
		$168,417 50
Game conservation:		
Printing	199 83	
Prosecutions and allowances	957 98	
Hunting license commissions	18,078 90	
Mountain lion hunting (and bounties)	4,812 58	
General patrol—pro rata share:		
San Francisco District (60 per cent)	33,553 68	
Los Angeles District (60 per cent)	14,259 67	
Sacramento District (60 per cent)	25,259 98	
		$97,152 62
Tahoe camping ground		402 11
Grand total		$356,620 13

CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 7 SACRAMENTO, JULY, 1921 Number 3

CONTENTS.

CALIFORNIA HAWKS: HOW TO IDENTIFY THEM.

By Harold C. Bryant.

From being the most maligned of all birds, the hawks and owls are now coming to be recognized as among the most helpful to mankind. Members of this group have been continually persecuted because a few species have shown themselves to be destructive to domesticated birds and mammals. Each hawk and owl has been judged by circumstantial evidence, and prejudice has caused the good to suffer with the bad.

In recent years, the farmer has come to a realization of the great damage caused by ground squirrels, gophers and other rodents and he

is willing that all the natural enemies of these pests should be encouraged. As a consequence, state laws protect the beneficial species of hawks and blacklist the destructive ones. Nevertheless, a beneficial hawk hanging on a roadside fence or tacked to the side of a barn is still a too prevalent sight. With the exact data on food habits that we now possess, there is no excuse for ignorance as to the economic value of each species.

In the hope of stimulating interest in the preservation of the beneficial raptores the following analysis of the destructive and beneficial hawks has been made, together with a field key, which, it is hoped, will make identification possible.

BIRDS OF PREY.

Birds of prey are recognized by strongly hooked bills with a soft skin, the "cere," surrounding the nostrils, and by the large strong feet with flexible toe joints, and long, curved, sharp talons which are powerful weapons for grasping and killing prey. Of particular use are the latter in holding the prey while it is torn to pieces. In the vultures, which are carrion feeders, the talons are not so well developed. All have a swift, sure flight. Their whole structure betokens "strength, activity, ferocity, and predatory nature." Although the above anatomical characteristics are held in common by all the raptores, yet a close study shows that the different species are grouped together because of like habits rather than because of like structure.

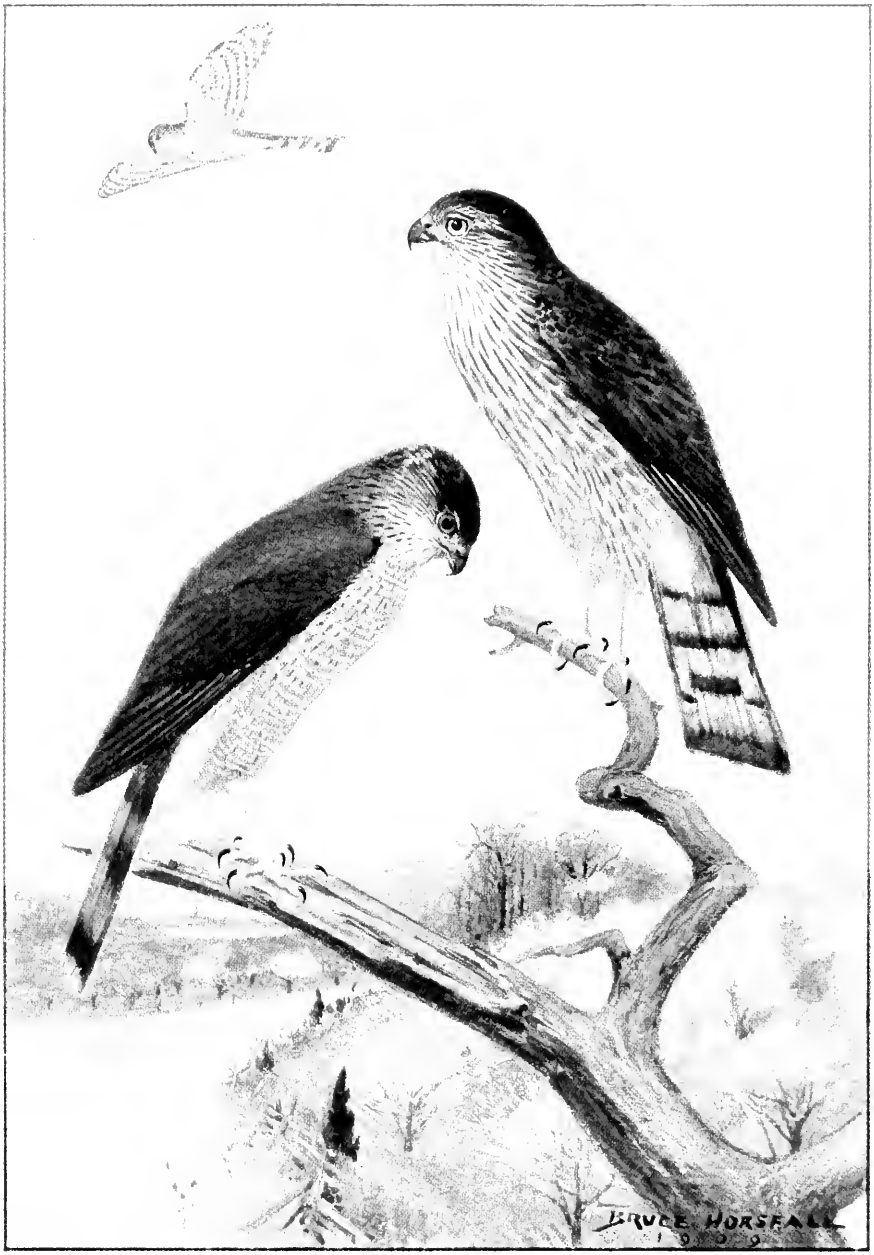
Hawks fly by day, and in the economy of nature owls take their place at night. The owls may be distinguished by their eyes being directed forward and by the disks of radiating feathers which surround the eyes. They are among the few birds which have binocular instead of monocular vision. Hawks have less fluffy plumage and smaller heads than owls.

The hawks are slow breeders, most of them laying but two eggs each season and rearing but one brood each year. The young grow very slowly and remain in the nest for a considerable period of time before developing the powers of flight.

Identification of hawks is oftentimes made difficult because the same species frequently has two color phases. Blackish or melanistic forms are of frequent occurence in several species of beneficial hawks. Since dark colored birds do not appear among the destructive bird eating hawks, it is safe to say that all black hawks are useful. Another means of discriminating between good and bad hawks is to be found in the seasonal occurrence; the destructive hawks are almost invariably winter visitants, consequently, the chances are that hawks shot in the summer are beneficial ones.

As a rule the sexes are colored alike. There is, however, a marked difference in size, the female being the larger. The fluffy juvenile plumage makes the young bird appear larger than the adult.

The food is made up chiefly of rodents and insects, and the birds gorge themselves whenever opportunity offers. Although the flesh is often picked from the bones, small animals are usually swallowed whole. Indigestible parts are often regurgitated in the form of pel-



SHARP-SHINNED HAWK

(Right Hand Figure, Immature Female: Left Hand Figure, Adult Male)

Order—Raptores
Family—Falconidæ
Genus—Accipiter
Species—Velox

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lets. The hair, bones, and other elements in a pellet can be identified and a comprehensive idea of the food may be obtained by a study of such pellets.

KINDS OF HAWKS.

Hawks are usually divided into four main groups: The meadow hunters, known as *harriers* (represented by but one form, the marsh hawk); the woodland hawks, known as *accipiters;* the soaring hawks, the *buteos* and eagles; and the "long winged chasing" hawks, known as *falcons.* Sometimes the carrion feeders, known as *vultures*, are included.

THE BLACKLIST.

By far the larger number of hawks are beneficial. It is, therefore, better to know the villians than to attempt to know all of the beneficial species. Attention is accordingly called to the following hawks which may properly be blacklisted. State laws give these hawks no protection.

All of the destructive species belong to the third group, the *accipiters.* All are typical bird hawks with long tails, short rounded wings, comparatively small heads, and with a rapid, darting flight. In the open their flight consists of alternate flappings and sailings. Seldom, if ever, do they give any cry. All habitually frequent wooded or brushy areas. These birds usually watch for their prey from some vantage point and dart in among the trees or brush to secure it. In the hand, they are readily identified by their short broad wings, and slender unfeathered legs and feet.

Three of the destructive species are very much alike in coloration and habits, their main difference being in size. We can, therefore, speak of three editions of the "chicken hawk." The first is the small sized "chicken hawk" known as the "sharp-shinned hawk." (See plate 1.) The second is the medium sized bird and perhaps the best known of all those attacking poultry, the Cooper hawk, sometimes called the "bullet hawk," and rightly called a "chicken hawk." An additional field character, to that of size in distinguishing the sharp-shinned from the Cooper hawk, is to be found in the shape of the tail. The tail of the sharp-shinned hawk is square-ended, whereas, that of the Cooper hawk is rounded. The third is the larger species found only in the higher mountains and in the northern part of the state, the western goshawk. All three are sometimes dubbed "blue darters" because of their manner of hunting. Very often they capture their prey in mid-air. The adult goshawk can be recognized in the open by its bluish colored back and wings and barred breast, as constrasted with the striped or streaked breast of the Cooper and sharp-shinned hawk. The young of the goshawk, however, have streaked breasts and can easily be confused with the Cooper hawk.

The food of these three hawks is made up almost entirely of birds, the larger species feeding to a considerable extent on such game birds as quail and grouse, in fact, to such an extent that the Cooper hawk is often known as the "quail hawk" and the goshawk as the "grouse hawk." The Cooper hawk often attacks pigeons and returns day after day to claim a victim. Stomach examination has shown that this hawk feeds almost wholly upon wild birds and poultry. Of all the common hawks this is the most "audacious highwayman." It preys commonly

on valley quail. In a nest of a pair of Cooper hawks in the San Jacinto mountains the remains of three chickens, a blue jay and a chipmunk were found (Grinnell and Swarth, 1913). The sharp-shinned hawk, of much smaller size, feeds upon the smaller birds, almost all of the commoner song birds falling prey to it. In the Fresno district, the birds which seem to suffer most from attacks by the sharp-shin are mockingbirds, intermediate sparrows, valley quail, and say phoebes (Tyler, 1913). This hawk dashes in and out among trees and shrubbery and often perches on larger limbs inside the foliage. It is most common about willow thickets and the trees along streams. A crashing sound as it strikes a bird in the foliage often betrays its presence and little bunches of feathers bear mute evidence of tragedies enacted. All

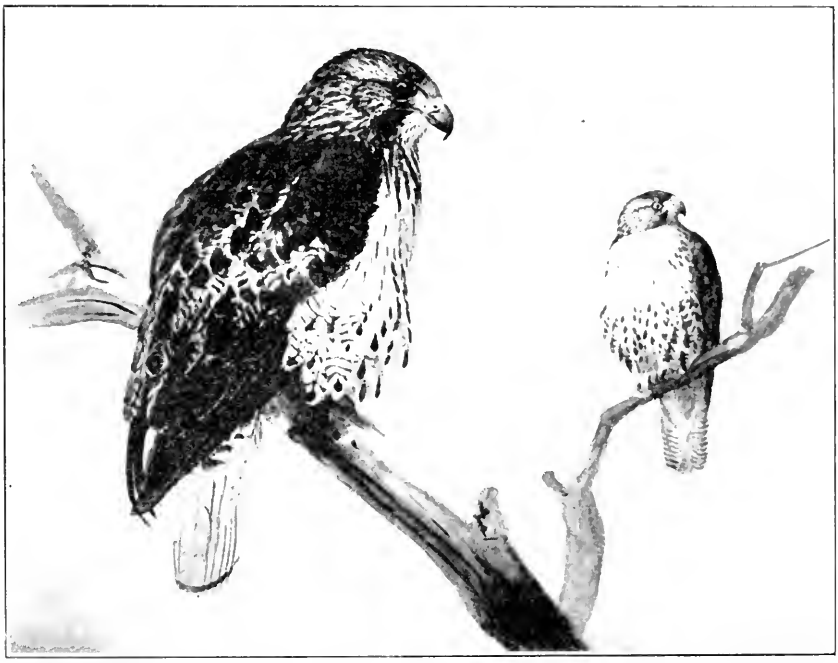

FIG. 42. Red-tailed Hawk (*Buteo borealis*). Courtesy of the United States Bureau of Biological Survey.

three species are likely to make their appearance in the chicken yard, in fact, about ninety-five times out of a hundred it is one of these three hawks which is to blame when poultry is found to have been taken by a hawk.

The duck hawk is the most powerful of the destructive species. It is a true falcon, and in Europe was considered the "noblest" of the birds used in falconry. It fearlessly attacks ducks and has even been known to attack some of the larger waterfowl. The rush of wings at it attacks its prey is said to resemble a heavy wind. Its food comprises birds, both game and nongame. Birds recorded as falling prey to the duck hawk in California are as follows: blackbirds, meadowlarks, red phalaropes, black turnstones, murrelets, auklets, ducks, doves, jays, and even sparrows. Furthermore, it is said to kill apparently for pleasure. At

any rate, it often kills more birds than it eats. Stomachs of two duck hawks from southern California, each contained the remains of a mourning dove. The short tail, pointed wings, slate-colored back, and black patches on the face should help in identifying this bird; but the general actions are still more useful in recognizing it.

The prairie falcon, much like a duck hawk in appearance, lives in the rough foothill country, nesting about cliffs, and is noted as a destroyer of ground squirrels. Although a close relative to the duck hawk, it is to be numbered among the beneficial species.

BENEFICIAL HAWKS.

The two best known beneficial hawks are the red-tailed hawk (see fig. 42) and the sparrow hawk (see fig. 43). The former is the large

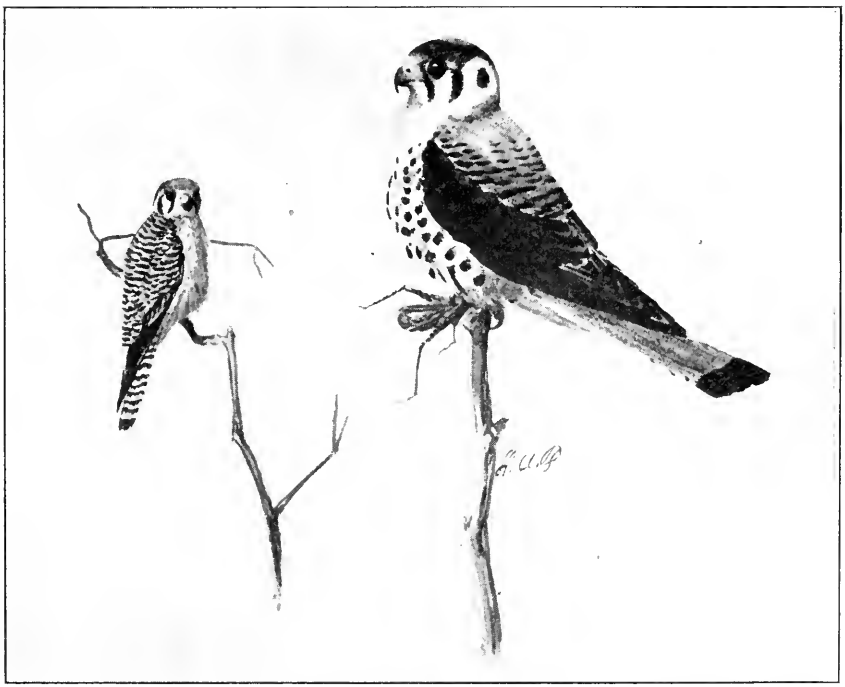

FIG. 43. Sparrow Hawk (*Falco sparverius*). Courtesy of the United States Bureau of Biological Survey.

hawk commonly misnamed "hen hawk," which is most often to be seen soaring around and around high in the air over open country, or perched conspicuously on top of a dead tree or telegraph pole. In the adult bird, the tail is reddish brown, but in the young birds the tail is barred. The common hawk call, sounding like the syllables "*pee-yarr,*" which so often drives poultry to cover, is given by this bird, but it very seldom bothers birds of any kind. The red-tailed hawk is a typical rodent hawk, having large clumsy feet suitable for capturing small animals on the ground. In flight also, the bird is too slow and clumsy to be successful in capturing birds. The occasional red-tail that attacks poultry

is usually a young bird, showing that the species prefers other types of food.

The food of this hawk is made up very largely of ground squirrels and mice, to which is added a goodly supply of some of the larger insects, such as crickets and grasshoppers. The stomach of a red-tailed hawk taken in the Berkeley hills contained one meadow mouse and two pairs of jaws of the common "potato bug," or "Jerusalem cricket." One red-tail taken in Los Angeles County contained a gopher; and three others were found to have been feeding on rabbits (Bryant, 1918). Over ninety per cent of the food of this hawk is made up of noxious mammals and insects. Remains of two ground squirrels were found in the nest of a pair of red-tails in San Diego County (Dixon, 1917). In nests of the red-tail remains of gophers, ground squirrels, meadow mice, a young cottontail rabbit, and two snakes—a striped racer and a gopher snake—were found (Dixon, 1906). The red-tail preys upon snakes and may often be seen carrying a snake in its talons. Stomach analyses made by the government show over eighty-five per cent of the food to be rodents.

A near relative of the red-tailed hawk is the Swainson hawk with a white throat and dark band across the breast. This is the only California hawk which develops a flocking habit. During the migration period, Swainson hawks may be seen in flocks moving leisurely across country. This bird might well be called a grasshopper hawk for it is most often to be seen capturing grasshoppers in open fields. The birds in catching grasshoppers are said to skip about in an awkward way looking as if rather ashamed of the performance. This species also feeds on mice and gophers (Tyler, 1913). This is a fairly common hawk in our great valleys.

Another relative less often seen is the ferruginous rough-leg, so called because of the feathering on the legs, which reaches to the toes. The bird, figuratively, wears boots, and this booted appearance is helpful as an identification mark, also the white underparts, often with a dark band, and the white patch at the base of the tail on each side. The rough-leg prefers open country and is often to be seen perched on the ground near squirrel burrows. This hawk, perhaps more than any other, merits the name "squirrel hawk." Meadow mice also prove tempting as food. A rough-leg taken at Cotati, Sonoma County, contained seven meadow mice (Bryant, 1913).

The rarer red-bellied hawk is a bird of the lowlands and marshes, recognized by its reddish brown breast and its mode of flight, which reminds one of that of a horned owl. This hawk feeds on caterpillars, insects and small rodents. The stomach of one bird taken near Corona, Riverside County, contained "potato bugs" (*Stenopelmatus*) and beetles, and that of another a pocket gopher (Pierce, 1919). The stomach of a third taken in Fresno County contained large hawk moth caterpillars, beetles and "potato bugs" (*Stenopelmatus*), (Bryant, 1921). In the nest of a pair of red-bellied hawks in San Diego County, was found one ground squirrel and two pocket gophers, carried there to feed the three young birds in the nest (Dixon, 1917). In another nest was found a brush rabbit, hair of a ground squirrel and an alligator lizard (Sharp, 1906). Stomach examination has shown fence lizards (Dixon, 1906), Jerusalem crickets and caterpillars.

The golden eagle (see fig. 44), although often accused of stealing farm animals and poultry, is deserving of careful protection, for its food is made up almost wholly of the larger rodents. A nest examined by J. B. Dixon in San Diego County, contained the remains of eleven ground squirrels, largely the surplus carried to the two young birds in the nest (Dixon, 1917). Rabbits and ground squirrels are the principal items of food. The notable decrease in numbers has been due to the desire

FIG. 44. Golden Eagle (*Aquila chrysaetos*). (Drawn by R Ridgway.) Courtesy of the United States Bureau of Biological Survey.

of many to kill something large, not to a desire for relief from depredations. It is particularly important that the golden eagle be left unmolested by the rancher.

The bald eagle (see fig. 45) depends so largely upon fish as a diet that it is almost invariably found along the sea coast or about large inland lakes. An occasional fawn, lamb, or pig is taken, but this eagle is primarily a fisherman. On San Clemente Island and other islands of the

Santa Barbara group, where this eagle nests, it is said to feed on sheep and lambs, as evidenced by bones near the nest (Howell, 1917).

The sparrow hawk (see fig. 43) is the smallest and usually the most common of all and is often to be seen perched on fence posts or telegraph poles. It has a cry that sounds something like the words "*killy-killy-killy-killy*," which sometimes gives it the name of "killy" hawk. The reddish brown tail of the adult and the black bars on the face will

FIG. 45. Bald Eagle (*Haliaeetus leucocephalus*). (Drawn by R. Ridgway.) Courtesy of the United States Bureau of Biological Survey.

help in the recognition of the bird, as will also its habit of poising in the air with beating wings. The sparrow hawk develops speed and captures its prey by dashing directly after it.

From the sharp-shinned hawk the sparrow hawk is distinguished by sharp, pointed wings which are in contrast to the short, rounded wings of the former. In the hand all of the falcons may be recognized by the notch near the tip of the bill which is lacking in other hawks. Although called "sparrow" hawk, this hawk very seldom preys upon birds, preferring large insects and mice. Grasshoppers and large beetles form

the principal items of food. Tyler (1913) reports grasshoppers as the staple diet of some sparrow hawks in Fresno County.

The less common pigeon hawk is to be distinguished from the more common sparrow hawk by its darker coloration, by a blackish instead of a brown tail, and by the white throat patch. This hawk has a habit of perching humped up on conspicuous perches and when frightened flies swiftly and fairly close to the ground to another perch not far distant. The pigeon hawk does not confine itself so largely to insects as does the sparrow hawk and is guilty of preying upon small birds as well as rodents.

In lowland country the marsh hawk (see plate 2) is a familiar bird with its long wings, long narrow tail and white rump patch. It is usually to be seen flying along with leisurely strokes of the wings, about three or four feet above the ground, quartering back and forth over the meadows and marshes searching for its prey, which is comprised almost entirely of meadow mice. On the sight of a mouse the bird suddenly plunges downward and makes off with the luckless animal. The marsh hawk will occasionally help himself to a bird, or even to poultry if available. The author once saw a marsh hawk make off with a killdeer. It will be found, however, that individuals, rather than the species as a whole, are responsible for depredations of this kind. With the possible exception of the skunk, there is no animal that exerts better control on meadow mice than the marsh hawk.

Young marsh hawks are reddish brown all over, but the adult male has a whitish breast, gray back, and wings with black tips—suggestive of a gull. This is the only American hawk belonging to the *harrier* or meadow hunter group and the only hawk which nests on the ground.

The white-tailed kite, another hawk which is gull-like in appearance and which frequents the marshes, is now very rare in California and needs careful protection to save it from complete extermination. Its food habits proclaim it a beneficial hawk. The stomach of a specimen from Santa Rosa contained a meadow mouse.

The osprey, or fish hawk, is found along the sea coast and around the larger bodies of water in the interior. The white head and breast are conspicuous. This bird feeds exclusively on fish, especially such slow moving ones as carp and suckers.

The United States Department of Agriculture has pointed out that "the sooner farmers, ranchers, horticulturists, and nurserymen learn that the great majority of birds of prey are their friends, and deserve protection, the sooner will depredations of noxious rodents and insects diminish." By encouraging beneficial hawks time and effort is saved, for they automatically help control rodent and insect pests, being ever alert and ready to move to a center of infection. If given a chance, they will prove more effective than either traps or poison. Protection of hawks is the most economical pest control measure.

It must be remembered that even the so-called destructive hawks have their place in Nature, for natural enemies of birds tend to maintain within proper bounds the numbers of the species on which they prey and preserve their fitness. Many believe that the relation between the predator and the animal preyed upon is such that direct increase follows destruction of the predatory species. These same individuals maintain that on an area set aside as a refuge, increase of bird and animal life

will not be noticeable unless "vermin" be destroyed. Since in the early days abundance of game was coincident with abundance of natural enemies this contention does not seem reasonable. Rather should one understand that under natural conditions there is a certain balance struck between a species and its natural enemy and oftentimes the activities of one help to balance those of the other.

Forbush (1916) who defends the above point of view gives the following example:

"The marsh hawk (*Circus hudsonius*) feeds to some extent on marsh birds and their young, but a much larger part of its food consists of meadow mice and frogs. These mice certainly would be very destructive to young birds were they not held in check, and large frogs are known to swallow the young of water birds. Marsh hawks and other enemies prevent many frogs from reaching a size when they would be dangerous to young birds.

"If nature is undisturbed, therefore, all the birds are reared and maintained that the land will support, but when civilized man steps in and disturbs the natural arrangement and balance, then, and perhaps then only, the natural enemies of birds may become unduly destructive, and must be checked."

Rodents constitute our worst farm pests. Were it not for natural checks to their increase it would be impossible to grow crops. Field mice have from four to six litters of young a year with from two to thirteen comprising each litter. It has been estimated that one pair of meadow mice are capable of producing nearly a million young in five years. Of course, such an increase is never really possible because of natural checks, including natural enemies. To eliminate natural enemies or even reduce their number disturbs the balance and increases the numbers of the pest.

Of course, artificial means of check, such as trapping and poisoning, have been devised, but their use entails time, energy, and expense. By encouraging natural checks on the increase of rodents more can be accomplished with less expenditure of effort. Most hawks eat rodents, and herein lies the reason for their encouragement.

A FIELD KEY.

Lest the good hawks be destroyed with the bad it is necessary to distinguish friend from foe. Ability to recognize the different species of hawks is, of course, the shortest road to conservation of the beneficial and destruction of the injurious. The average person finds it difficult to name a hawk seen in the open by reference to the average bird book because the distinguishing characters given are those suitable for use with a dead bird or specimen. As an aid to identification of live birds in the open the following key of field characters is appended, a key which it will be found emphasizes quite different characters from the more familiar ones found in bird books. This key has been prepared as an experiment to determine whether keys of this kind are possible, or useful. No doubt more accurate observation would be productive of

N. B. The United States Department of Agriculture has issued several bulletins dealing with the economic value of hawks, notably the authoritative work, "Hawks and Owls of the United States," by A. K. Fisher, which may often be consulted in libraries. The value of each species is judged by the results of many stomach examinations. Another review of the value of hawks is to be found in the National Geographic Magazine, Vol. 38 (Dec., 1920), under the authorship of Louis Agassiz Fuertes.

MARSH HAWK

Order—RAPTORES Family—BUTEONIDÆ
Genus—CIRCUS Species—HUDSONIUS

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still better field characters and in the light of later knowledge a better key devised.

The characters which must be studied in order to use the key are: mode of flight, shape or general countour, color, color markings, and habitat. Even a better character in some cases is the call, but this has not been widely used in the key because of the difficulty of conveying an idea of the call by means of syllables. Then too, some hawks are notably silent and others are heard to call only in the breeding season.

Field Key to California Hawks.

A Soaring flight; birds of open country, or large bodies of water.

B Body black or blackish brown in color.

C Head not feathered and reddish in color.

D About 30 inches in length, without white patches on underside of wings; wing tips silver gray beneath; carrion feeder_____ _____(Turkey Buzzard) TURKEY VULTURE

DD About 50 inches in length, with snow white patches on underside of wings (under wing coverts) appearing as windows when the bird is soaring overhead; carrion feeder; very rare _____ _____(Condor) CALIFORNIA VULTURE

CC Head feathered.

E Head and tail of adult white in color; bare yellowish legs; call *cac, cac, cac;* chiefly near sea or large bodies of water____BALD EAGLE

EE Head and tail of adult blackish brown; found in mountainous regions_____GOLDEN EAGLE

BB Body brownish in color; head feathered; thick set with broad rounded wings and broad spread tail.

F Less than 30 inches in length; under 4 feet wing spread.

G White patches on base of tail above; dark band separating white throat and belly; conspicuous black "wrist marks" under wing; legs feathered to base of toes; often perches on ground. (The American Rough-leg is a rare winter visitant which differs but slightly from the resident bird)_____ _____(Squirrel Hawk) FERRUGINOUS ROUGH-LEG

GG No white at base of tail; legs (tarsus) strong and unfeathered.

H Tail of adult reddish brown with whitish tip (immature birds readily confused with other Buteos); call a high pitched whistled *keee, keeee,* suggestive of the sound of escaping steam; tail spread fan-like in flight_____ (Hen Hawk; Buzzard Hawk) WESTERN RED-TAILED HAWK

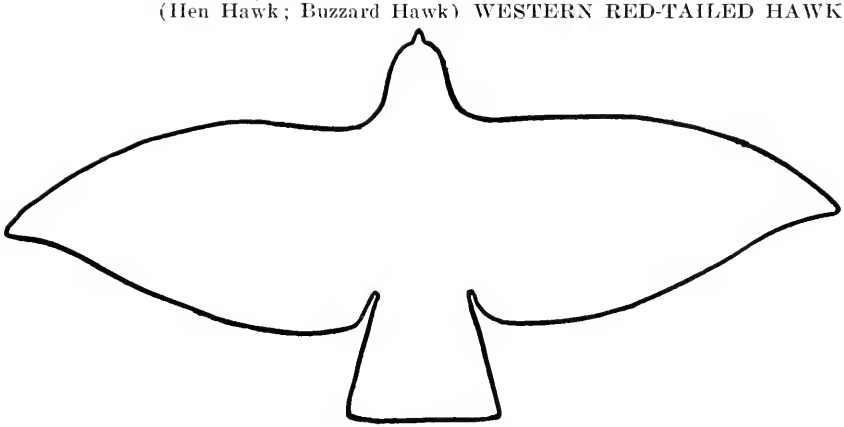

FIG. 46. Outline drawing of the red-tailed hawk, made directly from a freshly killed specimen, showing the broad type of wing usable as a recognition mark for this bird and other Buteos.

HHH Tail barred with brown and breast with band of brown; forehead, chin and throat white; commonly feeds on grasshoppers; only hawk displaying flocking habit; call *pi-tick, pi-tick, pi-tick,* frequently repeated (Bailey)_____SWAINSON HAWK

HHHH Tail blackish with white bars; breast and shoulders rusty red _____RED-BELLIED HAWK

FF More than 30 inches in length; wing spread over 6 feet; base of tail white in young; legs feathered to base of toes; call, *kiah, kiah, kiah.* (Bendire) _____GOLDEN EAGLE

BBB Body white in color except for bluish wings and black shoulder patches; gull-like in appearance; call, a plaintive, musical whistle_____ _____WHITE-TAILED KITE

BBBB Breast and head white; black eye stripe; feeds on fish_____OSPREY

AA Owl-like flight; beating wings; tail blackish, crossed by 4 or 5 white bars; breast and shoulder rusty-red; frequents willows and trees near rivers and marshes; call, *yee-ak, yee-ak,* repeated rapidly in a high key (Bendire)__ _____(River Hawk) RED-BELLIED HAWK

AAA Beating flight; harrier habits (alternate, measured flappings and sailings); long, pointed wings.

I Tail white; breast white; hovers; gull-like; rare__WHITE-TAILED KITE

II Tail not white; white rump patch, narrow tail as long as body; flies close to ground when hunting_____(Mouse Hawk) MARSH HAWK

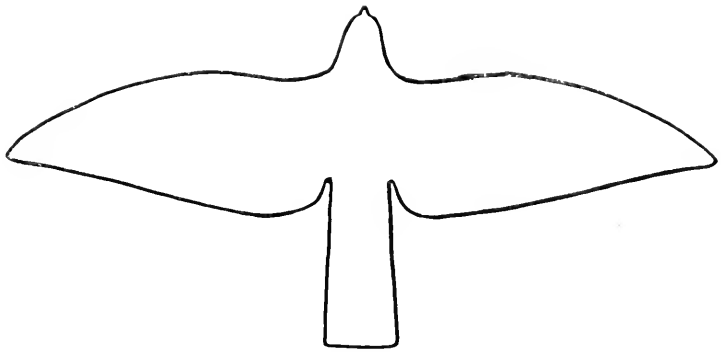

FIG. 47. Outline drawing of a marsh hawk, made from a freshly killed specimen, showing the long wings and tail which are characteristic of this hawk.

AAAA Dashing, darting pursuit flight, with alternating quick wing strokes and sailings in the open; long tail; no black markings under wings.

J Short, broad, rounded wings; barred tail; slender legs; no black bars on face; flight consisting of rapid flappings followed by a short soar; head comparatively small; seldom gives a call except when nest is disturbed.

K Length 11 to 13 inches; tail square; buoyant flight_____ _____(Bullet Hawk) SHARP-SHINNED HAWK

KK Length 15 to 19 inches; tail rounded; impetuous flight _____ _____(Blue Darter; Quail Hawk; Chicken Hawk) COOPER HAWK

KKK Length 22 to 24 inches; top of head black; conspicuous white stripe over eye; adult with barred breast and slaty blue wings_____ _____(Grouse Hawk) GOSHAWK

JJ Long narrow, pointed wings; black bars on face forming border to whitish throat; head comparatively large.

L Without white head.

M Length 15 to 19 inches.

N Found near water; powerful flight.____(Peregrine Falcon) DUCK HAWK

NN Found in open country of interior valleys; nests in cliffs; call a high pitched *keë, keë, keë* (Bendire)_____PRAIRIE FALCON

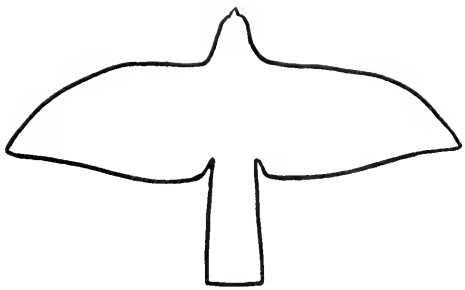

FIG. 48. Outline drawing of the sharp-shinned hawk, made directly from a freshly killed specimen, showing the short, broad wing and long tail usable as recognition marks with this and other accipitrine hawks.

MM Length 10 to 12 inches; slender build; reddish brown on back and tail; light under wings.

O Throat whitish; seldom hovers or soars; white throat patch; head large; speedy; back slaty-blue or brownish; darker in color than the sparrow hawk; rare in California_____(Merlin Hawk) PIGEON HAWK

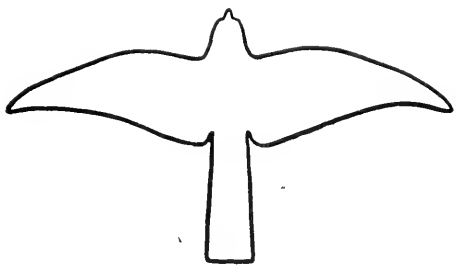

FIG. 49. Outline drawing of a sparrow hawk, made from a specimen, showing the long slender wings and long tail which may be used as recognition marks for all the falcons.

OO Throat not whitish; hovering habit; no white throat patch; wavering flight; back grayish or reddish brown; tail of male reddish brown; top of fence post, telegraph pole or tall tree usual observation station; call, *killy, killy, killy, killy*_____(Killy Hawk) SPARROW HAWK

LL White head; dark back; white breast; extremely long slender wings; black eye stripe with white above the eye; found near water; often to be seen plunging after fish; call, *ki-ik, ki-ik- ki-ik* (Dawson)__(Fish Hawk) OSPREY

A SIZE KEY.

In order to avoid the more technical terms employed in the preceding key, which lays emphasis on the mode of flight, and to make possible identification of a perched bird at fifty yards, the following more simple key is offered. A combination of both the keys will doubtless give the best results.

Size Key to Vultures and Hawks.

Very large hawks—over 30 inches in length—wing spread over four feet.
Body black in color.
Head unfeathered like a turkey; carrion comprises food.
Large, 50 inches in length; white patch under wing
(Condor) CALIFORNIA VULTURE

Smaller, 30 inches in length; no white patch; wing tips silver grey beneath
TURKEY VULTURE

Head feathered, white in color; white tail (adult)
BALD EAGLE

Body brown in color; found in mountainous country
GOLDEN EAGLE

Medium sized hawks—20 to 25 inches in length.
White on rump.
Distinct white rump patch; long sharp pointed wings; found in and near marshes
MARSH HAWK

White on each side of base of tail; broad rounded wings; legs feathered giving booted appearance; found in open country
FERRUGINOUS ROUGH-LEG

No white on rump.
Distinct black bar or bars on face.
Head white; found near large bodies of water
OSPREY

Head not white.
Black bluish; usually to be seen near water
DUCK HAWK

Black brownish; usually found in rough hilly country
PRAIRIE FALCON

No distinct black markings on face.
White stripe over eye; breast finely barred in adult; found in wooded country
GOSHAWK

No white stripe over eye.
Black shoulder patches; usually seen near marshes
WHITE-TAILED KITE

No black shoulder patches.
Tail long, barred with black.
Shoulder rusty red; usually seen in willows along streams
RED-BELLIED HAWK

Shoulder not rusty red; found in wooded and brushy country—the real "Chicken Hawk"
COOPER HAWK

Tail not long; fan-shaped in flight.
Dark band across breast; found in open country
SWAINSON HAWK

No dark band across breast; the commonest large hawk
RED-TAILED HAWK

Small hawks—10 to 15 inches in length.
White patch on throat
PIGEON HAWK

No white patch on throat.
Tail reddish brown; dark bars on face, the commonest small hawk
SPARROW HAWK

Tail not reddish brown; dark bars on face indistinct, if any; found in wooded and brushy country
SHARP-SHINNED HAWK

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A ROYAL SILVER TROUT CAUGHT IN LAKE TAHOE.

By J. O. Snyder, Stanford University.

Two skillful anglers, Dr. Ross Harbaugh and Mr. R. L. Handy, who regularly visit Lake Tahoe, report the not altogether infrequent capture of the royal silver trout, a species lately named *Salmo regalis*. That no mistake might be entertained as to their ability to distinguish the species a fine specimen was sent for determination to Stanford University where it was first described. This is the fifth specimen that has come to the hands of a naturalist, and data obtained from it is of great value in assisting to build up a description of the species. Unfortunately, it was eviscerated and nothing may be said of the sex, gillrakers, stomach caeca, etc.

The fish, caught one mile off Bijou, weighed 6½ lbs. and measured about 25 inches. It was greenish blue above, bright silvery on the sides and whitish below. There were a few very indistinct round spots on the head and on the sides below the lateral line. The fins were immaculate. This was a larger example than those originally described* and the head and fins were somewhat shorter.

The following measurements are recorded in hundredths of the length to base of dorsal fin. Length head .20, depth body .215, depth caudal peduncle .095, length snout .062, maxillary .11, diameter eye .03, interorbital width .08, depth head .14, snout to occiput .124, snout to dorsal .455, snout to ventral .54, height dorsal .11, height anal .11, length pectoral .13, length caudal .165. Number dorsal rays 11, anal 11, pectoral 14, scales lateral series 145, above lateral line 20.

There is no reason for confusing this species with any of the introduced forms as the Mackinaw trout for example, but it may be mistaken for silvery examples of the Tahoe trout *Salmo henshawi*, concerning which some remarks may not be out of place here. This is the commonly distributed trout of the greater part of Nevada and of the western slopes of the Sierra Nevada mountains, and it reaches its largest size in the Truckee basin.

This basin includes the Truckee River, Lake Tahoe and tributary streams which form its source, and Pyramid and Winnemucca lakes into which the river flows, and where its waters are finally carried off by evaporation. This basin, none of the water of which reaches the ocean, offers far greater environmental variations than is usual among much larger systems, and the trout seemingly react in a medley of colors, and assume a variety of minor characters such as are not often observed among individuals of a single species.

Many anglers distinguish trout by color and body proportions, and those that fish in the Truckee basin usually recognize several native kinds. First and most commonly known is the Tahoe trout with light olive body and an array of large black spots well scattered over almost the entire surface. Examples in the nuptial dress seen in the spring and early summer have metallic reflections shining through the body color, a broad pinkish stripe on the sides, and a scarlet patch on the cheeks and above the axil of the pectoral fin. The under surface of the lower jaw has two parallel stripes of bright red, and there is a spot of

*Bulletin Bureau Fisheries, Vol. XXXII, 1912.

red on the tongue beneath the tip. One or more bright coin-like spots of orange may be found anywhere on the head. Then there is the silver trout of Lake Tahoe, large in size, silvery in color, with many small narrow spots on the body and fins. It is usually caught in deep water. The royal silver trout not known to some anglers, blue or greenish blue above, silvery on the sides, with very small or not evident spots, might be mistaken for the above. The Truckee trout is the resident fish of the river. It is usually smaller and more brightly colored than the Tahoe trout. Another is the redfish remarkable for the great flame-red patch on the cheek. It is a migrant from Pyramid and Winnemucca lakes, entering the lower Truckee River to spawn. Also there is the tommy, a more modestly colored and smaller fish which enters the lower course of the Truckee to spawn. Finally, the emerald trout of Pyramid Lake which is pale green above, silvery on the sides and with indistinct spots or none. This fish does not enter the river to spawn.

Observation of these fish has convinced the writer that but three species are involved. There are the royal silver trout of Lake Tahoe, *S. regalis* and the emerald trout *S. smaragdus* of Pyramid Lake. These are alike in some respects, and both differ from all the others mentioned in having coarser scales, 124 to 145 series between the head and base of caudal fin. They also have fewer gillrakers and other distinctive characters. As each is confined to its particular lake there is no occasion to distinguish between them, as there is no opportunity to mistake one for the other. The others, the Truckee trout, redfish, tommy, silver and Tahoe trout, all belong to one species, *S. henshawi*. The latter has fine scales, counts of a large number indicating 153 to 163 as usual while a few have as many as 170.

Of these local varieties the redfish and tommy are perhaps the most remarkable, appearing as they do in two great waves of a nuptial migration which passes up the lower Truckee River with the rise of water due to winter rains. Formerly these trout were so abundant as to fairly fill the river at times. The redfish appear first, and as they progress from the lakes their brilliant hues become intensified in the bright desert sun until the whole body shines with iridescent yellow, vermillion and red, the cheek glowing like a coal of fire. The redfish migration wanes rapidly in March, the scouts of the tommies appearing mingled with the last straggling redfish, the more belated of which are lost among the advancing hordes of tommies. The tommy, the name taken from the Piute word tama-agaih, spring trout, is smaller, generally darker in color, and more heavily spotted than the redfish. Silvery tommies and redfish appear late in the season, possibly individuals fresh from the lake.

It will be recalled that the water of Pyramid and Winnemucca lakes is rather alkaline, not fit to drink, yet it supports great numbers of fish. We have here migrations of trout from the lake to the river, like those of steelheads from the ocean. It has often occurred to the writer that observations on the trout of this rather restricted basin might form a sound preparation for a more extended attack on the difficult problems offered by trout of much wider distribution.

THE NEW CALIFORNIA STATE FISHERIES LABORATORY*

By Will F. Thompson.

On June the thirteenth, construction began upon the new California State Fisheries Laboratory at San Pedro, the most important of our fisheries centers. It is to cost in the neighborhood of twenty-five thousand dollars, and will accommodate the present scientific staff of the Department of Commercial Fisheries. The conceptions which gave rise to its building are novel and worthy of remark at this time, for it is not generally known that this project is a distinct and noteworthy departure, a fact which Californians should know and appreciate.

The building will be located near Fish Harbor, San Pedro, within two blocks of the canneries there—with easy access to the vast store

Fig. 50. Elevation of new State Fisheries Laboratory being built at San Pedro.

of fish which is brought into them. The site has been granted to the Commission for a long period by the city of Los Angeles, and its acquisition has been a very fortunate thing. It is at the intersection of Seaside avenue and Tuna street, hence upon the two most important traffic ways in East San Pedro. Seaside avenue will, in the course of a few years, be connected with a boulevard to Los Angeles, through Wilmington and Long Beach. Tuna street, which is but a very short one, terminates upon the water front of Fish Harbor in the center of the canneries. The new building for the San Pedro office of the Commission will be built upon the same plot of ground, of the same type of architecture and will face upon Tuna street.

The laboratory building will be nearly fireproof, of reinforced concrete, with tile partitions and red tile roof. A perspective view of it

*California State Fisheries Laboratory Contribution No. 29.

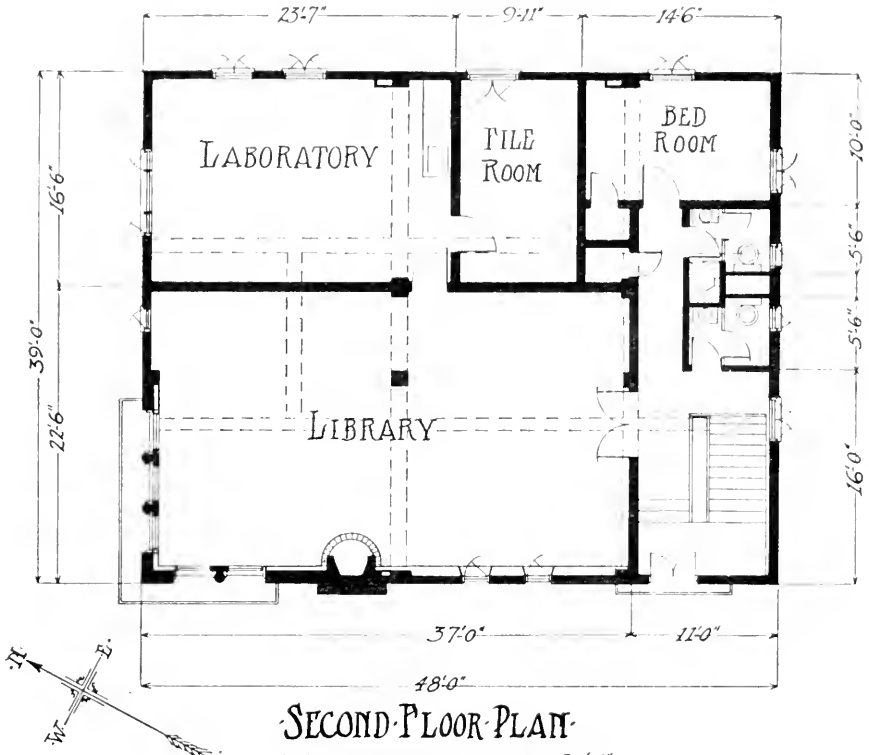
is given in figure 50, and the floor plans are shown in figure 51.* There are two stories. The lower contains two laboratories capable of accommodating several workers, with windows facing nearly north and hence with splendid light for scientific work. It has also a large workroom, floored with cement and with a door through which a truck may enter. There are also a dark room for photographic work and a store room for supplies. The upper floor contains a large room to accomodate the extensive and highly technical library necessary in the work of the laboratory, as well as the files of statistical records which will accumulate. In connection with this room is a laboratory and another smaller room, the latter also destined for statistical files. A bedroom is provided for the accommodation of the student workers who may be employed.

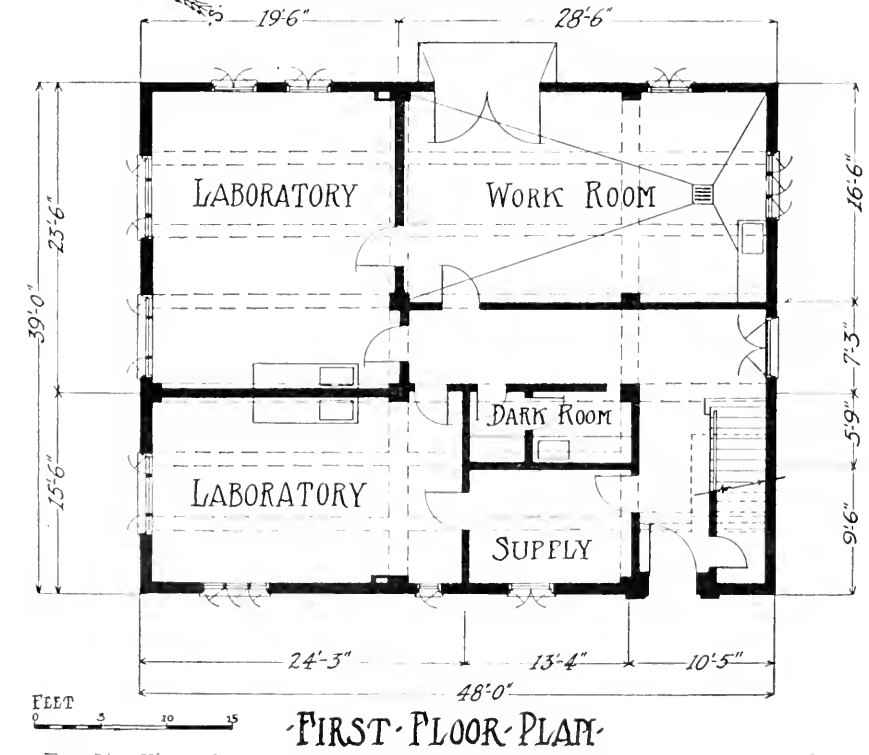
The purpose of this building is to provide quarters for the present scientific work of the commission, the aims of which have been previously stated in CALIFORNIA FISH AND GAME, but which are well deserving of brief recapitulation in this connection since they are in a measure distinct from those of any other biological laboratory, especially of any in America. They are, in the fewest possible words, the observation of the condition of the fisheries with a view to their preservation and freest possible use. That is, true conservation.

The real abundance of fish in the sea is not obvious to whoever may look. A fishery may languish because of changing natural conditions, despite untouched abundance of fish; or, on the contrary, constantly improved apparatus may yield larger and larger returns in the face of real over-fishing. A fishery is, indeed, highly selective in its action and dependent on many things other than the real abundance of fish. So it happens that "observers" of the highest scientific standing casually contradict each other as to the existence of depletion and the inexhaustibility of the sea. Is it any wonder, then, that the alleged criminal "exploitation," brought before legislative tribunals, pleads—as does the murderer at the bar—that his life be not taken without proof? For opinion, backed by scant evidence, is not proof, and "exploitation" does furnish food for the nation and is respectable, wealthy, and of good reputation generally. Opinions do have a great deal of force where, as in the case of conservation of birds and mammals, mere observation in the field is convincing to any fair-minded person, but in the case of marine fisheries this is not true.

So, in place of opinion, the real conservationists—and among these are many of the commercially interested men—must endeavor to furnish what is tantamount to legal proof. Such men as have composed the Scottish Fishery Board—men who have patiently and carefully examined into the condition of various fisheries—have proved the existence of depletion in several of these fisheries, and have demonstrated the character of data necessary, and we have profited by their experience. These data are statistics, so detailed, so extensive, and so accurately gathered that changes in gear, changes in fishing ground, and many other things may be discounted. Such data must also be examined and tested by the biologist with his criteria of over-fishing. To give such

*By courtesy of the State Engineering Department, the floor plans modified by Mr. Higgins for purposes of reproduction.


23'-7"
9'-11"
14'-6"
LABORATORY
FILE ROOM
BED ROOM
LIBRARY
39'-0"
16'-6"
22'-6"
10'-0"
5'-6"
5'-6"
16'-0"
37'-0"
11'-0"
48'-0"
N
E.
W.
SECOND FLOOR PLAN


19'-6"
28'-6"
LABORATORY
WORK ROOM
DARK ROOM
LABORATORY
SUPPLY
39'-0"
23'-6"
15'-6"
16'-6"
7'-3"
5'-9"
9'-6"
24'-3"
13'-4"
10'-5"
48'-0"
FEET
0 5 10 15
FIRST FLOOR PLAN

proof as these data provide, is the purpose of the new laboratory. It is for the digestion and biological analysis of statistics.

Until such is done neither can exploitation proceed freely, nor may we be sure that over-fishing will not go so far as to be irremediable. There is, after all, no method for knowing how much strain a fishery will endure save by trying it, and this implies the duty of careful observation. That duty rests with the government in legal control of the fisheries and their machinery of exploitation.

The Fish and Game Commission has, in California, a system of statistics entirely suitable for such analysis. That now in use is without parallel in any country or state, to the best of our knowledge, and forms a wide and firm basis for true conservation. It is not based on estimates, volunteered information, nor inquiry, but is an actual record of the commercial transactions which take place between fisherman and dealer. This record is from carbon copies of the fisherman's receipt upon which he receives his money, and is far more probable to be correct, naturally, than any other record obtainable. It has actually provided many of the fresh-fish dealers with a record of their transactions for the first time. With all its faults—which those concerned with its administration are prone to magnify rather than ignore—so much light has been thrown upon the returns formerly obtained by inquiry and circulated questionnaire, that we regard them as of small value in comparison with what we now get.

But in addition to the high degree of accuracy, it is now possible to follow the catches of single boats from year to year, and thus to accurately compare the abundance of fish from day to day and from year to year. And it is the interpretation of the statistics from the standpoint of changes in abundance—including depletion—to which the new laboratory will be mainly devoted. The distinction between the effects of over-fishing and those of hydrographic or economic changes, and the explanation of the latter, imply the careful analysis of statistics from a mathematical and biological standpoint. It will be the function of the new laboratory to contribute toward that end, and toward the formulation of whatever knowledge exists. Such a function, it should be noticed, is based primarily upon the legal control of the state over its fisheries, and upon its power to enforce the gathering of statistics—thus assuring, we believe, the permanency of the work.

Finally, attention might be called to the fact that the vast quantity of material handled by the commercial fisheries provides an unequalled opportunity for the solution of many of the major problems of biology. We trust that the laboratory will make its contributions to those as well as to the more immediate ends.

To the proper furtherance of the aims we have outlined above, the statistical files from the state will be placed in the new laboratory, where they will be—in accordance with the law—safe from damage and accessible to investigators.

It has been realized, however, that to secure proper support for the work in hand, an exhibit open to the public will ultimately be necessary. The results obtained, the facts known about our fisheries and those of other countries, must be presented graphically and attractively. So it is planned at some time in the future to add a large, well-lit exhibit room on the southern face of the new building, between the laboratory and the new office quarters.

AN IMPORTANT DECISION ON THE FISHWAY LAW.

The Anderson Cottonwood Irrigation District is a political subdivision created under the provisions of the Irrigation Act.

The district constructed a dam across the Sacramento River above the city of Redding, Shasta County, which prevented the passing of fish up the Sacramento River. Under the provisions of section 637 of the Penal Code the district was served with a notice to construct a good and sufficient fishway over said dam.

The district refused to comply with the order and on December 20, 1920, injunction proceedings were begun against the district by Hon. Jesse W. Carter, district attorney of the county of Shasta and an application made by him for a temporary injunction restraining said district from operating said dam.

The hearing on the temporary injunction was set for January 7, 1921, before the Hon. Eugene P. McDaniel, judge of the superior court. Defendant Anderson Cottonwood Irrigation District filed a demurrer and on January 7, the matter was argued and submitted and on May 19, 1921, Judge McDaniel rendered his decision, a copy of which follows:

In the Superior Court of the State of California, in and for the County of Shasta

THE PEOPLE OF THE STATE OF CALIFORNIA, *Plaintiff*, vs. ANDERSON-COTTONWOOD IRRIGATION DISTRICT, A BODY POLITIC AND CORPORATE AND W. F. SMITH, CHARLES HAMPTON, CHARLES SPANN, W. A. BROWN AND EARNEST SCHULER, AS DIRECTORS OF SAID ANDERSON-COTTONWOOD IRRIGATION DISTRICT, *Defendants*.

The complaint in the above entitled proceeding, after the statement of necessary formal matters, alleges that the Sacramento River is frequented by a great number of salmon and is regularly stocked with salmon by the Fish and Game Commission of this state; that the upper reaches of said river above Redding are the natural spawning grounds of said salmon; that the defendants have constructed, operated and maintained across the entire width of the river at the city of Redding, a dam for the purpose of diverting the waters of the river into the main canal or ditch of the defendants; that said dam constitutes an obstruction in the river which prevents the free passage of salmon over, through, by or around said dam, and that by reason thereof, said salmon are prevented from reaching their natural spawning grounds and thus prevented from propagating, reproducing and replenishing the river with salmon, which are alleged to constitute one of the valuable natural food supplies of the people, of great monetary value; and that unless the obstruction is removed, said salmon, by reason of their inability to reach the spawning beds annually and reproduce themselves, will be shortly and ultimately exterminated, to the great and irreparable loss, damage and injury to the people of California; that the maintenance of said dam by defendants is in violation of the rights of the people and constitute a public nuisance; that defendants threaten to maintain, and unless restrained by the court, will maintain the dam to the plaintiff's irreparable injury.

Following, the complaint then prays:

1. For a permanent injunction against defendants to enjoin and restrain the maintenance of said dam across the river and from obstructing the river so as to prevent the free passage of salmon;

2. That defendants, upon an order to show cause, be enjoined *pendente lite*.

Defendants have demurred on general grounds to said complaint and have made return to the order to show cause, and support said return by a number of affidavits. Upon the hearing testimony was received from witnesses for both parties upon a stipulation that the testimony should be transcribed and considered as affidavits upon the consideration of the said application for an injunction *pendente lite*.

The defense contends: 1. That an adequate fishway has been provided in its dam;

2. That the irrigation district is a political subdivision of the state, exercising a function of the state government;

3. That the injunction, if granted, would prevent the execution of a public statute by officers of the law for the public benefit;

That the injunction cannot be granted to prevent the execution of a public statute by officers of the law for the public benefit; and that nothing which is done or maintained under the express authority of the statute can be deemed a nuisance;

4. That in this proceeding, under the facts shown by the affidavits and testimony on the part of the defendants, estoppel against the state has been established;

That the dam in question is under the authority of the Department of Engineering, and not the Fish and Game Commission.

5. That by the enactment of the California Irrigation District Act, the state has not only waived its property rights in the stream by implication, but has, by the provisions of section 56 of the act, expressly granted such rights to the district.

Some of the foregoing matters were presented in support of the defendants' demurrer to the complaint, and nearly all of them were urged in support of defendants' opposition to the issuance of a temporary restraining order.

It is not necessary for this court in a long opinion to review the many authorities cited in the exhaustive and able briefs of respective counsel. Only those authorities will be cited which are necessary to notice as support for the court's conclusion upon the issues.

The demurrer will first be disposed of. In my opinion the facts stated in the complaint are sufficient to constitute a cause of action, and when conceded to be true, as they must be on demurrer, show such an obstruction of the free use of property as to interfere with the comfortable enjoyment of life and property, not only by an entire community and neighborhood, and a considerable number of persons, but by all the people of the State of California.

People vs. *Truckee Lumber Company,* 116 Cal., 397;
Yolo Water and Power Company, a corporation, vs *Superior Court,* Vol. 30, C. A. D., 3.

The last above cited case in my opinion disposes of several of the defenses of the defendants herein, in as far as those defenses bear upon the demurrer. It holds that the superior court has jurisdiction to hear and determine a suit brought in the name of the People of the State of California, against a public utility to enjoin it from committing a public nuisance.

This case is also reported in 185 Pac. 195, and seems to be the latest expression of our courts as to the right to maintain a suit against a public utility for the abatement of a public nuisance by an injunction. It is my conclusion, therefore, that the demurrer should be, and it hereby is overruled.

The testimony produced by the respective parties in affidavit form and that orally received by the court from the witness stand was irreconcilably conflicting. That on the part of the defendant controverted or at least attempted to controvert every material averment of the complaint as to the creation of the public nuisance in question.

In view of the conclusion reached as to the issuance of a temporary restraining order, it will be unnecessary at this time for the court to decide some of the contentions, for instance the matter of estoppel *in pais* urged by the defendant. However, the opinion may be expressed that there was not sufficient evidence on the part of the defense to establish any estoppel as against the plaintiff.

The general laws of the state, particularly those of the Penal Code, furnish ample authority for providing adequate fishways over dams and artificial obstructions. The California Irrigation District Act furnishes ample authority for the building of obstructions and dams in the streams of California for the purposes of irrigation; but there is no necessary conflict, implied or otherwise, in the statutes relating to these matters, nor any adequate reason for any clash of authority between different state agencies in enforcing all the laws.

It was never the intention of the Legislature, in enacting the irrigation law, to permit irrigation districts to destroy the fishing interests of the state, nor was it its intention to permit the penal laws to operate in such a way as to prohibit the construction of necessary works needed for the development of vast irrigation projects. These laws must all be given a reasonable interpretation and so carried out and enforced as to avoid unnecessary conflict, and so that all of the varied interests of the state may be conserved. The plaintiff herein seeks not the destruction of the dam across the Sacramento River, but only desires to prevent its maintenance in such a manner as to bring about the destruction of the fish in the stream.

In my opinion, there is little merit in the argument that this proceeding is an attempt to interfere with the operation of any public statute.

The testimony for both parties on the hearing shows that the dam in question is at most not to exceed fifteen feet in height and it therefore undoubtedly is true that it is reasonably possible to construct an adequate fishway over, by or around the said dam, if the opening now existing in the middle of the dam, as a matter of fact, be an inadequate fishway or no fishway at all, which is the big question in the case.

Upon that question, as noticed before, there is so far such conflict as to require in its determination a decision upon the merits of the whole case. While it would seem that perhaps enough testimony was received by the court to enable it to resolve the conflict, I feel sure that there would be grave danger of error and injustice by its determination at this time. Witnesses for the plaintiff of reputable character in all respects testified to facts indicating that it is a practical impossibility for spawn-laden fish to pass through the twelve foot opening in defendants' dam during the running season to the spawning grounds. In opposition, equally reputable witnesses on behalf of defendants swear positively that such salmon readily pass up the river

through the said opening. One witness declares he observed as many as ten salmon pass up and over the dam through the opening in five minutes.

The court is astonished there should be such a conflict on a question capable of actual demonstration. It should be easily determined by ocular investigation during the fish running season. When the matter is fully at issue, the hearing may be brought on before the court during the spring or fall run of salmon; if respective counsel and the court will arrange to have the suit heard at such a time, then in addition to hearing witnesses testify, the court, if it saw fit, could actually go to the dam and there by observation and examination, learn the real facts.

While now satisified that it is probable that there is a serious obstruction to the free run of salmon and grave danger of depletion in the number of salmon reaching the spawning grounds, with consequent injury to a renewal of the supply, the court is not now satisfied that there is danger of irreparable injury; at any rate, irreparable injury greater in estimation than might result to the defendants and to the people at this time, if the defendants should be compelled, by a mandatory injunction, to make a larger opening in the dam, as the irrigation season is almost at hand and defendants' supply of water might be cut off by the issuance of such injunction *pendente lite*.

Upon the authority of the cases cited by defendants' counsel, viz., *Gagliardo* vs. *Crippen*, 22 Cal. 362, and *Schwartz* vs. *Arata* et al., Vol. 31, C. A. D. 265, 188 Pac. 313, it clearly is a matter of discretion with the court whether to issue the injunction or not, and in view of the foregoing considerations, in my opinion, no injunction should be issued until the case is heard upon its merits.

To recapitulate: 1. It hereby is ordered that plaintiffs' motion for a temporary restraining order or injunction *pendente lite* be and it hereby is denied.

2. It hereby is ordered that defendants' demurrer to plaintiff's complaint be and it hereby is overruled, with leave to defendants to file their answer within ten days.

Dated: May 19, 1921.

(Signed) EUGENE P. McDANIEL.
Judge Presiding.

This is a most important decision upon the law of fishways for there is no doubt that when a trial is had on the merits of the case it can be shown that the dam in question is such an obstruction to the free passage of salmon that unless a good and sufficient fishway is constructed it will completely exterminate the run of salmon on the Sacramento River, its tributaries, McCloud and Pitt, and other streams.

CALIFORNIA FISH AND GAME

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All material for publication should be sent to **H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.**

JULY, 1921.

A HAWK NUMBER.

This number contains an article designed to interest our readers in the conservation of hawks. Beneficial hawks, because of deeds committed by a few relatives, have received much persecution at the hands of farmer and sportsman. Being large conspicuous birds and with a slow rate of increase they have suffered more than others; some species have been practically exterminated. The Condor, or California Vulture, is now one of the rarest birds in the state and the White-tailed Kite is approaching extinction. Neither can be considered injurious species. In addition to a discussion of the economic value of the various species of hawks based on California data, there is added a field key which it is hoped will be found useful by those desiring to distinguish the beneficial from the injurious hawks. An attempt has been made to use characters helpful in field identification rather than those useful with a bird in the hand.

SOME OF THE IMPORTANT CHANGES IN THE LAWS AFFECTING GAME.

A number of important changes were made in the seasons for taking game, at the 1921 session of the state legislature.

The deer season in the Sierra districts and also in Humboldt, Del Norte and Siskiyou counties will not open until September 1 and will close October 15. In southern California the season will not open until September 16 and will close October 15. In the coast districts the season will be the same as last year, opening August 1 and closing September 14.

Ducks, geese, brant, jacksnipe and mudhens may be killed from October 1 to January 15.

The most radical change was the creation of practically a blanket season on all species of quail. Heretofore, mountain quail could be taken in the Sierra districts September 1; under the new law the season will not open (except in Del Norte, Humboldt and Siskiyou) until November 1 and will close January 15. In the counties mentioned quail may be taken between October 15 and December 15. The same season for taking quail will apply to cottontail and brush rabbits, November 1 to January 15.

Sage hen may now be taken from August 1 until September 15. This will give an opportunity to take young birds before the flesh has become strong from sage. In district 4½ sage hen cannot be taken at any time of the year.

The change in the trout law delaying the opening of the season one month in the principal districts will give much better fishing within the next few years. Trout have not finished spawning by the first of April and if the supply of fish for the greatly increased number of anglers is to be kept up, breeding fish must be given every opportunity to spawn. Under the new law the season will be open from May 1 to October 31 in districts 1, 1½, 2, 3, 4 and 4½. A new district was made in the western part of Mendocino County consisting of that portion of the county draining direct into the Pacific Ocean. In this district, known as 2½, the trout season will be open from July 1 until Febraury 14. The season in the Tahoe and other smaller districts will be the same as last year.

Another important provision in the trout law is the reduction of the limit to 25 fish per day. This will be a great help in keeping California streams filled with trout. Added protection is given trout and other game fish by a new section numbered (632 a) and by an amendment to the section referring to night fishing and hunting. Section 632a prohibits the placing of any obstruction in any stream that will impede in any way fish from making their way up and down stream.

The other section provides that no game fish may be taken between one hour after sunset and one hour before sunrise.

The section prohibiting hunting in game refuges was amended so as to prevent the possession of game or fire arms in any refuge except under permit from the Fish and Game Commission.

SUMMER RESORT WORK TO BE CONTINUED.

Several years ago the Fish and Game Commission began carrying their educational campaign into the summer resorts where it was found that people were particularly susceptible to information concerning fish and game and wild life conservation. It was found also that a large number of people could easily be reached in a short length of time. Under urge from the National Park Service an intensive educational campaign was undertaken in Yosemite National Park, under the title "Nature Guide Service." Thousands were taken on trips afield gaining first hand information of wild life and over twenty-six thousand persons attended camp-fire talks and illustrated lectures given by the nature guides.

This work is to be continued in Yosemite during the summer of 1921, the Fish and Game Commission sending their educational director, Dr. H. C. Bryant, to take charge of the work. Dr. L. H. Miller, of the Southern Branch of the University of California, will share in the work and other assistants have been provided. Nature study libraries and exhibits showing the work of the Commission form a part of the program. "To read nature as one reads a book" is the motto followed. Certainly, work of this kind is of great service in building a public sentiment favorable to wild life conservation.

ARE BAG LIMITS TOO LARGE?

Consideration of present day game laws and the need for more restricted bags leads one to question the advisability of continuing to allow each hunter to have a separate bag limit on the various species of game. Why should a man be allowed twenty-five ducks, eight geese and twenty-five snipe in a single day should he be able to secure them? Or why should the law allow the upland hunter fifteen quail and fifteen doves in one day? Certainly, such bags would be far more than a man could utilize himself or advantageously give away.

The day is not far distant when bag limit laws will be effective regardless of species. Fortunately, there is a tendency among hunters to limit their kill to the number of birds they can utilize, and consequently, such a law would only curtail the game hog.

DUCK HUNTING FROM AN AIRPLANE

There has been considerable discussion and consequent investigation concerning the protection of the rice fields from the depredations of ducks. In 1919, it was decided that the most effective methods of control were to be obtained by herding and bombing, and the government solution of the problem appeared satisfactory to the growers.

Since then a good deal of publicity has been given the method of protecting rice crops by airplane duck patrol. The Standard Oil Bulletin, November, 1920, states that: "last year an aeroplane patrol was established as an experiment. It worked so well that this season it was repeated, and now five planes are kept busy, making both day and night flights to frighten off the wild ducks."

The American Game Protective Association makes the following criticism:

"We have been told that permits were granted to the rice growers of California to use aeroplanes to frighten the ducks from their growing crops. This appeared to us to be a very good idea, as efforts to frighten birds away from growing crops by gunfire has never accomplished the results desired, and is nearly always used by unscrupulous gunners as an excuse to shoot out of season. However, if aeroplanes under permits of this kind are actually killing birds, such permits should be immediately revoked."

Last fall a motion picture was shown over the country of one of these hunts, and at the same time, pictures appeared in the Sunday news supplements which showed that many birds were slaughtered by being hit with the propeller and other parts of the machine. The projection of the motion pictures was discontinued when it was learned that this picture was causing many protests, and that investigations

were being made to ascertain where the pictures were taken. The supposition seems to be that it was photographed in California, and that the airplane was operated by an army lieutenant from Cressy Field. If this proves to be the case, certainly some immediate provision should be made to protect the migrating waterfowl and to prevent a glaring violation of the Migratory Bird Treaty Act. The state law prohibits the shooting of game birds or mammals from an airplane, but does not definitely provide against ruthless slaughter by propeller and guy wires.

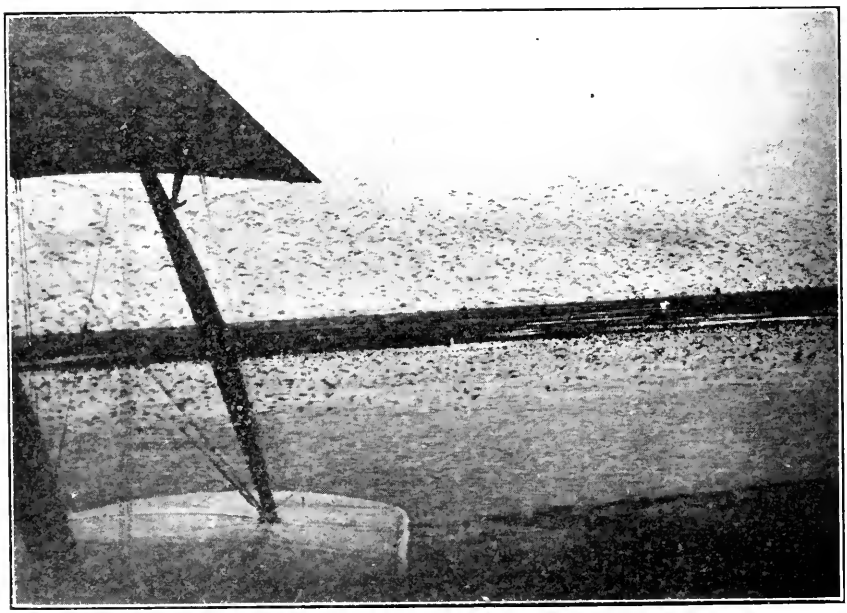

FIG. 52. Airplane routing ducks from the rice fields. Photograph by L. V. Halbrook, special Standard Oil agent at Willows, California. Courtesy of the Standard Oil Company of California.

SALMON DEPLETION IN BRITISH COLUMBIA.

During the war there was a noticeable dependence upon the results of scientific research. It is becoming more and more evident that more dependence can be placed upon conclusions of men who have scientifically investigated a problem than upon the guesses of the untrained worker. We have seen no better example of this change in attitude than in the recent reports regarding the prospective take of salmon in British Columbia during the coming season. Even the "British Columbia Financial Times," a journal of finance and commerce, has published in full the report of Dr. C. H. Gilbert, of Stanford University, who points a dark future of the salmon run in the Fraser River. He offers the ominous prediction that "big years" are wholly a thing of the past. The same article accompanied by an editorial appears in the "Canadian Fisherman," (March, 1921). On the basis of the findings of this scientist also, the American Can Company is planning to furnish only one-third of the number of cans usually supplied the canneries of this section.

Thus it can be seen that the predictions of a scientist bear more weight than those of the average fisherman who would predict, on the basis of past cycles, another splendid season for the year 1921.

In Dr. Gilbert's article, "The prospects of Fraser River sock-eye run in 1921," he states that two entirely independent lines of evidence had pointed to a greatly decreased run of salmon in 1917. One of these was the blockade of the Yale Canyon in 1913, which was just in time to

intercept the spawning run of that year —due to be a "big year," for prior to 1917, a big year occurred without fail in every fourth season. In 1917, a pack of 560,000 cases was produced, little more than one-fifth the pack of the big year of the previous cycle.

It is known to all packers and fishermen that the year before the large run was always made conspicuous by the occurrence of large numbers of greatly undersized individuals—male fish—which evidently constituted a class apart from the main body of the run, and which in the small years of each cycle were rarely encountered. The packers put up these fish separately because they contained less oil and were paler in color, as an inferior grade. They were thus in a position to compare their abundance in the years of their occurrence with that of four or eight years previously. From observations made, it came to be currently believed that whenever the number of small fish was relatively large then the big year which followed would be correspondingly increased in comparison with other big years. Then it became further known that the "usual run of sock-eyes to the Fraser were maturing the fourth year of their age, while these undersized males—or grilse, as we call them —were maturing in their third year; and they would therefore make their appearance in the run one year earlier than would the four-year fish which resulted from the same spawning. If, then, the spawning of the last big year had been an unusually successful one, this might be expected to result in an exceptionally large run of grilse three years thereafter, and an equally exceptional run of the four-year fish which would constitute the big run of the following year. The number of three-year grilse in the year before the big year might well, therefore, give a clue to the probable size of the big year itself."

For this year, the same two lines of evidence are available. The data derived from the numbers of grilse, which made their appearance, and the success of the spawning fish of the three and four-year cycles, both point to a definitely worse condition for 1921.

Careful study and investigation which began in 1911 has satisfactorily determined this conclusion, and Hon. Wm. Sloan, Commissioner of Fisheries for the Province of British Columbia, is quoted as having said, "Dr. Gilbert's paper must, I think, impress the fishing interests of the state of Washington of the necessity of prompt action, and that the methods that must be adopted to reestablish the runs to the Fraser, which in former big years were so profitable to them and our own interests, will be equally successful in restoring the runs of the lean years."

CONSERVATION AND THE SCIENTIFIC COLLECTOR.

For several years past there has been a tendency in many states to restrict the scientific collector of bird specimens and eggs. In some states, the privilege of scientific collecting has been entirely prohibited. Since practically all useful information regarding wild birds and animals is a result of the acquisition of specimens, the necessity for work of this kind is evident. The curtailing of scientific collecting must result in decreased scientific information. Furthermore, there is the danger of decreasing the number of ornithologists by cutting off the opportunity for the right sort of study. Our best ornithologists owe their early interest and their development largely to the unrestricted chance for securing specimens.

We have grave doubts as to the wisdom of tightening up on those who are solely interested in birds from the scientific point of view. We cannot understand from whence comes the pressure which forces government officials or state officials to further restrict the collector. Certainly, such restriction cannot be considered an important conservation measure, as compared with other measures. Compare the effect on the species wrought by the sportsman and that by the work of the scientific collector. The sportsman is allowed twenty-five ducks in a single day and fifty per week. There are no collectors in California, even including public museums, who add twenty-five specimens of ducks to their collections in a whole year. Note also that the sportsman concentrates his attention on a few species of game birds, taking a large toll, whereas, the scientific collector obtains protected song birds largely, on which there is no concentrated hunting and

where the toll is respectively very small on any one species. There are about one hundred and fifty scientific collectors in California as contrasted with more than one hundred and eighty thousand hunters. Hardly one of these collectors hunts for sport. Specimens of eggs taken do not represent, as a rule, a lessening in the annual increase of a species, for a second clutch of eggs is nearly always laid. Conservation is not hindered but advanced.

The test of legitimate collecting should be placed upon the spirit of the collector, and so long as he demonstrates that his interest is in a scientific study of wild birds and animals and that he can contribute to science, he should be encouraged rather than discouraged.

POWER PROJECT HEARING.

An important hearing on the project for the building of a large dam on the Klamath River was held at Yreka on May 12. The Federal Power Commission delegated F. H. Fowler, district engineer of the United States Forest Service, as chairman. The protestants represented were the Shasta Valley Irrigation District, Yreka Chamber of Commerce, and the Fish and Game Commission.

The certain destruction of the salmon run in the Klamath River, as a result of the proposed power project, has led the commission to oppose the undertaking. Dr. J. O. Snyder, of Stanford University, acting as a fishery expert for the commission, pointed out that two species of trout, in addition to the salmon, would be ultimately destroyed, if prevented from reaching their breeding grounds. He also pointed out that the salmon when they reach the lower part of the river are unripe and that spawning operations under such conditions would be practically impossible.

Residents along the Klamath River pointed out the value of the river as a spawning stream. The contemplated new road from the coast to Yreka will open the stream to recreationists and the destruction of the game fish in the river would have a bearing on the whole country.

TRAPPING WATERFOWL ALLOWED IN ENGLAND.

A recent conversation with a well-known sportsman naturalist who has just returned from England brought out the astonishing information that the trapping of waterfowl attracted to a locality by decoys is still allowed in Great Britain. This method of securing game birds has been frowned upon for many years in America and the average sportsman would point out the great danger to waterfowl as the result of such methods. Yet, apparently, waterfowl shooting continues to be good in Great Britain. What the compensating factors are, we do not know. We wonder whether there is as concentrated hunting and as many hunters in England as there are in America.

GOOD BLACK BASS FISHING IN LAKE COUNTY.

Few Californians realize the splendid black bass fishing to be had in Lake County. With favorable weather conditions, the finest sport can be obtained. The season, which usually begins on April 1, has been rather late this year, nevertheless, a catch of twenty-two was made during April. Sportsmen of Lake County are offering a fifty dollar prize for the largest black bass taken during the season. The two fish standing highest thus far in the contest weigh six pounds four ounces and seven pounds twelve and three-quarters ounces respectively. The fish from Clear Lake and Blue Lakes, coming from cold water, are much more palatable than those taken from the warm muddy water of our larger streams. The lakes of Lake County deserve to be the mecca for the black bass fishermen of middle and northern California.

LAKE COUNTY SPORTSMEN ORGANIZE.

Lake County sportsmen always noted for their interest in fish and game, have lately organized the Lake County Fish and Game Protective Club. They have already lined up one hundred and eighty men to attain the following objects:

"The protection and conservation of fish and game abounding in Lake County in particular and the State of California in general; to promote and encourage clean and law-abiding sport with rod and gun, target and trap shooting, and other forms of sport which may be indulged in under the supervision of this Club and at all times, to insistently discourage any and all violations of the fish and game laws of this State, and to lend assistance wherever and whenever possible to the proper authorities in prosecuting any and all such violators."

The dues of the organization are only one dollar a year. Already traps have been installed at Lakeport, and money has been appropriated for a permanent acquarium in San Francisco to boost the black bass fishing in Lake County. Deputy J. D. Dondero has been active in forming this new club.

JUDGE CLAYTON AND THE MIGRATORY BIRD LAW.

If all Federal judges delivered charges of a similar character to that of United States District Judge Henry D. Clayton, it is believed that the people generally would be educated up to the point where they would recognize the need for such laws as the Federal Migratory Bird Treaty Act and would demand a strict observance and enforcement of it. In delivering his charge to the grand jury at the spring session of the United States court at Opelika, Alabama, on April 4, this judge devoted a portion of his address to the Federal Migratory Bird Treaty Act.

Judge Clayton spoke as follows:

"Gentlemen of the grand jury, I call your attention to our National Migratory Bird Law. I do this for the purpose of asking you to examine into any infractions of this law, and also for the purpose of directing public attention as far as I can to this important subject, to the end that uninformed sportsmen may not violate the law and to warn those who are not sportsmen that they must not violate the law."

He emphasized also the need for those who know of the law and who realize its importance to talk on the subject at every convenient opportunity, especially, to the young people, in order that they might be better informed.

To the sportsmen he said:

"Every man who loves the sport of shooting should send a request to the United States Department of Agriculture and ask for Bulletin 1138, which contains the game laws, state and Federal. It will cost only the postage on his letter or card."

In conclusion Judge Clayton laid particular stress on the fact that Congress and the courts aimed to uphold this law. His closing statement was as follows: "Let me emphasize the fact that it is the intention of Congress and the courts to have this law enforced."

RESOLUTION ON THE CONSERVATION OF FISHERIES.

The following resolution has been submitted to a conservation committee of the San Diego Society of Natural History:

WHEREAS, It has been repeatedly shown and is well-known that over-fishing has depleted or destroyed the fisheries of anodromous and of ground fishes in easily accessible coastal waters everywhere to the serious injury of peoples dependent upon them for food;

WHEREAS, There is evidence that the rapidly improving methods of fishing are threatening pelagic fisheries with similar depletion or destruction;

WHEREAS, These dangers to both types of fisheries are seriously increased by the use of enormous nets and other gear which injure or capture many fishes not salable or which injure and fail to capture many of those salable which escape to die because of their injuries;

WHEREAS, Due to use of such gear there is further danger to such fisheries by disturbance and breaking up of spawning beds for either themselves or fishes upon which they prey;

WHEREAS, There is frequent wilful violation of protective laws on the part of commercial fishermen, especially certain aliens who also wantonly waste and destroy great quantities of sea foods which they can not successfully market; and

WHEREAS, It cannot be expected that commercial fisheries under a system of open competition can possibly protect these marine resources from dangerous exploitation; be it

Resolved, That this organization urge upon our people the necessity of providing adequate limitation as to numbers and equipment of commercial fishermen, together with complete prohibition of net and other gear which is highly destructive or injuriously disturbing to marine conditions of life;

That we deplore the activities of destructive and irresponsible aliens for which we urge completely repressive measures;

That we hereby approve and sustain those efforts of our public officials which tend to preserve these valuable resources, and

That we urge and encourage these officials to still greater effort as opportunity may be found in that direction.

CHINOOK SALMON IN LAKE ONTARIO

The United States Bureau of Fisheries, during the fiscal year 1919, planted 434,500 Chinook fry and 149,500 Chinook fingerlings at different points in Lake Ontario, and these fish, which have now reached a length of about ten inches, have been found at the mouth of the Niagara River.

Mr. H. Otto Wagner of Youngtown, New York, who operates a fishery at the mouth of the river, states that sixteen of this species have been caught which were all about the same size. An expert in the Bureau of Fisheries identified two fish sent by Mr. Wagner to the commission on October 27, 1920, as Chinook salmon nearing the end of the second year of growth. — *The Conservationist*, March, 1921.

THE FISH AND GAME COMMISSION PATROL SERVICE.

In considering the patrolling duties of the Fish and Game Commission, we are convinced that those entrusted with this responsibility are leading a very active life.

The patrolling service consists of the water patrol and the land patrol forces.

Patrol Boats.

In 1910, the patrol boat "Quinnat," which is a cruiser, or raised deck type of boat, was built for the commission, and today the commission has six patrol boats for the enforcement of the fish and game laws of the state.

San Francisco Bay and the near outside waters are covered by the boats "Quinnat" and "Steelhead," the river fishing districts by the boats "Rainbow," "Barracuda" and "Shad." The first two are commercial fisheries patrol boats, while the other three come under the heading of general patrol, as they have considerable game as well as fisheries patrol work to do.

The "Albacore," built in 1918, is used for the patrol of southern California waters. It is sixty feet in length with a cabin and accommodations for six persons. The boat is used for patrolling and investigation work from Santa Barbara to San Diego. The average mileage for this boat for the twelve months during 1920 was 541.6 miles per month—this figure includes all time lost in lay ups, stopping for repairs, etc. And although the figures for 1918-1919 are not at hand the mileage was probably more.

Land Patrol.

Patrol by land and water are closely linked together, for in connection with the Commercial Fisheries' patrol service there are three men in the employ of the commission who work about the piers and the fishing docks. Such patrolmen are stationed at San Pedro, San Diego and San Francisco. The man at San Francisco gives this branch of the work all of his time.

Aside from the water front patrol there are the game wardens and the deputies who also work out from each district office. A number of these men have automobiles, and in the mountainous and wild trail country the distances are covered on horseback. The average number of miles covered per month by automobile by the deputies of the commission has been estimated to be 935. During the trout planting seasons, their travel is necessarily heavier than during the other seasons of the year, for the two Fish and Game Commission distribution cars must be met by the men with their trucks to handle the shipments of fish, and the distribution ars alone covered during the past two seaons 65,000 miles. Without in this instance mphasizing the other phases of the work of these men it is interesting to see how perpetually the men of the patrol force must be "on the job" in the discharge of their duties.

MUNICIPAL CAMPS INCREASE IN NATIONAL FOREST PARKS.

Free permits for eight municipal recreation camps in the national forests of California have been issued by the Forest Service of the United States Department of Agriculture. This state is taking the lead in establishing these camps, where the residents of the cities which maintain the camp may obtain a summer outing at cost.

Last year four such camps were operated in the California National Forests —two by the city of Los Angeles and one each by Sacramento and Oakland. These four represent an investment of $70,000, and nearly 5000 guests were accommodated.

This year Los Angeles will have a third camp in operation, and San Diego and Fresno and Riverside counties expect to open camps also. In addition to its camps, the Los Angeles Playground Department organizes and supervises two-week hiking outings in the Angeles Forest. Three of the eight camps are in the

Angeles, two in the Cleveland, and one each in the Sierra, Stanislaus and Eldorado National Forests. The camps are from 25 to 150 miles from the municipalities that maintain them.

Only residents or taxpayers of the municipalities that operate the camps are eligible as guests, and, because of the low cost of the outing, each camper is required to render on an average one hours' daily service as outlined by the director in charge, and must also furnish his own bedding. Guests are well housed, fed, and entertained. The following rates for a two-week outing, including transportation, were in effect last year:

National forest.	City.	Name of camp.	Mls. to cmp.	Cost.
Angeles	Los Angeles	Seeley	75	$12.75
Do	do	Radford	96	14.25
Stanislaus	Oakland	Oakland	150	18.00
Eldorado	Sacramento	Sayles Flat	90	25.00

These rates were all for adults, and the rates for children under 10 were from 50 to 60 per cent of the above. The lower rates at the Los Angeles camps are probably accounted for by the fact that these camps have been in operation for several years, while 1920 was the first season for Sacramento and Oakland. The Los Angeles camps accommodated over 3500 of the 5000 guests at the municipal camps in the national forests of the state. The business men of Sacramento are so well pleased with their municipal camp that they are raising a fund of $10,000 to be donated to the city to build permanent cabins at the camp for sleeping quarters, such as are already installed at the Los Angeles camp.—*United States Department Agriculture* Weekly News Letter.

ESTABLISH QUARANTINE ON FOXES IMPORTED FOR BREEDING.

To protect owners of fox farms, the Secretary of Agriculture has ruled that all foxes offered for importation into the United States from any part of the world, except those imported for zoological gardens or similar institutions, shall be subject to inspection by an inspector of the Bureau of Animal Industry. The foxes must also be quarantined under the supervision of the inspector of the bureau until it can be determined by inspection or examination whether they are affected with a contagious disease. If such disease is found, the animals must be returned to the country of origin or be destroyed. This regulation goes into effect June 1, 1921.

The new regulation states that permits must be procured for all foxes offered for importation into the United States as provided by Regulation 11, for the importation of cattle, sheep, goats and swine, and all foxes imported for breeding purposes must be entered through ports designated for the entry of foxes as follows: Boston, Massachusetts; New York, N. Y.; Rouses Point, N. Y.; Calais, Maine; Pembina, North Dakota; and Seattle, Washington.

They must be accompanied by an affidavit made by the owner or importer declaring clearly the purpose for which the foxes are imported, viz, whether for breeding purposes or for zoological gardens or other institutions. Feed, attendants, and quarantine will be at the expense of the owner, and each owner or his agent shall give satisfactory assurance to the inspector at the time of admission to quarantine that such provision will be made. The place of quarantine, its construction, arrangement, and equipment will be subject to the approval of the Bureau of Animal Industry.

The demand for fur and the attractive prices which it commands has interested many people who are favorably situated to breed fur-bearing animals. A number of fox farms have been established in the northern states. To encourage this work and to guide those who undertake it, the department has published Farmers' Bulletin 795, the Domesticated Silver Fox; and Yearbook Separate 693, Fur Farming as a Side Line; and Department Circular 135, Maintenance of the Fur Supply.

THE SILVER FOX RANCH AT LAKE TAHOE, CALIFORNIA.

Mr. William Lewis, of Lake Tahoe, returned from a trip east last October with ix splendid specimens of registered silver black foxes to add to his ranch. These were all purchased from the Borestone Mountain Fox Ranch of Onawa, Maine, after careful inspection of the best

ranches in Canada and the United States. The present investment is still further proof of Mr. Lewis's confidence in this most interesting breeding industry. His ranch is at Pomin's, in a beautiful situation on the shore of Lake Tahoe. It has been built according to the most modern methods and is today probably the most up to date ranch in the west, containing nothing but high-grade registered stock.

Mr. Lewis believes in purchasing animals only from such high type blood-lines as have actually proved their value in competition. It was for this reason that he purchased all his stock this year from the Borestone Mountain Ranch, which the recent fox shows have proved is the leading ranch of North America. Mr. Lewis reports that this ranch is on the top of a mountain in an ideal situation in the heart of the Maine woods. But the fundamental reason the Borestone foxes are today the champion prize winners over all other foxes, Canadian or American, is due to their careful breeding. Their owner, Mr. R. T. Moore, a graduate of Harvard and the University of Pennsylvania, has made a study of the breeding methods, employed in the development of our famous race horses and registered live stock and has applied them to the improvement of foxes.

That these methods have been successful has been proved at the big fox shows, held in the East, at Boston, Montreal and Muskegon, during the past two years. At the very first live fox show the Borestone foxes swept the prizes, winning as many ribbons and cups as were won by any three competitors. A pup, eight months old, Borestone Sirius, was awarded the grand championship over all the adults. Among his competitors was the brother of "Reid," a fox that subsequently won the championship of the Montreal Show in 1920, and is owned by Mr. Moore.

At the much larger show held in Boston last December, the Borestone foxes again triumphed, winning fourteen ribbons and five of the eight silver cups offered for thoroughbreds. Of the three remaining cups, one was awarded to the Borestone ranch, but was refused by the owner, as he had offered it himself, and a Borestone fox tied at 93¾ points for the other two. In addition a fox born on the Borestone ranch, "Borestone Loami," was awarded the highest score in the show, 96 points, winning two silver cups and the nternational Championship of North America. In the field against her were one hundred and fifty foxes and forty of these were of the best Canadian strains, seven of which had already won prizes at the Montreal Show. One of these defeated oxes, subsequently, won the grand championship of the Muskegon Show, where the Borestone foxes were not entered. Mr. Moore now owns the grand champions of he three big fox shows and the only two foxes, that have ever been awarded 96 points or more:

Borestone Loami 96 points, International Champion, Boston, 1920.

Borestone Reid, 96 points, Grand Champion, Montreal, 1920.

Borestone Sirius, 93 points, Grand Champion, Boston, 1919.

Nearly every fox purchased by Mr. Lewis is closely related to these famous animals, or to the other eleven prize winners, of the Borestone ranch. His "Tahoe Loami" is a daughter of the famous "Borestone Loami," his "Tahoe Otto" is a half brother of the same fox, and "Tahoe Lone Star" is a nephew of "Sirius" and also of "Borestone Rigel" 94½ points, champion pure black fox. With such stock the Tahoe ranch has a splendid foundation, and under the ideal conditions at Tahoe will no doubt make a plendid showing.

Fox breeding today is beyond the experimental stage. It has been placed upon sure foundation by the progressive work f the American Fox Breeder's Association. Until this association was formed t was impossible for a novice to tell the difference between poor foxes and good ones. Many inferior animals were sold at fabulous prices by unscrupulous fox raders and promoters. This will no onger be possible, if the prospective fox breeder will take advantge of the opporunities, provided by the American Association, for him to differentiate between good and bad stock. First of all, they have established a standard of perfection, by which a fox may be judged. Second, they created an advanced registration system, by which all superior foxes, that should attain 85 points or more under the standard of perfection, could be registered as of undoubted first quality. Third, due to Mr. Moore's enthusiastic

promotion and energetic effort, despite the cold water thrown on the movement by the older breeders, the first live silver black fox show was held in Boston. It was a complete success both financially and otherwise. The Canadian government sent the chiefs of their department of conservation to it, to consider the possibilities of holding a similar show, and the Montreal show of 1920 was the result.

As a consequence of these innovations, the prospective purchaser can now be sure of getting really first quality foxes for his money. He should insist that the parents of his foxes are, not only pedigreed and registered animals, but that they are also in the advanced registered class. Better still, he should, if possible, attend one of the big fox shows and there see for himself what kind of foxes are awarded the prizes.

The American Association is really a national organization, for the members of its board of governors hale from all parts of the country. Recently Mr. Lewis has been honored by being made a governor of this association. Through him it will be possible for all fox breeders of the extreme West to keep in touch with the American Association and the latest developments in this fascinating new industry.—J. H. SANDERS, *Truckee, Calif.*

WILD FOWL NEED PROTECTION AND FEEDING GROUNDS.

Although legislative measures for the protection of wild fowl have multiplied, and have added to the restrictions on hunters, these regulations have not been sufficient to maintain these game birds in their former abundance. Regions that once were the summer homes of myriads of wild ducks have been drained and placed under cultivation, and extensive areas where the birds at one time bred are now populous farming communities. These changes, say biologists of the United States Department of Agriculture, have crowded out the former feathered residents and have served in a corresponding degree to reduce their numbers. Realization of these facts has led recently to the adoption of other measures to encourage waterfowl. A number of extensive marsh areas have been made permanent refuges under the guardianship of the Department of Agriculture, and many private preserves, some formed by artificial means, have been established where the birds are protected while nesting. In addition, in a number of cases, rigid local restrictions have been placed upon hunters.

As a means of cooperating in such efforts to maintain and increase the numbers of waterfowl, the Biological Survey of the United States Department of Agriculture has undertaken investigations of the general conditions under which wild ducks live and thrive, coupled with counts of the birds found in areas varying in character. During three summers, field studies were made dealing with wild ducks in the Bear River marshes in Utah, a report of which has just been published by the department in Department Bulletin 936, Wild Ducks and Duck Foods of the Bear River Marshes, Utah.

During the three seasons devoted to this work, twelve species of ducks and the Canada goose were found breeding in the region included in the Bear River marshes, which covers an extensive area at the northern end of Great Salt Lake. In an enumeration made during May and June, 1916, of the eleven species of breeding ducks, 3,650 pairs were counted, and it is believed that this number represents between 60 and 100 per cent of the total number of breeding ducks occurring there that season. Allowing five young reared to maturity as the average for each pair, and considering 1916 as an average season, the bulletin states that, at a conservative estimate, between 25,000 and 30,000 wild ducks, native to the marsh, are to be found there at the close of the breeding season.

It was found that, in addition to the large number of birds reared on the Bear River area, many other ducks came in after the nesting season to remain there until fall. That birds from the Bear River section range widely after leaving these marshes has been shown by records of ducks that have been banded and released there and subsequently were shot elsewhere. Records thus obtained show that birds released near the mouth of Bear River in migration cover the region from Oklahoma to Texas and west to California. The department urges the establishment of a greater number of preserves where

wild fowl may breed and rest unmolested, and find an ample supply of food.—*United States Department of Agriculture.*

BIRD BANDING.

The first American to become interested in the banding of birds was the great nineteenth century naturalist, Audubon. Curious to know what became of the birds that flew south with the approach of cold weather, he put threads about the legs of a brood of phoebes that he had been watching and in the following spring was rewarded by having two of the birds return to nest near the haunts where they had learned to fly. Bird banding is not confined to the banding of non-game birds alone. In the United States Department of Agriculture Weekly News Letter, of June 1, 1921, there is the following interesting article on the banding of ducks:

When a wild duck decides to move from his summer home in Canadian wilds he neglects to leave a forwarding address to indicate where his winter quarters are to be established. The Bureau of Biological Survey, United States Department of Agriculture, is working on a method to offset the duck's carelessness. This consists of a system of trapping the birds and marking them with aluminum leg bands that carry a number and the legend "Biol Surv., Wash., D. C." When a banded duck is killed, the hunter removes the band and returns it to the Biological Survey with information showing when and where the bird was recovered.

During the past autumn a Canadian collaborator of the Survey, Mr. H. S. Osler, operated a duck trap at Lake Scugog, Ontario, where he captured and banded over 200 black ducks and mallards, with a few ring-necked ducks and blue-winged teals. Some of these were killed near the place where they were banded, but others were from such localities as to indicate approximately the route taken by these birds in their journey to the Southland. In all, about 25 of Mr. Osler's ducks have been killed and the bands returned from points in Ohio, Indiana, Kentucky, Tennessee, Arkansas, Mississippi, Louisiana, and Texas. One of the blue-winged teals was killed near Port of Spain, Trinidad, British West Indies, more than 2,500 miles from Lake Scugog, where the band was attached.

The systematic banding of birds, as undertaken by the Biological Survey, will furnish conservationists with much valuable information.

FACTS OF CURRENT INTEREST.

Deputies Clark and Burke arrested six Japanese near Pigeon Point, San Mateo County, for having 150 undersized abalones in their possession. These men were notified to appear before Judge Ray Griffin, which they did, and were fined $100 apiece.

* * *

Mr. Jay Bruce, state lion hunter, succeeded in killing nine mountain lions during the first three months of the year, as well as three bobcats.

* * *

Deputy Von Arks made cases last year within a five-mile radius of his home, in Sonoma County, which brought in fines aggregating thirteen hundred dollars. Deputy Von Arks evidently believes in cleaning up his home town first.

* * *

During February and March there was a round up of violators of the fishing laws in district twelve. Sixteen men were arrested of whom six were convicted, the fines totaling $695. Four nets totaling 667 fathoms were confiscated. Two of them were sold and netted $145. During March deputies O'Connell and Newsome confiscated seven nets, totaling 2295 feet, which were being illegally used in a closed district.

* * *

Deputies Groves, Lencioni, and Von Arks, working the coast between Russian Gulch and Wallalla at low tide, arrested sixteen violators for having in possession undersized abalones. The offenders were taken before Judge Charles of Sea View and the fines will aggregate over seven hundred dollars. The largest fine was one hundred and twenty-five dollars, which was awarded a market fisherman. The small sized abalones confiscated totaled several hundred.

HATCHERY NOTES.

W. H. SHEBLEY, Editor.

As the egg-collecting operations at the various hatcheries have not been entirely completed yet, we are, consequently, unable to definitely submit the number of trout fry which will be available for distribution from the various stations during the coming season. We anticipate that the output from all of the hatcheries of the state for the year 1921 will be approximately 25,000,000 trout fry. If the number of trout fry actually distributed even approximates this figure, it will be the largest distribution of fry ever made in one season in the state.

Due to adverse climatic conditions in some sections of the state, we did not take as many eggs at the spawning stations as we had anticipated; but this partial failure is, in a great measure, offset by favorable situations obtaining in other districts.

MOUNT SHASTA HATCHERY.

From present indications, we will have for distribution from Mount Shasta Hatchery this season, approximately 11,000,000 trout fry consisting of rainbow, Loch Leven, German brown, eastern brook, steelhead, and possibly a small number of black-spotted trout fry.

The Loch Leven and German brown and practically all of the eastern brook trout eggs were taken from the adult fish kept as a breeding stock in the Mount Shasta Hatchery ponds. The rainbow eggs were received from the several rainbow egg-collecting stations located on tributaries of the Klamath River, Siskiyou County.

In addition to the rainbow eggs hatched at the Mount Shasta Hatchery, a sufficient supply of eggs of this specie were received to permit of shipments being made to Mount Whitney, Ft. Seward, Kaweah and Wawona hatcheries. The supply of steelhead trout eggs which is being hatched for distribution from the Mount Shasta Hatchery was received from the Brookdale and Ukiah hatcheries.

The two fish distributing cars are in the shops of the Southern Pacific Co., at Sacramento, being overhauled and placed in first-class condition for the season's operations. The work on the two cars is practically completed and at least one car will be ready for commencing the season's operations on or about June 1.

Distribution operations from the Mount Shasta Hatchery will be commenced nearly a month earlier than is usually the case. It was essential that we commence this work earlier than in former years owing to the greater number of trout fry which we will have to distribute from that station this year.

As mentioned in a previous issue of CALIFORNIA FISH AND GAME, there were hatched at the Mount Shasta Hatchery this season nearly 6,000,000 chinook salmon eggs, which were received from the Federal Bureau of Fisheries' station at Mill Creek and from our own salmon egg-collecting station at Klamathon, on the Klamath River. As soon as the oldest of the salmon fry were of suitable age for planting, they were distributed in the head waters of the Sacramento River and the balance of 3,000,000 were removed from the hatching troughs and placed in the three large salmon rearing lakes on the Mount Shasta Hatchery grounds. These fry will be fed and held over the summer and released in the head waters of the Sacramento River during the fall months.

FALL CREEK HATCHERY.

Rainbow egg collecting operations at the Fall Creek Hatchery were very successful, there being nearly 1,000,000 eggs of this specie collected. Approximately 600,000 of the eggs have been hatched and will be held throughout the summer months and distributed in the Klamath River at the proper season. The balance of the eggs were shipped to the Mount Shasta Hatchery to be hatched and reared for distribution in other localities of the state.

In addition to the rainbow trout hatched at Fall Creek station, 3,000,000 of the salmon eggs collected at Klamathon Hatchery last fall were hatched and are being reared for distribution in the Klamath River. A portion of the fry will be planted during the late spring months and the balance will be held in ponds constructed for the purpose last summer, and

one additional pond which is now in course of construction. These fish will be held and fed throughout the summer and distributed in the Klamath River next fall.

BOGUS CREEK STATION.

Bogus and Camp Creek egg-collecting stations have been closed after completing the most successful season since the stations have been established. Over 6,000,000 rainbow trout eggs were collected from these two stations during the season which has just closed. All of the eggs collected were shipped immediately to the Mount Shasta Hatchery for incubation. During the summer some minor repairs and improvements will be made at these plants in order that they may be in readiness for operations next season.

HORNBROOK STATION.

The Hornbrook station was operated during the past season, but the number of eggs collected was far below the normal take, less than 200,000 eggs being taken during the entire season. This was due to the fact that the flood waters of the early part of the spawning season changed the course of Cottonwood Creek, forming a sandbar between the old mouth of the stream and the new cut, which prevented the trout from entering the stream to spawn. Prior to the cutting of the new channel, the flood waters were entirely over the top of the racks, thus permitting the first part of the run of spawning fish to pass on up the stream. The small number of eggs taken were received from the few stragglers which came up the creek through the old channel.

Before the station can be successfully operated, it will be necessary that considerable work be done in opening up an adequate channel to permit the fish to ascend the stream at the mouth of the creek.

MOUNT WHITNEY HATCHERY.

During the early part of December, 300,000 Loch Leven trout eggs were shipped to Mount Whitney from Mount Shasta Hatchery and during the first part of April, 500,000 rainbow trout eggs were shipped from the same station. Shipments of steelhead trout eggs to the number of 800,000 were made to the Mount Whitney Hatchery from Brookdale Hatchery. The fry resulting from these three shipments of eggs are developing into fine, healthy fish, and will be ready for distribution early in the summer.

Further shipments of rainbow trout eggs will be made from one of the other stations and we are also contemplating opening up the Rae Lakes rainbow egg-collecting station. All eggs received from this source will be immediately transported to the Mount Whitney Hatchery, where they will be hatched and reared.

LAKE TAHOE HATCHERY.

The new Lake Tahoe Hatchery, which was completed last fall, was opened for operations on May 14. A shipment of black-spotted trout eggs was taken to the hatchery on that day from the new egg-collecting station established on Blackwood Creek. Other shipments of black-spotted eggs will be forwarded as the eggs are taken at Blackwood Creek. Shipments of steelhead trout eggs from the Brookdale and Ukiah hatcheries have been shipped to the Lake Tahoe Hatchery, and within the next two or three weeks rainbow eggs will be shipped in from one of the rainbow egg-collecting stations.

MOUNT TALLAC HATCHERY.

Mount Tallac Hatchery was opened for operations during March. As in former years, seining operations were conducted at the mouth of Taylor Creek, for the spawning trout from which are obtained the black-spotted trout eggs.

In addition to the egg-collecting operations conducted off the mouth of Taylor Creek, an egg-collecting station was established on the upper Truckee River. The stream was racked, and a trap, tank, etc., were installed. The results obtained from the operations to date have been very satisfactory.

As above mentioned, a station was put in operation at Blackwood Creek and the eggs received from this plant are incubated at the Mount Tallac Hatchery and the new Lake Tahoe Hatchery. One million black-spotted trout eggs have been taken to date.

FORT SEWARD HATCHERY.

The 500,000 chinook salmon shipped to Fort Seward from the Mount Shasta

Hatchery during February were hatched and the resulting fry distributed in Mad River, tributaries of Humboldt Bay, Eel River and other waters of Humboldt County. This was done during the month of April. Two hundred and fifty thousand rainbow trout eggs were shipped to Fort Seward from Mount Shasta Hatchery on May 16, and the resulting fry appear to be strong, vigorous fish. Over 800,000 steelhead eggs were shipped in from Ukiah Hatchery and these, together with the rainbow fry, will be given a wide distribution in the waters of Humboldt, Mendocino and Trinity counties during the coming summer.

SNOW MOUNTAIN STATION.

Steelhead egg-collecting operations at the Snow Mountain egg-collecting station did not prove to be as satisfactory as was anticipated. While there was a fair rainfall in that section this season and other climatic conditions were favorable, the usual number of steelhead spawn fish did not reach our station. Consequently, we were unable to take the usual large number of eggs. Approximately 2,000,000 eggs were taken as a result of the entire season's operations. We had expected to receive not less than 4,000,000 and possibly 5,000,000 or 6,000,000. A thorough investigation as to the reason for the failure of the spawning fish to ascend the stream to the Cape Horn dam, where our station is located, resulted in our finding that the stream had been blocked by fences, cleverly arranged in the Eel River, some distance below our stations. These had been constructed by persons who wished to prevent the fish from ascending the stream, in order that they might catch them. Those responsible for this outrage should be prosecuted to the full extent of the law, particularly since the legislature has just passed an act making it unlawful to bar the passage of fish by any weir, fence or obstruction.

The eggs taken at Snow Mountain station, with the exception of about 200,000, which were hatched for distribution in the upper waters of the Eel River, were immediately transported to Ukiah Hatchery.

UKIAH HATCHERY.

The Ukiah Hatchery was opened for operations on March 19. A total of 1,859,000 eggs were received from the Snow Mountain station. These were eyed and shipments made to the Fort Seward, Mount Shasta and Lake Tahoe hatcheries. Between 500,000 and 600,000 steelhead eggs will be hatched at Ukiah Hatchery for distribution in the streams of Mendocino and Sonoma counties.

SCOTT CREEK STATION.

Egg-collecting operations at Scott Creek station have been the most satisfactory since the station was established. Three million steelhead trout eggs have been collected and operations have not as yet been completed. There will probably be something over 100,000 eggs yet taken. All eggs were transported to the Brookdale Hatchery as soon as the fish were spawned.

BROOKDALE HATCHERY.

As stated above, the Scott Creek station produced well over 3,000,000 steelhead trout eggs, all of which were transported to Brookdale Hatchery where they have been eyed and shipments of eggs made to the Mount Shasta, Mount Whitney, Lake Tahoe, Wawona and Kaweah hatcheries. In addition to eggs shipped out to the above named stations from the Brookdale Hatchery, approximately 900,000 steelhead fry will be reared for distribution in Santa Cruz, Santa Clara and San Mateo counties. Arrangements are being made for the shipments to these three counties.

DOMINGO SPRINGS HATCHERY.

Domingo Springs Hatchery was opened for operations during the middle of March and preparations were made for trapping the run of rainbow trout ascending Rice Creek to spawn. Severe storms in that section made it very difficult for the men to get into the station. They were obliged to go in over fourteen feet of snow in some places.

The heavy snow did considerable damage to the racks and traps at Domingo Springs Hatchery, and also to the fish-culture equipment installed at the mouth of Warner Creek last fall. It is our intention to operate at Warner Creek this season, in conjunction with the Domingo Springs Hatchery, where all eggs secured from the former plant will be incubated. At this date no eggs have been taken at

Domingo Springs or Warner Creek as the "run" of spawning fish from Lake Almanor is very late, but we anticipate a very successful take of eggs.

CLEAR CREEK HATCHERY.

The Clear Creek Hatchery was opened for operations during the middle of March, as were the Domingo Springs and Warner Creek stations. Egg-collecting operations are somewhat earlier at Clear Creek than at Domingo Springs and to date we have secured approximately 1,500,000 eggs. A portion of the eggs secured from the Clear Creek and Domingo Springs hatcheries will be hatched at these two stations to supply local streams with trout fry, and the available balance will be shipped to the new Feather River experimental station.

FEATHER RIVER EXPERIMENTAL STATION.

As mentioned in a previous report, we are establishing an experimental hatchery on Jamison Creek, a tributary of Feather River. The station is located between Blairsden and Johnsville, in Plumas County. The purpose of establishing a station at this point is to eliminate, to a great extent, the necessity of transporting trout fry from the Mount Shasta Hatchery to stock the waters in this district, as well as the district along the Yuba River, in the vicinity of Sierra City.

Eggs will be shipped to this hatchery from the Domingo Springs and Clear Creek stations. The first shipment of 200,000 eggs was delivered from Clear Creek Hatchery on May 16. On May 14, a shipment of 100,000 steelhead trout eggs was received from the Ukiah Hatchery. The eggs appear to be in first class condition. As soon as the eggs commence to hatch, we will be better able to determine what the outcome of the experiment will be.

If there is no loss of fry or eggs, additional eggs will be shipped to the station and this large territory will be supplied with trout fry from the experimental hatchery during the coming season.

NORTH CREEK HATCHERY.

Egg-collecting operations at North Creek station have been very successful. Eggs have been collected from the large rainbow trout ascending North Creek, Metcalf Creek, and Grout Creek from Bear Lake, and while operations at present are not complete, we expect to take 2,500,000 rainbow trout eggs this season. One million five hundred thousand eggs will be transferred from the North Creek Hatchery to the Bear Lake Hatchery, at Green Spot Springs, from which station the resulting fry will be distributed during the coming summer in Big Bear Lake and various streams of San Bernardino County. The North Creek Hatchery will also be operated to full capacity. The fry reared at this plant will be distributed in Big Bear Lake also. We also expect to have a couple of small shipments of eggs to send to the Mount Whitney Hatchery where they will be hatched for distribution in other waters of southern California.

WAWONA HATCHERY.

Three hundred thousand rainbow eggs, and 100,000 steelhead trout eggs from Brookdale Hatchery, have been shipped to Wawona from the Mount Shasta Hatchery and the resulting fry will be distributed in Merced River and other streams of that section during the coming summer.

Previous to opening the Wawona Hatchery for operations on April 23, certain necessary repairs were made to the flume and water distributing system at the hatchery. All the repairs could not be finished this spring, consequently, we will have to complete the work after the fry have been distributed during the summer.

KAWEAH HATCHERY.

Owing to the fact that we were unable to proceed with the construction of the permanent hatchery on the Kaweah River, it was necessary that we again operate the small experimental station established three years ago near the town of Hammond. Three hundred thousand rainbow and 100,000 steelhead trout eggs were shipped to Kaweah Hatchery and the resulting fry will be distributed in the waters of Tulare County, as has been our practice during previous seasons.

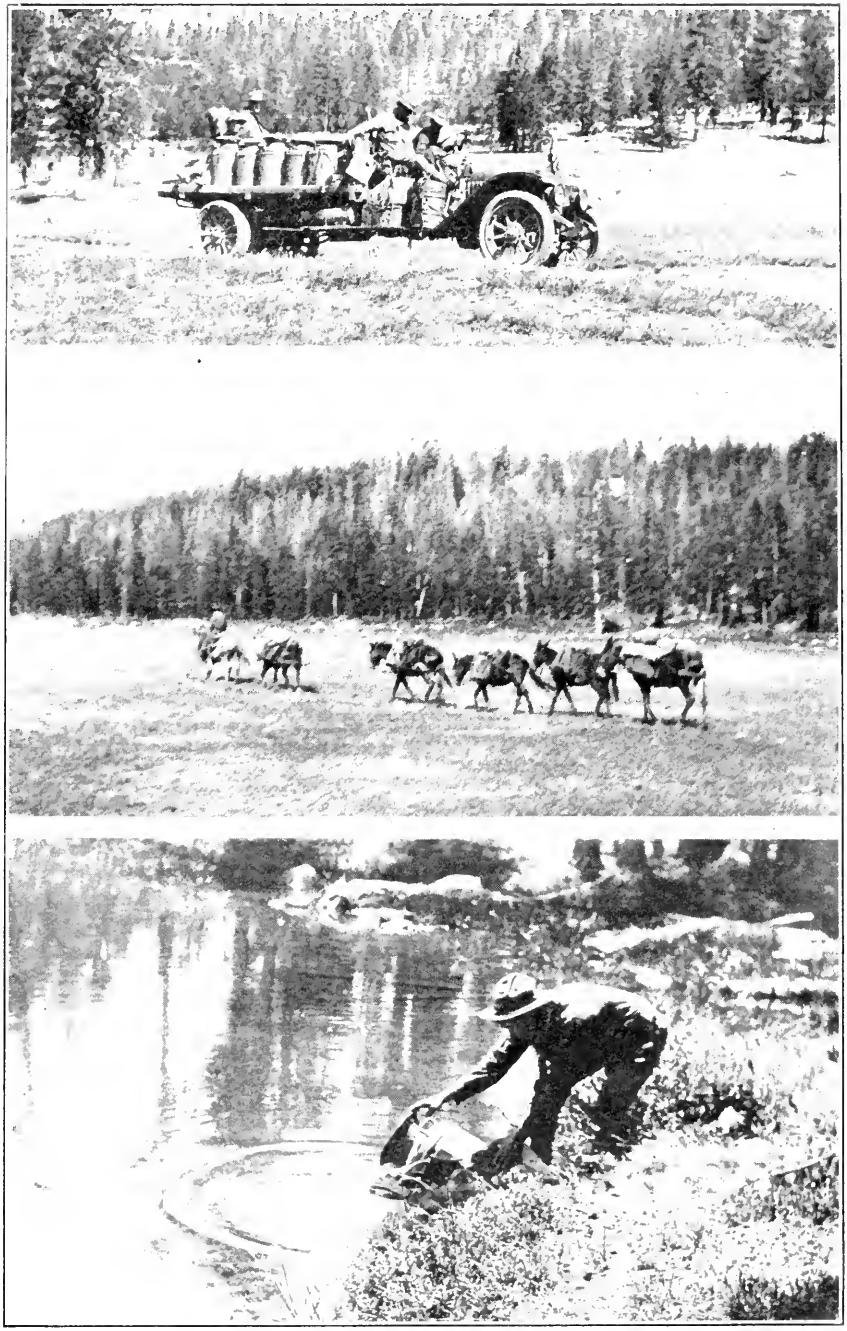

FIG. 53. Planting trout in Yosemite National Park; necessitating transportation by rail, motor truck and pack train. Photographs by H. C. Bryant.

COMMERCIAL FISHERY NOTES.

N. B. Scofield, Editor.

NEW COMMERCIAL FISHERIES LEGISLATION.

The past session of the State Legislature was remarkable in that there were fewer fish and game bills for the Fish and Game Committees to consider than for many sessions. Most of the bills introduced proposed only minor changes in already existing laws. The opinion is quite general that the present game and fisheries laws are fair and in the interest of conservation. There is also a stronger inclination for the legislators to seek and accept the advice of those of the Fish and Game Commission who have made a study of the fish and game conservation problems.

The few bills affecting the commercial fisheries which finally were passed were all good bills and received the signature of the Governor. These bills become laws on July 29, 1921. The following is a brief summary of the fisheries bills which were signed by the Governor, taken up in the order of their introduction:

Senate Bill No. 265. By Senator Rigdon.

Abalones and Clams.

Amends the present law, section 628*f* of the Penal Code.

Reduces the daily bag limit on Pismo clams from 36 to 15, but permits shipment and sale. Changes the abalone seasons by making a uniform closed season for all species of abalones from January 15 to March 15. Raises the minimum size limit on red abalones, which may be taken for commercial purposes to eight inches in greatest diameter. Restricts the commercial taking of abalones in districts 10 and 18 to the territory lying outside of a line twenty-five feet beyond low tide mark. The minimum size limit on red abalones which are taken from the shore to twenty-five feet beyond low tide mark, remains at seven inches in greatest diameter, but the number of any species of abalones which may be taken from this inshore area must not exceed ten per day and they must not be sold.

It is expected that this law will greatly reduce the commercial taking of Pismo clams and give visitors to the beaches where these clams are found an opportunity to gather enough for their own use. It is hoped and expected that the changes in the abalone law will permit the full utilization of this valuable food resource and provide enough abalones for those who prefer to gather their own from the shore.

Senate Bill No. 576. By Senator Rominger.

Fish Reduction.

This bill amends section 5 of the act regulating the use of fish in reduction plants, etc. The present act, which was passed two years ago, intended to give the Fish and Game Commission full power to regulate the use of fish in reduction plants, but in a recent friendly suit in Los Angeles to determine if it did give the power intended, it was the opinion of the court that it did not. Therefore, section 5 was amended and enlarged so as to prohibit direct fishing for edible fish for reduction purposes and to prohibit taking any fish in excess of what can be converted into human food except by special application to and permission from the Fish and Game Commission. Such excess of catch can not in any case exceed 25 per cent of what is used for human food.

Senate Bill No. 644. By Senator Lyon.

Kelp Harvesting.

A new act which supplements an act regulating the cutting and harvesting of kelp.

The present law worked all right during the period of the war when kelp potash brought a very high price, making it profitable to cut the kelp and transport it long distances to the reduction plants. The conditions are different now and all of the kelp companies have ceased to operate. The price of potash has fallen to such a figure that it will not pay any company to engage in the kelp reduction industry unless by-products in addition to potash can be made use of and even then they cannot operate profitably unless they are assured of a continuous supply of kelp

close at hand. Under the old law any licensed company could cut kelp on any of the beds which had been declared open for cutting by the Fish and Game Commission. The result of this arrangement was that many companies wished to cut in the beds located near the better harbors and these beds were quickly exhausted, compelling the companies to frequently go long distances for their supply of kelp.

It was to encourage the reestablishment of the kelp industry by leasing to a company those kelp beds or positions of beds which lie close at hand, that this bill was drawn.

Senate Bill No. 811. By Senator Scott.

Shrimps.

Amends section 628 of the Penal Code.

Provides that the unmarketable shrimps which are taken in district 13 (South San Francisco Bay) while fishing for the fresh shrimp market, may be dried.

After much experimenting it has been found that the small shrimp unsuitable for the markets, cannot be screened out and returned to the water alive as was intended under the old law. The shrimps are easily screened after cooking for they are then doubled up and the small ones screen out, but efforts to screen them before cooking failed. The smaller shrimps are perfectly good for drying purposes and this law will prevent a considerable waste and possibly result in a reduction in the price of fresh shrimps.

Assembly Bill No. 485. By Mr. Gray.

Districts.

Amends the act dividing the state into fish and game districts.

The changes in this act which will affect commercial fishing are:

District 7 is extended to the south line of Mendocino County in order to take in the salmon trolling territory at Fort Bragg and Shelter Cove which need different regulations from the rest of district 10 in which they were before. (See under Assembly Bill No. 832.)

Vallejo Channel and the lower end of Napa River are stricken from district 12 B, thus throwing them into district 2, where netting is prohibited.

The southern limit of the netting district, 12 B, is placed at the right of way of the Santa Fe Railroad instead of the south boundary of San Joaquin County. Netting south of the Santa Fe right of way is prohibited.

Districts 20 and 20 A (Catalina Island) re changed. District 20 will extend from South East Rock to Lions Head, taking in about two-thirds of the waters on the ast and northeast side of the island. District 20 A will consist of the remaining tate waters surrounding the island. Jnder the provisions of Assembly Bill No. 831, netting is permitted in district 20 A, but in district 20 netting is not only nlawful but the possession of nets in the district is prohibited.

Assembly Bill No. 830. By Mr. Stevens.

Striped Bass; Shad.

Amends section 628 *a* of the Penal Code.

Closes the fall netting season for striped bass and shad on September 17, instead of September 25, thus conforming o the new closing date for salmon netting.

Provides that no more than five salmon may be taken per day in district 2 and prohibits taking striped bass less than twelve inches in length with hook and line. The minimum size which may be taken with nets remains at three pounds. Prohibits the possession or sale of striped bass weighing more than ten pounds, during the months of April and May.

Provides that striped bass which are legally taken during the open season may be held through the closed season of June and July under regulations to be prescribed by the Fish and Game Commission.

Assembly Bill No. 831. By Mr. Stevens.

Nets and Lines.

Amends section 636 of the Penal Code.

Provides that gill and trammel nets of not less than seven and one-half inch mesh may be used for salmon only during the months of June and July in district 12 B.

Prohibits the possession of beach seines, ound-haul or purse nets in districts 12 nd 12 B.

Prohibits the use of fyke nets for taking cat fish.

Permits the use of crab traps in those districts where crab nets are allowed.

Prohibits the possession of nets in district 20.

Assembly Bill No. 832. By Mr. Stevens.

Salmon.

Amends section 634 of the Penal Code.

This bill is of importance for it places further restrictions on the taking of salmon which show that they are in need of additional protection. The suggestion for salmon conservation made in the last issue of CALIFORNIA FISH AND GAME were largely followed in this bill. The rapid increase in the catch by outside sea trolling, left the salmon insufficiently protected. It was the object in this bill to cut down the catch about equally in all districts and not cut down the river catch alone as suggested by the outside trollers, or cut down the outside catch alone as suggested by the river fishermen.

The upper Sacramento River district 12 A netting season was reduced fifteen days so that the open season for that district is the months of January to April, inclusive. For the balance of the river, the fall netting season was closed eight days earlier. These eight days are taken from the time when the run is heaviest and amounts to much more than the short time would indicate. This provision will cut down the river catch a little over 10 per cent.

A closed season is provided for Monterey Bay of January, February and March, which will cut down the catch in pounds at that point about 10 per cent. As this season comes at a time when small, immature salmon are taken in numbers the saving in numbers of fish is more than the saving in weight indicates. A closed season from March 1 to April 15, is provided for district 10 and a closed season of March and April for district 7. These two last are outside trolling districts and the closed season is to protect the immature salmon which are caught at the beginning of the season.

The bill provides that Eel River be closed to the use of nets after January 1, 1922, but permits the commercial taking of salmon on the lower river by trolling during the months of September, October and November.

Assembly Bill No. 1015. By Mr. Benton.

Croakers, Halibut and Barracuda.

Amends section 628 *c* of the Penal Code.

Prohibits the sale of California whiting, yellow-fin and spot-fin croakers. The sale of California halibut under four pounds in weight, or of barracuda under three pounds in weight or of albacore under six pounds in weight is prohibited as in the old law. In addition to the non-sale of these last three kinds of fish, this bill prohibits the possession of over fifty pounds of undersized fish.

FISHERIES NOTES FROM SAN PEDRO

Eight fishermen were arrested and convicted during April and May, 1921, for violations of the state fish laws pertaining to district 20. One of the heaviest fines imposed was meted out to Tony Marincovich, a San Pedro fisherman, in the justice's court at Avalon, Catalina Island, on May 13, 1921. Defendant in this case was fined $500 with the suspended jail sentence of one hundred days for maintaining a net in district 20 in violation of section 636.

The first albacore taken by a local boat this season was brought to San Pedro on June 8. Six fish averaging about sixteen pounds each were taken with jig lines.

The new fireproof cannery of the Halfhill Packing Corporation, recently completed on Channel 3 at Long Beach, is being put in readiness for the tuna season. In the meantime this company will pack chicken.

A decision that may affect the common practice by canneries in receiving tuna "subject to condition after cooking," was given by Superior Judge C. S. Crail at Department 4 in Los Angeles on June 9, in action brought by the crew of the "Golden Gate" for fish refused as unfit for canning purposes. Judgment was granted in favor of the plaintiff for seven and one-half tons of spoiled fish. This decision may result in fishermen taking more care with their catches on account of the possibility of canners refusing any fish that looks doubtful.

The boat "Kotobuki," Captain M. Yamamoto, arrived in San Pedro on June 13, with eight and one-half tons of seaweed (*Gelidium sp.*) taken in Mexican waters. The entire load was consigned to the American Agar Company in Glendale, California, which company is en-

gaged in manufacturing agar-agar. This seaweed was taken near Point Banda in approximately three to four fathoms of water by means of hooks attached to long poles.

PACIFIC FISHERIES SOCIETY MEETING.

The Pacific Fisheries Society will hold its annual meeting at the University of California, Berkeley, on August 4, 5 and 6. Some interesting papers will be read and discussions held on the development and conservation of the commercial fisheries as well as on the subject of sport fishing. The meetings will be of interest to those engaged in the fishing industry as a business, as well as to those interested in problems of conservation, for an effort will be made to get these two factions into close touch with each other. The final program will be announced about the middle of July. Some of the papers will cover the following subjects: Whales and Whale Fisheries of California; Seals and Sea-lions of California and their relation to the Fisheries; Fisheries Investigations of the California Fish and Game Commission; Future of the Pacific Coast Salmon Industry; Relation of Hydro-electric Power Development and Irrigation Projects to the Salmon Industry and to Trout Fishing; Fish Canning and Inspection; Fisheries Schools, etc.

The affiliated societies of the Pacific Division of the American Association for the Advancement of Science will also meet at Berkeley during these three days. The public is invited to these meetings. Papers relating to the fisheries will be given before several of these societies and any one attending the meeting of the Pacific Fisheries Society will have an opportunity to hear them.

Saturday, August 6, will be given over to many field excursions to visit places of scientific interest and to visit the local fisheries. Further information may be obtained from the secretary of the Pacific Fisheries Society, Mr. George F. Sykes, Corvallis, Oregon, or from the Department of Commercial Fisheries of the Fish and Game Commission at San Francisco.

STATE FAIR EXHIBIT OF FISHERIES

The Fish and Game Commission has secured twenty-four by forty feet additional space in the main exhibit building at the Sacramento State Fair and will enlarge the scenic and live fish display which has been one of the most attractive exhibits at the fair during the past two years. An area of sixteen by forty feet will be devoted to an educational exhibit of the state's fisheries resources and to the fisheries conservation work of the commission.

NOTES FROM THE STATE FISHERIES LABORATORY.*

WILL F. THOMPSON, Editor.

THE PERSONNEL.

The Fish and Game Commission has lost the services of Miss Helen M. Edwards, who married Mr. Samuel Bacon the latter part of April. Miss Edwards has been acting as scientific assistant to Mr. Thompson during the stay at Hopkins Marine Station, Pacific Grove. Her

*California State Fisheries Laboratory, Contribution No. 28.

The listing of small publications of members of the laboratory force together with the Fish Bulletins issued by them has led to some confusion. Hereafter these will be numbered as sent to the printer, not according to the date of printing. The correct numbers are as follows:

Fish Bulletin No. 4, contribution No. 22.

The Future of the Sardine, California Fish and Game, Volume 7, No. 1, contribution No. 23.

Notes from the State Fisheries Laboratory, in California Fish and Game, Volume 7, No. 1, contribution No. 24.

The Abundance of Young Pismo Clams, in California Fish and Game, Volume 7, No. 2, contribution No. 25.

Quarter-oils or Half-pound Ovals, in California Fish and Game, Volume 7, No. 2, contribution No. 26.

Whales and Sardines, California Fish and Game, Volume 7, No. 2, contribution No. 27.

place will be hard to fill, but nevertheless, the best wishes of all with whom she has been connected in her work go with her.

Besides Miss Edwards, the commission has had Mr. Thompson and Mr. W. L. Scofield at the Hopkins Marine Station during the past year, pending the construction of the new laboratory at San Pedro. In anticipation of the beginning of building operations, Mr. Thompson has transferred his residence to San Pedro. This has somewhat crowded the quarters there as they are now constituted, but it is hoped that this will not be permanently the case. Mr. W. L. Scofield has also left the Hopkins Marine Station, going to Palo Alto, where he will work at Stanford University for several months. This leaves no one at present in Pacific Grove. The Fish and Game Commission owes much to the Marine Station for the space kindly granted its workers.

During the coming summer, Mr. O. E. Sette will be engaged in work for the commission in continuation of his sardine studies which he has been pursuing at Stanford University. He will make his headquarters at San Pedro with the other members of the laboratory staff.

THE LIBRARY FOR THE NEW LABORATORY.

The work of collecting a library for the scientific work to be carried on in the new laboratory has been under way some time. There have been many difficulties in the way, such as the unsettled conditions in Europe, the determination of the method of purchasing such periodicals as are desired, etc., but it is now hoped that the more serious of these have been overcome. There are now on our shelves the complete publications of the Scottish Fishery Board, together with those of the Irish and British governments; the Reports and Bulletins of the Bureau of Fisheries of the United States; the Reports of the Dove Marine Laboratory; the Danish, Dutch and Norwegian government publications; those of the Canadian government; of the states of Rhode Island and Massachusetts; of the Province of British Columbia; and many separate volumes bearing on fishery matters. We have to thank the Dove Marine Laboratory, Prof. E. E. Prince of Canada, the Danish, Dutch and the Norwegian Fishery authorities for their generous donation of literature. There are now well toward completion the negotiations for the purchase of all the well-known scientific journals which are specially devoted to the subject of fisheries, and it is hoped that by the time the next issue of CALIFORNIA FISH AND GAME appears, we will be able to record the arrival of many of these. The low exchange value of the money of various European nations has rendered the purchase much less expensive than would have been the case previous to the war.

It is unfortunate that some of the sets obtained, notably that of the Bureau of Fisheries of the United States, are somewhat incomplete because certain numbers are out of print. We greatly desire to obtain these, however, and would be much obliged to anyone assisting us by the donation of odd issues of the various sets we may desire.—W. F. T.

THE BASKING SHARK AT MONTEREY

The Basking Shark, known to science as *Cetorhinus maximus*, has been recorded several times from Monterey, but its occurrence is nevertheless an interesting event, especially to the fishermen. This giant shark, with its gill openings extending well around toward the front of its throat, always attracts much attention when brought ashore. At Monterey it is usually taken in the lampara or gill nets, in which it becomes entangled until it is supposed to smother to death by the closure of the gill openings. It does great damage to the net in the meanwhile, and the fishermen do not welcome it. On May 3, 1920, a specimen was brought in to the wharf at Monterey, and measured by W. L. Scofield, who found it to be twenty-two feet long from the tip of the snout to the end of the tail. Again, in April, 1921, a specimen twenty-four feet in length was brought in by a lampara fisherman. In the endeavor to recoup some of the loss caused by the damage to his nets he exhibited the great shark for an admission charge. It is said that he failed in the venture.—W. F. T.

A RAG FISH AT MONTEREY.

There are several "rag" fishes found on our coast, one of which is hereby noted as occurring at Monterey. Mr. Higgins has had the good fortune to find a still rarer member of the group, and describes it below. The specimen found at Monterey was *Icosteus aenigmaticus* of Lockington. It was taken during 1919, but the date and place of capture, save that of Monterey Bay, was not recorded. The specimen at hand is twenty-three centimeters in body length, and twenty-seven and three-tenths in total length.

The salient characters of this "rag" fish are its lack of stiff bones, which makes it much like a thick, flat, bundle of rags, its yellowish color with purplish spots of irregular shape, and the row of spined scales along the lateral line. The fin rays are all of them covered by small spinules. It is very evidently a fish from the deep water, but just what depth we cannot surmise. It may be a pelagic.—W. F. T.

A STRANGE RAG FISH AT SAN PEDRO.

Closely related to the family of rag fishes, of which *Icosteus* is the typical genus, is the little known species, *Acrotus willoughbyi*, Bean. A specimen was taken in a mackerel net off San Pedro, March 31, 1921, and brought to the wholesale markets. We were unable to obtain the specimen as it was sold for exhibition, but careful measurements were made and there can be little doubt of its correct identification.

The fish was fifty-seven inches long, fourteen inches deep, and rather flattened laterally. The body was very limp and yielding as in other members of this group, due to the cartilaginous nature of the skeleton, the flesh was soft, and the naked skin tender and easily broken. The mouth was large, with thick lips, the nose broad and rounded, resembling with its large nostrils the muzzle of a calf. The fish was so fragile that it was somewhat mutilated when it reached the market, the gaff having torn through the jaw when landing the fish from the net.

The first or type specimen was taken in 1887 on the coast of Washington, apparently thrown up from deep water in a storm. Another was taken there subsequently, and one was taken at Monterey. This occurrence is especially noteworthy as the species has rarely been seen by naturalists and has never before been taken on this part of the coast.—E. H.

CUTLASS FISH TAKEN OFF LONG BEACH.

Following the practice of noting the unusual, the occurrence of the cutlass fish, *Trichiurus lepturus*, Linnaeus, which has recently come to the notice of the laboratory staff, entirely incidental to the regular work, may be here recorded.

Two specimens were taken, one on the first and another on the fourth of January, 1921, off Long Beach, in from three to five fathoms of water. They are each about two feet long, one and three-quarters inches deep, and very much compressed laterally. The mouth is large with long sharp teeth, the eyes large, and the skin is naked and of silvery color. The dorsal fin extends the length of the body to the long thread-like tail.

The species is common in the West Indies, and has been reported on the Atlantic coast as far north as Cape Cod. It is known in the Pacific from Panama, Lower California, and Japan, but this is probably its first appearance in this region.—E. H.

THE GRUNION.

The traditional spring spawning runs of the grunion on the sandy beaches of southern California have created the usual excitement at Long Beach this spring. These little fish, as described by Mr. Will F. Thompson in Fish Bulletin No. 3, come up on the beach with the high tides of the second, third and fourth nights following the full moon of the spring months, to deposit their eggs in the sand away from their enemies in the ocean. Although the deposited eggs are free from most enemies, great numbers of the spawning fish are taken by the "grunion hunters," who gather on the beach at about high tide and capture the fish as they are left on the sand between waves.

On March 23, the first night upon which a run might be expected, no fish were observed to be spawning. No observations were made on the two following nights, but during the second scheduled run, April 24, 25 and 26, large runs were observed on all three nights.

Runs were also reported to have occurred during the high tide of the new moon period early in May, but the extent and dates of these runs are not known. The full moon run in May, seemed to be a little out of the ordinary, as on the first night of the run, May 23, a considerable stretch of beach was carefully watched, but no spawning fish were observed, only a small number being seen in the surf. The presence of the fish in the surf was also made evident by the capture of quite a number by the use of a net in the shallow waves. On May 24, the run was but little better than that of the night before. The many people who scanned the beach were able to collect a few fish by wading out into the shallow receding waves, but very few fish were observed to be spawning. The results of a search for eggs in the sand on May 25, verified the conclusions from the observations of the two nights before, for only two pods of eggs were found as the result of quite extensive digging. The run of May 25 seemed to be normal in every way and many people who had searched the beach in vain the two previous nights were well paid for their efforts with a good supply of fish.—H. B. H.

LIFE HISTORY NOTES.

INTRODUCED DOVE THRIVES IN LOS ANGELES.

The Chinese spotted dove (*Spilopelia chinensis*), as a resident of Los Angeles first came to my attention in 1917, when a dead bird was found by school children in Hollywood. The skin of this specimen was preserved and is now in the museum of the Nature Study Department of the Los Angeles County schools.

At that time it was said to be common in a restricted locality in northern Hollywood. Reports of its occurence have increased in frequency and from a much wider area, until in the first week of April, a bird was noted by the writer, at close range, near the museum in Exposition Park.

Various reports as to the origin of this colony have not satisfactorily established whether the progenitors were liberated, or whether they were escaped cage-birds. The fact remains that the species is firmly established, and as a city-dweller, safe from hunters, is rapidly increasing in numbers.—L. E. WYMAN, *Museum History, Science and Art, Los Angeles, California.*

MOUNTAIN LION SWIMS RIVER.

It seems to be the general belief that the mountain lion is very shy of water, and that he will go out of his way in order to avoid crossing a stream when it is necessary for him to swim. My experience in trailing lions does not bear out this impression. In fact, two male lions which I killed at different times in Shasta County were voluntarily swimming the McCloud River, at different places, on every trip around their beat. Deer were as numerous on one side of the river as on the other, so it was not necessary for the lions to cross in order to get food. And as in each instance, the tracks were several hours old, it is apparent that these lions did not swim the river to confuse or avoid the dogs, but that they were merely following their natural instinct.

Another instance of this kind was in January, 1921, when I was hunting from Kinsley Ranger Station, Mariposa County, in the company of Mr. Joseph Dixon of the Museum of Vertebrate Zoology. After several days of storm, the weather cleared about dark on the evening of January 19. There was about six inches of snow on the ground when we left camp early on January 20. At about 9 a. m. we found the track of a large male lion on Grizzly Mountain. The tracks were about twelve hours old when we found them, which was indicated by the condition of the snow where the tracks were made.

On account of the dense brush in places we were unable to keep up with the dogs. As a result, by the time we had trailed the lion about six miles south to the north rim of the Merced River, and at a point about 2000 feet above the river, we

could just faintly hear the hounds baying as they crossed over the south rim, at about the same elevation. We hurried down the mountain to the river and soon found the tracks of the lion and dogs entering the water on a sand bar at about 600 feet west of the mouth of Slate Gulch and about three miles east of Briceburg.

I was sure that the dogs would tree the lion before night, so that I was determined to follow them, although Mr. Dixon had had to return to Berkeley. As the river was about 100 feet wide and too cold and swift to swim with safety, I decided to build a raft. I stopped a passing telephone lineman and got some spikes from him. Then I gathered some discarded railroad ties and driftwood and built a raft at the upper end of a pool. Using a piece of driftwood for a paddle, I ferried across. The dogs had crossed the river at about 12 o'clock noon and by the time I had built the raft and crossed to the south side it was 2:30 p. m.

I soon found the track of the lion and dogs climbing the mountain on the south side of the river. After trailing them about two miles up the ridge toward Filiciana, I heard the dogs barking "treed" in the head of a short canyon on the west side of Slate Gulch. When I arrived at the tree, the lion jumped out, but treed again about a hundred yards farther up the canyon. He was lying in the narrow fork of a tall live oak and when I shot him through the heart with the revolver, he sank into the fork and died.

Then I climbed the tree and tried to dislodge him, but as he weighed about 160 pounds, and as it was necessary to lift the carcass about four feet to slip the hips through the fork, I was unable to free him. I then thought of cutting off one of the forks with my skinning knife. By this time, it was getting quite dark and a storm was threatening, and with a hard, rough trip of two miles down the canyon and the river to cross, I decided to cut the carcass in two behind the shoulder and drop the front half to the ground, leaving the rear half in the tree.

By the time that I reached the river, it was quite dark and as the raft had drifted half way down the pool while I was crossing earlier in the day, I was forced to abandon the raft, on the return trip, near the north bank, and wade out to avoid being carried into the rapids. I now walked three miles down the river to Briceburg where I arrived about 8 p. m., after being on the trail fourteen hours.

This lion had crossed the river probably ten hours ahead of the dogs and was following his regular beat as I found his old tracks while trailing him on the south side of the river. There was also the skeleton of a calf near the place where the lion was treed. He had probably been killing cattle there during the summer.—JAY C. BRUCE, *San Lorenzo, California.*

CURLEW NUMEROUS.

Since its protection, the Hudsonian curlew (*Numenius hudsonicus*) is becoming more numerous again, in this vicinity. I have lived and hunted in this country around Rio Vista from boyhood and have entertained a number of the most prominent sportsmen from many states on my reserve, and I have naturally taken a keen interest in the wild game life of the locality. I have heard the old settlers here tell how the jack curlews were upon these plains in countless thousands at one time. Whether they were killed off or inhabited another region, I am unable to relate, but I do know that for the last twenty years at this season of the year we have only seen an occasional flock. However, about a week ago I noticed a flock of about one hundred of these birds on the pasturage grounds each day. The flock has been increasing until it has reached about five times its original size. On April 26, 1921, about sunrise, I saw a flock of about five thousand which all seemed to be whistling at the same time. I was greatly astonished, as I had never seen these birds in such numbers before. This large flock did not stop in this vicinity, but traveled straight on southward; and each day I have seen curlew still migrating to the south, but not in such great numbers. There are a great many here at present, yet they are not so numerous as they were a week ago. They are evidently traveling to a new feeding ground.—S. C. CHURCH, *Rio Vista, California.*

ALBINO DEER SEEN IN THE STANISLAUS FOREST.

On February 1, of this year, Ranger Freer saw a white or albino mule deer in the Stanislaus National Forest. Several months later, on May 7, when Ranger Freer and former District Ranger Fowler were out repairing telephone lines they again saw an albino deer. These two records of the appearance of an albino deer were of unusual interest to us.—J. V. WULFF, *Sonora, California.*

A TRAPPER'S EXPERIENCES.

I laid out my first line of traps on the twenty-fifth of October, 1920, stringing them from Logan Meadow north to the junction of the main and West Chiquito creeks, crossing here and keeping along the ridge until opposite Placer Station, where I crossed over and continued north to Arnold meadow. Then I crossed back to Logan via Mebold and Summit meadows, covering about thirty miles each day. Of course, I later varied this line in several respects, at one time running up the Joaquin to Squaw Dome, and again trapping the other side of the river as far down as Kaiser crossing.

My first catch, on the twenty-sixth of October, consisted of three grey foxes and one skunk. All of these skins were exceedingly blue and unprime, so I set all traps off that day and left them until the fifteenth of November, and even then I caught foxes that were not at all prime. In my mind there is not the slightest doubt but that the trapping season is at least one month too early even for that country; yet there are always trappers at work on the first day of the season (October 15) as low down as Finegold. Then they wonder at the prices which they receive for their furs.

For coyote bait I used squirrel meat ground very fine, to which I added a small amount of tincture of asafetida (God only knows how to spell that word—but you know what it is—I used to wear it around my neck to prevent diseases when I was a kid) and some oil of rhodium. I set three traps in a Y form, driving a stake through the rings completely out of sight, and covering the whole thing over very carefully. In the course of two months, I was able to so set such a group of traps that the coyotes would take enough notice of it to turn a trap over once in a while, or scratch the bait from the center of the set. I then found that they were suspicious of any set that was bounded on any side by any obstacle whatever—and after that I set them in the openings; and this was the secret of the whole game. I caught seventeen of these so-called coyotes in a very short time. A peculiar thing about them is that, while in the trap, at least, they will utter no sound whatever and, instead of striving to get away, they will simply grovel in the dirt like a domestic dog trying to beg forgiveness; also they will positively not meet your eye. On the contrary with the grey fox—they are continually on the prod and will growl, snap and bark from the time they see you until they are dispatched. I also caught a large black eagle in one of these sets, and he was as docile as a chicken, not even hissing at me when I let him out of the trap. Later I caught another of these birds, but the coyotes found him first and left me only his two feet.

I spoke to you about finding the carcasses of eight deer that had undoubtedly been killed by coyotes. These kills were always in the deep snow and one could visualize every move that was made. In each case the deer was chased by not more than two animals—sometimes only one—and caught by another as he circled back over his trail. I have always read that these animals hamstring a deer, but in so far as I could tell these deer were pulled down from in front by a nose hold, and when you take into consideration the size of these coyotes it does not seem at all impossible. My largest was sixty-two inches long and would weigh something over 100 pounds, but the average was better than fifty-eight inches from tip to tip, and just that much bone and muscle. In broad daylight I saw one carrying a full grown badger by holding it in his teeth and throwing the weight over his left shoulder. When caught in a trap they will tear manzanita bushes over two inches through into the smallest shreds. The one thing I couldn't understand about these killings was that they were all large deer and mostly bucks. It was some little time after the rutting season and after the bucks had plenty of time to regain strength. The last one I

found was about the twenty-fourth of February, and as I attempted to lift the head both horns came off in my hand. This for your information regarding the time deer drop their horns at that elevation. This was a perfect four-pointer.

During my stay in there I saw but one loin track, and though I followed for several miles I could not find where he had either attacked or molested any deer. I am, therefore, of the opinion that a great many of the kills with which lions are blamed should go to the coyote. J. T. Hogue told me that he had found a great many deer killed by lions in his time, but he admitted that he had seen no sign of a lion at a great many of these carcasses and had simply taken it for granted that it was a lion. When the Teafords were in there hunting lion and bear last winter they saw one lion track—this lion had come from Shake Flat across country to the Soda Springs on West Chiquito and straight through to Jackass—in a straight line and with never a stop, although he was passing through a country that literally swarmed with deer of all kinds. Certainly, at that time of year he was going straight through and out of the deer country, and though the boys followed him for two days he did not stop or make a kill of any kind. George Teaford and W. B. Day, both old-timers, tell me that they have seen deer killed by single coyotes—and since these animals of which I speak are not much smaller than the old timber wolf, it does not seem at all impossible.

Unless the price of fur goes up to a point where it will pay to trap these coyotes, or until a bounty is placed on them by the county, it will be but a very few years before they do some real damage to the deer. Of course one wonders why they have not reached such numbers in the past as to have exterminated all of the deer, but I think that civilization is concentrating the deer and the coyotes into such a small tract of land in the hills that the coyote is gaining advantages every year—especially during the hard winters. This same question is asked about the tree bettles—why they haven't destroyed all the timber before, since they were left alone for years—while I know there is a real reason I don't know what it is.

As for deer—our first few months in there we saw great numbers of does, and with every doe there was at least one fawn and sometimes two. Wagner told me that there were a great many barren does, but all the barren does I saw had their fawns close by. And that reminds me of another peculiar thing. There was a cave on the Logan side of the river where I thought there might be a bear or so, and while I was sitting there one day waiting for the dog to come up, so I could send him in, I saw an old doe and two fawns come down to drink on the other side of this river. It was the twenty-sixth of November and the deer had just started running, the first signs of this being on the twenty-fifth. This old doe led both fawns down and they started to drink. As soon as she saw they were busy at it she started up the hill on a dead run, but they heard her and caught her before she had gone 200 yards. She walked calmly back to the river with them again and started them to drinking again. This time she made her get away, although the poor little devils ran and bleated around there for half an hour, until they finally laid down under a big oak and tried to forget it. I do not know that this is the way the doe gets away from her fawns at this time of the year, but this I did see; and I also know that after the season of mating is over she comes back to her fawns again. During November and part of December these little devils were all alone, but at the time we left the hills—February 27—every doe had her fawns with her and seemed as loving to them as ever. The whole trip was the most interesting I was ever on, and I really believe I learned more about nature in those five months than during my entire life.

I had an interesting experience with a skunk. It has been my belief that I was a regular skunk trapper and on this particular day I found a large one in a trap on a sloping hill. The idea is that if you get their hind feet off the ground (their rear muscles being the ones that work the scent bag) you can kill them without smelling up the fur. I, therefore, lifted this fellow off the ground with a pole and hung him by one of the springs of the trap in a manzanita bush. I then walked up very close to him so as to be able to

shoot him through the brain. As I did so he reached one leg behind him, got a purchase on one of the limbs of the bush and shot me square in the eye and ear, at the same time dropping down out of the bush, where he proceeded to work on me from the ground up. As soon as I had sufficiently recovered to open one eye, I took a squint at him and he was sitting there calmly chewing on the fish head with which I had baited the trap. This calmness of theirs impresses me more than anything else that they do, except, of course, the thing I have just mentioned. When you come on them in a trap they will invariably look up at you for an instant and then go on eating, or picking their teeth, or whatever it may be that they are interested in.

After the twentieth of November the large bucks started to come down from the high country, though the spikes and forked horns had been running wild a week previous to this. After that the ground was torn up in huge chunks on every hillside and opening, in the entire forest. It was not my luck to see any real fights, though I heard one time a clashing of horns in the brush within thirty feet of the trail that must have meant trouble. Also, two of the last coyotes that I trapped had large unhealed gashes in their heads and along their sides that could have been made by horns only.—Roy H. Blood, *Madera, California.*

AN OPOSSUM SEEN IN PACHECO PASS.

Last summer I was driving from Fresno to Monterey via Pacheco Pass, when about fifteen miles out from Hollister and east of that place I saw something which at the time I believed to be a cat. Although dark, I had a strong spot light and by using it I could see the shining eyes of the animal. I brought the car to a sudden stop and ran up to where it was lying, whereupon, it started to walk off. I grabbed a small stick and hit it lightly. It lay as if dead—it not only was playing possum, but it was a possum! It had the long slick tail which is similar to the tail of a rat. The hair was gray and white tipped and the face was the bald face of the opossum (*Didelphis virginiana*). I picked it up and held it for a few seconds, but it began to squirm and when I dropped it it ran into the shrubs at the side of the road and was gone.—R. D. Libby, *Fresno, California.*

THE OPOSSUM IN VENTURA COUNTY

Being a southerner and having had, last November, a fine opossum (*Didelphis virginiana*) killed by a friend, and baked with sweet potatoes in the true southern style by an old negro from Dixie, I was particularly interested in the item published in the January number of California Fish and Game.

The opossum, a male, was killed in Ventura County, about two miles up the Santa Clara River from the mouth and was the first one ever heard of in this vicinity. It was larger than any I ever saw in the south—California must agree with them.

Since this opossum was killed, I have heard of two being caught near the line of Ventura and Los Angeles counties, but these were only reports. I did not see the animals myself.—Geo. P. Austin. *Oxnard, California.*

CONSERVATION IN OTHER STATES.

MUSKRAT SEASON CLOSED IN MINNESOTA.

In October, 1920, the department sent out thousands of questionnaires asking for information and an expression of opinion from trappers, fur buyers and dealers, farmers and sportsmen as to what steps should be taken to preserve a breeding nucleus of muskrats.

Fully 90 per cent of the answers favored an immediate closed season. The commissioner petitioned Governor Burnquist for additional protection which was duly granted and order No. 2 was issued protecting muskrats until the close of the 1921 regular session of the Minnesota legislature.

It developed later that muskrats were still numerous in some localities and complaints of the damage to highways and grades poured in so rapidly that the department could not possibly investigate them all. Whereupon another petition was prepared asking for a lifting of the ban in thirteen counties. This was acted upon favorably by Governor Preus and order No. 3 was issued.—*Fins, Feathers and Fur*, December, 1920.

SPORTSMEN'S CLUBS IN NEW YORK

"There are today in New York some 475 sportsmen's clubs comprising a membership of about 40,000 hunters, fishermen, and other conservationists. Even this total, however, is smaller than it should be, in view of the fact that last year some 300,000 persons purchased hunting and trapping licenses in New York—to say nothing of the fishermen of whom no license is required."—*The Conservationist*, April, 1921.

INTEREST IN FISH AND GAME CONSERVATION IN UTAH.

Interest in fish and game conservation in Utah has been greatly stimulated through the efforts of the United States Forest Service, which has organized local fish and game protective associations and unified them into a state organization. Since October, 1920, more than twenty-five locals have been established.

ANNUAL DIVIDEND FROM FUR-BEARING ANIMALS OF NEW YORK STATE.

The game and fur-bearing animals of New York state, if capitalized, are worth not less than $53,000,000; they return an annual dividend of more than $3,200,000; and they cost the state for their protection and increase the nominal sum of $182,000. This cost of protection and increase is thus less than 6 per cent of the annual dividend.

REPORTS.

VIOLATIONS OF FISH AND GAME LAWS.

January 1, 1921, to March 31, 1921.

Offense	Number of arrests	Fines imposed
GAME		
Hunting without license	20	$200 00
Trapping without license	4	40 00
Deer—closed season—killing or possession	23	875 00
Does—spike bucks, fawns—killing or possession	4	475 00
Bear—closed season—killing or possession	1	10 00
Brush rabbits, squirrels—closed season—killing or possession	6	100 00
Quail—offering for sale—excess limit—killing or possession	10	350 00
Doves—closed season—killing or possession	1	25 00
Ducks—excess limit—closed season—killing or possession	12	250 00
Protected shore birds—killing or possession	8	225 00
Non-game birds—killing or possession	17	755 00
Night hunting	12	50 00
Shooting ducks from power boat	1	25 00
Mudhens—killing or possession closed season	1	25 00
Total game violations	120	$3,405 00
FISH		
Angling without license	10	$190 00
Clams—undersized—excess limit—taking or possession	12	310 00
Crabs—undersized—excess limit—taking or possession	16	360 00
Abalones—undersized—closed season—taking or possesion	19	627 50
Lobsters—undersized—taking or possession	1	25 00
Striped bass—underweight—taking or possession	9	155 00
Young fish—taking or possession	2	20 00
Barracuda—underweight—taking or possession	1	25 00
Sturgeon—closed season—taking or possession	1	20 00
Sunfish, crappie—closed season—taking or possession	5	40 00
Trout—excess limit—closed season—taking or possession	7	190 00
Illegal nets in restricted districts	18	595 00
Total fish violations	101	$2,557 50
Grand total fish and game violations	221	$5,962 50

SEIZURES—FISH AND GAME AND ILLEGALLY USED FISHING APPARATUS

January 1, 1921, to March 31, 1921.

GAME.	
Deer meat	376 lbs.
Quail	148
Ducks	857
Doves, pigeons	1
Rabbits, squirrels	12
Miscellaneous birds	30
Beaver skin	1
Pine marten skins	5
FISH.	
Striped bass	926 lbs.
Barracuda	8625 lbs.
Halibut	5669 lbs.
Sunfish	21
Trout	22
Crabs	2516
Abalones	317
Abalones	6497 lbs.
Clams, pismo	690
Clams, cockle	982 lbs.
Lobsters	1920
Lobsters	100 lbs.
Illegal nets	16
SEARCHES.	
Illegal fish and game	16

STATEMENT OF EXPENDITURES.

Period from July 1, 1920, to March 31, 1921.

Administration:		
Commissioners	$310 68	
Executive offices	19,169 10	
Printing	4,985 82	
Research and publicity	4,789 95	
Accident and death claims	1,427 61	
		$30,683 22
Commercial fish culture and conservation:		
Superintendence	$11,814 75	
Inspection and patrol	23,754 51	
Research	22,948 71	
Statistics	7,989 15	
Market fishing license commissions	375 50	
Propagation and distribution of salmon	19,739 93	
		86,622 55
Sporting fish culture and conservation:		
Superintendence	$11,203 55	
Printing	198 54	
Prosecutions and allowances	391 85	
Angling license commissions	12,627 40	
Fish exhibits	4,323 19	
General patrol (pro rata share)—		
San Francisco District (40 per cent)	38,943 71	
Los Angeles District (40 per cent)	12,506 31	
Sacramento District (40 per cent)	21,413 88	
Propagation and distribution of trout	109,069 47	
		200,677 90
Game conservation:		
Printing	$267 18	
Prosecutions and allowances	970 73	
Hunting license commissions	19,134 70	
Mountain lion hunting (and bounties)	6,724 76	
General patrol (pro rata share)—		
San Francisco District (60 per cent)	43,283 45	
Los Angeles District (60 per cent)	16,533 10	
Sacramento District (60 per cent)	32,123 74	
		121,173 59
Tahoe camping ground		402 11
		$439,559 37

CALIFORNIA FRESH FISHERY PRODUCTS FOR MONTHS OF JANUARY, FEBRUARY AND MARCH, 1921.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Colusa, Butte, Tehama, Glenn	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Imperial	Total	Mexican, brought into California
Albacore												45				45	
Anchovies								1,850		5,800		2,420		48,555		58,625	
Barracuda											33,041	352,118		332,060		717,219	1,757,921
Bluefish									1,523	16,772						18,295	
Boccaccio								41,043	111,986	347,674						500,703	
Bonito											30	21,671	8	20,203		41,912	22,587
Carp				15,184	35,788		14,857	40								65,869	
Catfish		37,761		5,831	16,383		7,173									67,151	
Chilipepper								22,985	2,513	32,277						57,775	
Croakers												57,327				57,327	295
Cultus Cod	487							35,109	7,727	28,161		297	26	527		72,334	
Dolphin																	
Eels																	
Flounders	9,629		465	1,448			3,060	18,926	9,031	910	105	885				44,459	
Grayfish							176	29,870		565		13,054	4,985	205,381		254,031	
Greenfish																	
Hake								6,600	12							6,702	
Halibut								1,417	472	2,064	60,125	500,138	46,761	202,063		822,340	236,258
Hardhead				324	26 976		34,657									61,957	
Herring	4,994		731				21,220	441,325		1,300	10					469,580	
Kingfish								3,052	30,128	887	92	113,695		1,145		149,840	315
Mackerel										1,442	2,313	704,749	9,952	72,647		791,133	29,684
Marlin																	
Mullet														433		433	7,670
Perch	16,129	62	24,169				14	16,709	1,610	13,998	7	21,795	82	2,063		96,641	3,898
Pike				589	1,815		2,329									4,733	
Pompano									37	174	16	3,622		20		3,869	305
Rock Bass											74	13,913	1,954	17,565		33,516	3,095
Rockfish	1,416		60					125,470	61,417	254,830	21,721	512,851	11,761	261,926		1,251,452	13,610
Sablefish								153,995								153,995	
Salmon	67		194	33,884	27,225	2,383	57,161	112 478	5,653	174,583						413,638	
Sandabs								148 623	13,528	1,313		1,437	5			167,906	
Sardines			98						92	1,479,625		17,240,790	822,175	1,451,914		20,954,691	
Sculpin												8,794		4,974		13,768	312
Sea Bass—Black												4,130		19,050		23,180	21,562
Sea Bass—White									146	110	1,358	43,203	142	39,194		84,243	85,439
Sea Trout												92	2,510			2,602	6,568
Shad				2,565	5,336		17,997	1,320	10							27,228	
Shad—Buck				477	824		4,419									5,720	
Shad—Roe				1,971	930		7,359									10,260	
Sheepshead											209	448		9,594		10,341	

Skates								22,295		1,662		1,406	232			25,595		
Skipjack																		
Smelt	8,978		5,502				4,221	51,338	221	4,830	22,629	50,129	921	13,771		162,540	607	
Sole								880,307	35,500	14,595	7,224	48,145	729	6,163		992,663	175	
Splittail				165	12,169		159									12,493		
Striped Bass			272	9,457	8,622	41	130,414	15,942		15						161,763		
Stingaree												203		1,555		1,758		
Suckers					1,976		85									2,061		
Swordfish																		
Tomcod							20	15,078								15,098		
Trout—Farm																		
Trout—Steelhead																		
Tuna												101		2,209		2,310	682	
Tuna—Bluefin																		
Tuna—Yellowfin												1,060				1,060		
Turbot			146													146		
Whitebait			919													919		
Whitefish												12,082		3,013		15,095	606	
Yellowtail							516					117,788		76,920		195,224	100,794	
Miscellaneous				49				4,633	2,358	3,018	6,617	7,086	857			24,618	200	
Total fish	41,700	37,823	32,556	71,884	138,107	2,424	305,837	2,151,395	284,004	2,386,635	164,901	19,818,565	903,110	2,792,951		29,131,862	2,292,577	
Crustaceans:																		
Crabs (doz.)	1,048	22	79					9,405	122	5						10,681		
Ecrevisse (doz.)																		
Shrimps								150,189				639	26			150,854		
Spiny Lobsters											13,607	34,223	937	17,727		66,494	383,279	
Mollusks:																		
Abalones										235,320	16 686					252,006	8,094	
Clams—Cockle	5,466		1,359								276			235		7,336		
Clams—Mixed	4,598		13,519								533	155				18,805		
Clams—Pismo									957		42,758					43,715		
Clams—Softshell	112	2,084	9,145				29,089	12,553								52,983		
Cuttlefish			40					2,217	6,333	13,316		173				22,079		
Limpets																		
Mussels							40		600	485	97	65				1,287		
Oysters—Eastern (No.)			301,181					783,670								1,084,851		
Oysters—Native																		
Snails																		
Squid										32,623		13,225		39,964		85,812		
Miscellaneous:																		
Frogs (doz.)																		
Terrapins (doz.)																		
Turtles													61			61	145	
Scallops											636					636		

All amounts shown in pounds unless otherwise specified.

CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

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FIG. 54. Sardine boats waiting to unload, San Pedro. Photograph by E. M. Nielsen.

THE SARDINE OF CALIFORNIA.*

By Will F. Thompson.

In this number of California Fish and Game appear a series of articles upon the California sardine, dealing with the history of the fishery, the methods of catching, of canning, and the use of waste fish as fertilizer. They are not technical in nature, being designed for readers interested in fisheries in general, and do not attempt to speak authoritatively on debated points. The industry has been, for the past five years, an important one in California, and crucial years are ahead of it.

It should be understood, in the first place, that the sardine packed in California is a true sardine, in the sense understood by scientists of recognized standing.

This is not true of the "sardine" packed in Maine and other New England States. That is in reality a young herring, known to naturalists as *Clupea harengus*, whereas the true sardine is known as *Sardina pilchardus*. This herring is caught in great numbers along the Maine coast in weirs, or traps made in relatively shallow water. Its habits are different in many respects from those of the true sardine, for the eggs of the herring are laid on the sea bottom and attach themselves

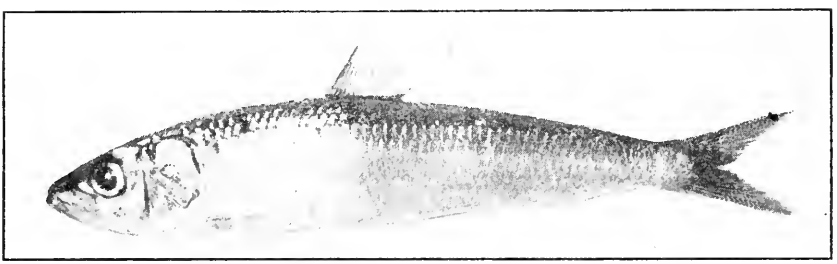

Fig. 55. The California sardine, a specimen without the usual spots. Photograph by H. B. Holmes.

there, while the eggs of the sardine are laid free in the water and drift with the currents. The differences in structure, flavor, etc., are equally marked.

The same remarks may be made about the Norwegian "sardines" save for the fact that among them one finds two species of fish widely different from the true sardine, namely the young of the herring, and the bristling, or young of the sprat, called *Clupea sprattus* by European writers. It is noteworthy that the English courts decided in 1916 that Norwegian fish packed as "sardines" could not be admitted into England under that name. According to the review of the court, bristling had been packed in oil in Norway since 1874, and they were at first called "Sproetten in oel," later "Sproetten a la Sardine," and finally "Norwegian sardines." The name sardine was therefore limited to the young of the pilchard, which are canned in France, Spain, Portugal and Italy as sardines. The pilchard itself is canned in Cornwall as pilchard. Later the Australian courts followed the example of the English.

*California State Fisheries Laboratory, No. 30.

The true sardine, or pilchard, is found from England along the Atlantic coast of Europe southward into the Mediterranean, and the adjacent coasts of Africa. It has been divided into two races, or varieties, the one found in the Atlantic and known as *Sardina pilchardus pilchardus,* the other found in the Mediterranean and known as *Sardina pilchardus sardina.* It still remains to be carefully investigated whether the difference between these two subspecies, or varieties, or races, is less than exists between some of the other "species" of sardine.

There are, indeed, throughout the world a number of these very closely related species of sardines. Thus there is the sardine of the Pacific Coast of America, from Alaska to Mexico, known as *Sardina coerulea,* and that of the coast of Peru, known as *Sardina sagax,* perhaps belonging to the same species, but more likely not. There is a gap of considerable extent between the extremes of their distributions, namely the tropical waters of the Gulf of Panama, and careful examination of many specimens will some time be necessary to determine their distinctness. Nevertheless, they both are extremely closely allied to the sardine or pilchard of Europe, in habits, distribution in the sea waters, movements and structure. This is granted by every competent authority. They are the only true sardines found in the waters of the Americas, save, perhaps, a species found occasionally in the West Indies, for no sardine is found on our Atlantic coast.

On the other side of the Pacific there are found the Japanese sardine, *Sardina melanosticta,* and the Australian *Sardina neopilchardus.* These are both very close to the European species. There is also a sardine to be found in the waters of the Cape of Good Hope, known as *Sardina ocellata.* The interrelationships of these various species are very poorly known and the morphological characters upon which they are based are insufficiently studied.

However, it is very plain that they are entitled to the name sardine, or pilchard, in contradistinction to the young of the herring, or sprat.

Regarding their habits and rate of growth, not a great deal is known. It is known that the eggs are pelagic, that is, laid so that they float freely in the open ocean waters, and that the adults in the waters of Europe and America disappear before spawning. Whether they are subject to the great fluctuations in abundance to which the herring is, still remains to be seen. The California Fish and Game Commission has collected careful data which it is hoped will in due time throw light on the subject of habits, rate of growth, migrations, and the presence of great changes in abundance. If the results which have been obtained in work on the herring can be paralleled, they will undoubtedly prove of much importance.

The following articles are regarded in no sense as a part of this work, although they do, to a certain extent provide a basis for judgment as to the changes which may occur in methods of fishing and canning in the future. This is especially true of the article on fishing gear and methods. An article by Professor Starks of Stanford University has appeared, in the April, 1918, number of CALIFORNIA FISH AND GAME upon the scientific characters of the members of the sardine and herring family found in the waters of California, and anyone interested is referred to that publication.

HISTORICAL REVIEW OF CALIFORNIA SARDINE INDUSTRY.*

By Will F. Thompson.

The sardine industry in California is, as it now exists, essentially a product of the great war. Previous to its outbreak there had been a relatively small pack at Monterey and San Pedro, but the machinery for a vast expansion already existed in part in the tuna canneries of southern California. With the practical cessation of sardine imports into the United States in 1915, and the later great foreign demand, the pack of California sardines rose to great heights. Now with the coming of peace and the gradual return to normal conditions still so far removed, it remains to be seen how our new industry will meet competition. The development of fishing and packing methods have thus far been incidents only in the thorough upheaval of 1914, and the history to be here recorded gives little clue to how well fitted they are for survival. So, in a measure, this review is not a history, because it is written during the event.

Nevertheless, since the existence of methods, and a knowledge of the availability of the raw material, enabled the California sardine canners to so readily seize their great opportunity, the prewar period is of much interest. Failures and crudities naturally played their parts, as might have been expected, for a bodily transportation of fishing and canning methods from the great existing European and Maine fisheries was impossible. The California sardine is a true sardine, with vastly different habits than the young herring and sprat of the Maine and Norwegian fisheries. Where in Maine weirs may be employed, here nets must be used. And of course, the quality of the fish is also different, requiring different treatment. At the same time, the difference between French and American labor and physical conditions effectively precluded the introduction of French methods of canning save in a general way. It is highly to be regretted that even at the time of the outbreak of the war, cannery methods were still imperfect and that such packs as that of the round can had still to be tried.

THE PREWAR PERIOD.

The canneries.

The Golden Gate Packing Company of San Francisco was the first sardine cannery on the Pacific Coast. During 1890, 1891 and 1892 it put up 20,000 cases of sardines in quarter-pound cans of the usual type, 7000 cases of one-pound round cans, and 7000 of two-pound. But, so it was said, the appearance of the sardines was erratic, and this, combined with other causes, resulted in the sale of the machinery, and its shipment to San Pedro, where sardines were to be found more consistently.

There it was utilized by the Southern California Fish Company, managed by A. P. Halfhill. This concern continued to pack sardines in a limited way until 1909, but in the meantime, in 1906, it had begun packing tuna, and toward this its energies were principally directed

*California State Fisheries Laboratory, No. 31.

until 1916. Other canneries, such as the Lower California Fisheries Company, the Pacific Tuna Canning Company, and the Premier Packing Company, all of San Diego; the Halfhill Tuna Packing Company, the South Coast Canning Company, and the Los Angeles Tuna Canning Company, of Long Beach; and the Van Camp Sea Food Company and the White Star Tuna Packing Company of San Pedro, began operations on the tuna. So that in 1916 there were ten firms engaged in packing this fish in southern California, with a long winter season when no tuna were available while sardines were. These firms provided the first great pack of sardines.

In northern California no such parallel industry had prepared the way. But F. E. Booth had, in 1903, started a cannery at Monterey, and in 1906, the Monterey Fishing and Packing Company (later reorganized as the Pacific Fish Company) had established itself. Mr. Booth began in a small experimental way about 1902 in a shed on a back street in the town of Monterey. His real canning operations were begun in 1903 in a small building on the waterfront where his cannery now stands. He started with quarter-oils and a little later packed larger fish, calling them mackerel, to suit the market then existing. However, seven or eight years later, the federal government ruled that they would have to be labelled sardines. The early canning was done by the old method of hand flaking, drying in the sun, and hand soldering the cans. For the first three years there was not even a power winch for hoisting the fish from the boats to the cannery wharf. Fish were hoisted by hand, pulled up in baskets and carried in the same to the tank in the cannery. The pound oval pack which has become the specialty of the Monterey canneries was developed under these normal conditions, and was well established at the outbreak of the war. So here, although but two canneries awaited the great expansion of the industry, they were on a relatively firmer basis, in so far as the sardine was concerned. In 1916, not only were the two existing firms kept busy, but a number of new canneries were started.

The fishing methods.

But, in northern California there had also developed a successful method of fishing, which provided a more uniform and cheaper supply of fish. This successful method was the use of the lampara.*

There has been some controversy as to whether or not fishing before 1905 was done with a gill net, and whether this was carried on during the daylight or at night. Gill netting, at present, is done in a small way for bait and for the fresh fish market, and has been practiced thus for many years at Monterey. So it is possible that during the first year of experimenting the fish were supplied by the gill net fishermen.

However, from 1903 to 1905 a purse net was used for sardines, for the most part in the daytime, usually in the afternoon, but occasionally at night. The fish were located by seeing them jump at the surface or by seeing schools in the shallow water. The cannery (F. E. Booth) furnished the equipment and the fishermen worked by the month for wages.

*These notes regarding the lampara are those of Mr. W. L. Scofield, who kindly made inquiries regarding the matter at the writer's request.

Instead of the modern lighter the "Sacramento River seine boat" was used. It was a light, double-ended boat, carrying the net and the catch. The seine was circled by hand from the skiffs, pursed from the seine boat or the skiffs, and pulled up between the fishing launch and the seine boat. The catch was dipped out and into the seine boat, about as at present.

The net was made of one-inch mesh, from No. 6 cord, was twelve fathoms deep and two hundred long. There being no "bag," the fish were held by pursing the bottom by means of a rope run through rings. The net was extremely heavy because of the small mesh, and ten men were necessary. Hauls had to be made in shallow water, because the fish were almost sure to be frightened and to sink below the net if the water were deep enough. Fortunately the sardines could be found in shallow water a good part of the year.

As the capacity of the cannery was only about ten tons, but one crew of ten to twelve men under a captain was employed during the first three or four years. The fishermen often failed to obtain a supply, and in 1905, the captain, Pete Ferrante, with Booth's backing, sent to Tangier for a lampara net, essentially similar to the one described elsewhere in this volume. This net had a bag of fine mesh in which the fish were trapped before they could sink, and it was easier to haul because of the coarse mesh in the wings. The purse seine and the lampara were at first used together, one for the day, the other for the night fishing, but in 1906 the purse net was abandoned because more expensive. Other lamparas were patterned after this first one, which soon went to pieces, and of course many modifications have been made since. But the use of the lampara soon enabled the fishermen to catch sardines in deep water and at night, when they could be located by their phosphorescence. The result was a larger and more certain supply. It can not be doubted that the lampara has played a most important part in the establishment of the sardine industry on this coast.

In 1905 or 1906, the lampara was carried on the launch, and a barge substituted for the seine boat. Since then larger and larger launches have been used, with more powerful engines, just as in all other marine fisheries the methods of transportation have been steadily improved. The nets themselves have been deepened to fish more efficiently, and in southern California the type of net which the Japanese fishermen have modified from the lampara is thought by many to be a great advance.

THE WAR PERIOD.

Then, with two canneries packing sardines at Monterey, the tuna canneries awaiting a method of filling in the long winter season in southern California, and the methods of fishing already developed, there occurred the outbreak of the Great War in 1914. It altered the sardine industry on this coast as thoroughly and profoundly as it did any other industry. First, in 1915, the domestic market was abandoned by the foreign packers to our own Maine and California industry, imports dropping sharply and continuously. Then, in 1917 and 1918, the European markets themselves were opened to our products by the derangements of supply, etc., in Europe, while with our entry into the war came the insistent campaign for food conservation, including the

eating of fish rather than meat. The effect of foreign conditions upon our imports of "fish packed in oil" and our exports of "canned fish except salmon" is shown in Figure 56, taken from the reports of the Department of Commerce of the United States. This illustrates this point well, since sardines form the bulk of both categories. It will be noted that imports declined in 1915, but that exports did not rise until later.

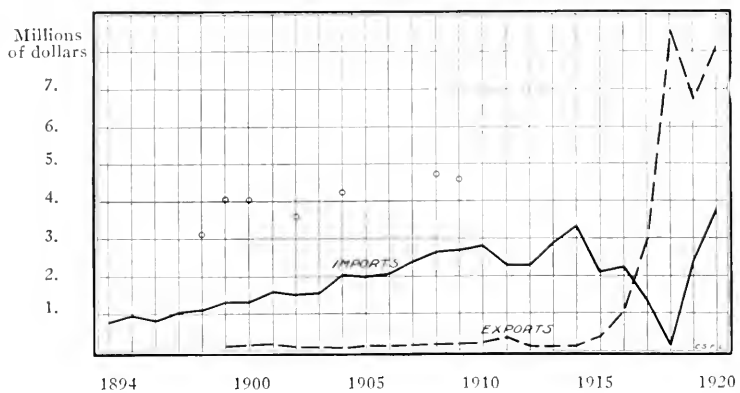

FIG. 56. United States imports and exports, to show condition of foreign trade. Imports of "fish (except shell-fish) packed in oil," and exports of "canned fish except salmon," as given by Monthly Summaries of Foreign Commerce of the United States, issued by Bureau of Commerce. Total value of Maine pack of sardines for various pre-war years shown as circles.

Foreign conditions.

To understand this change, however, the condition of affairs in Europe must be analyzed, and we may briefly review the history of the fisheries at Stavanger, Norway, where the packing of the Norwegian "sardine" is extensively done. In the lower part of Figure 57 are shown the exports to the United States. It is obvious that the fall is entirely parallel to that shown by Figure 56 for the imports into the United States, and that it was a fall of identical character in quantity as well as in value. However, in Figure 57, the middle section shows that the total quantity packed did not fall until a year or perhaps two years later, and that the value of the packed fish did not fall until three years later, namely, in 1917. In other words, the market for Norwegian sardines was found in Europe during the first years of the war, just as trade reports also indicate that better prices were obtainable in the British and German markets than in the United States. This condition prevailed during 1915, and also to an even more marked degree during 1916, a year termed by the Norwegians the "golden year" because of the high prices, and despite the rise in cost of materials and labor. But in 1917 and 1918 the exports to the United States and the total production both fell, because of scarcity of materials such as tin plate, olive oil, fuel oil, the prevalence of labor troubles, influenza and the placing of embargoes by belligerent countries. In 1917, for instance, there was a marked shortage of tin plate, save where the factories supplying goods to Germany were provided with cans by that

country. These conditions continued and were intensified during 1918, so that, in contrast to 1916, it was termed a "dead" year.

The effect of such changes as they affected the Norwegian canneries is, in passing, of great interest to us, as perhaps such changes as occurred to them may be apparent in the case of our own industry. The first result of the increase in price obtained was the founding of more canneries in 1916, and the later closure of many. Then there was

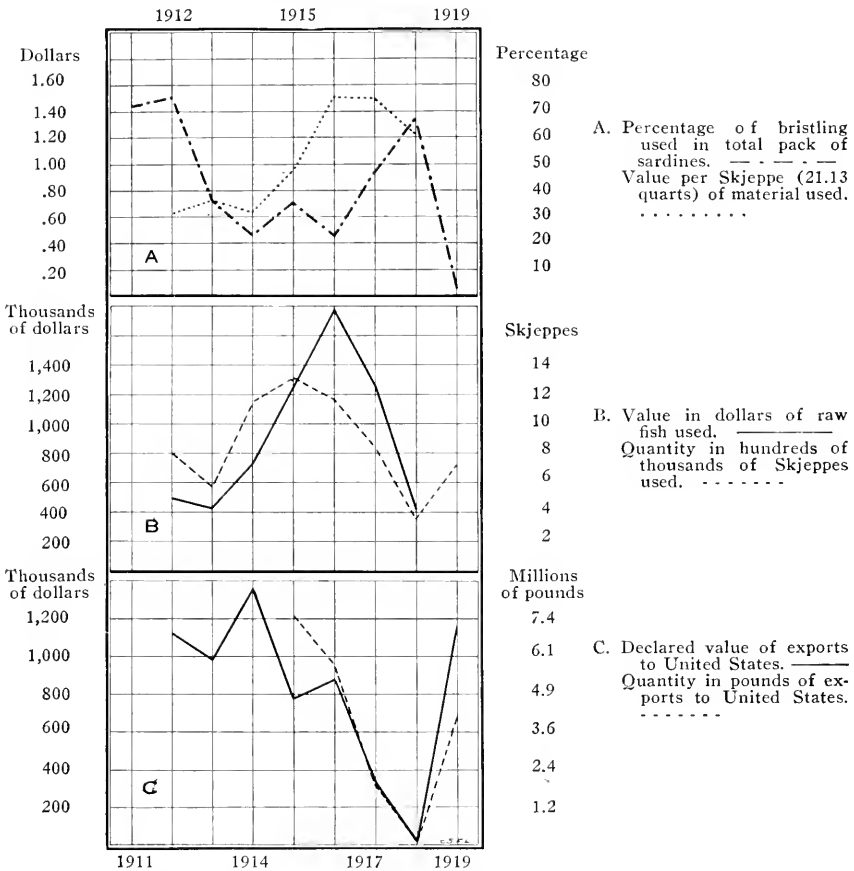

FIG. 57. Condition of sardine fishery at Stavanger, Norway. Data from Supplement to Commerce Reports, Bureau of Foreign and Domestic Commerce.

the increased value per unit quantity of fish used, apparently not dependent upon the composition of the catch. Thus in the upper section of Figure 57, the percentage—among the total of herring and sprat—of bristling, or young sprat, which are supposed to provide the best pack of "sardines," is shown by the line of dots and dashes. It is obvious therefrom that the largest part of the war pack was made from the young herring and the blending, or mixture of sprats and herrings, and that not until the very small pack of 1918 did the percentage of bristling rise. And that very promptly fell upon the

resumption of packing and export to the United States in 1919. But the value of raw fish per "skjeppe"* rose and fell in accordance with the value of the total. In other words, the war market was flooded with the pack of herrings and blanding, while the number of canneries first increased and then diminished.

That some such conditions applied throughout Europe would seem to be true from the fluctuations which occurred in the importations from various countries into the United States. These are shown in Figure 58. With the exception of the imports from Italy, all countries

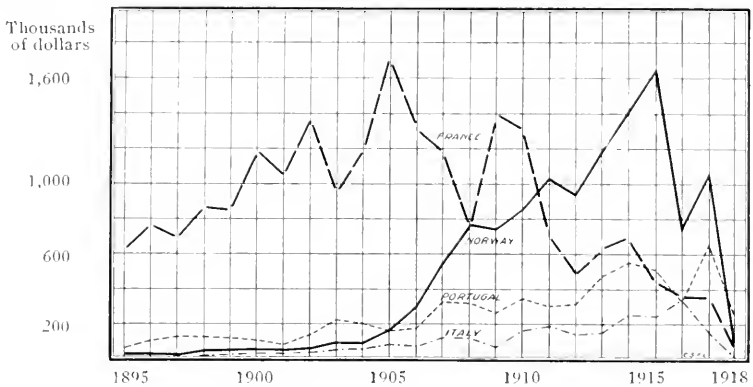

FIG. 58. Imports into the United States of "fish (except shell-fish) packed in oil," from various countries, showing rise of Norwegian and fall of French imports during pre-war period, also fall of all imports during war. Data from Bureau of Foreign Commerce and Navigation of the United States.

showed a decreased total in 1916, and a near collapse in 1918. Our consular reports show much the same to have occurred in Portugal as in Norway, namely, a first diversion of produce to European markets, then a general slackening of the industry, producing, in so far as imports into the United States were concerned, a nearly continuous fall. We may therefore summarize the causes of the fall in imports and the rise in exports as due to, first, the abandonment of the American market by European packers, and then the collapse of the European industry in part at least. American packers therefore were first offered a better domestic market and then a share in the European market in addition.

The rise of the California industry.

It will be seen that the most favorable conditions existed for our sardine fisheries, and the resultant effect upon the extent of our pack may be seen in Figure 59. Almost all sardines which are taken in this country are packed, and the increase in pack is clearly shown. The first great pack was, it is obvious, in 1917. And this corresponds with the great rise in value of sardines in this country, resultant in part from the conditions we have dealt with above, and in part from war conditions considered more generally in their effect on the domestic markets. At the same time we must remember the great encouragement

*A skjeppe equals 21.13 quarts.

given to the use of fish during 1917 and 1918 after our entry into the war. In Figure 60, we have shown the rise in value of Maine, Norwegian, Portuguese and French sardines in so far as they were obtainable in the Los Angeles markets, utilizing quotations on cases of a hundred quarter-pound oil sardines. When it is borne in mind that the California sardines were packed to meet the high values of 1917 and 1918, Figure 59 should be clearly understood.

	1915	1916	1917	1918	1919	1920
	millions	millions	millions	millions	millions	millions
Sardines	4	16	104	158	154	119
All fish	78	70	200	250	250	208

FIG. 59. Catch of sardines in millions of pounds, compared with catch of all fish in California durin war period. Data from reports of California Fish and Game Commission, save for 1915, which is fro reports of the Federal Bureau of Fisheries.

The rise in value is shown in Figure 60 on a logarithmic scale, which has the effect of making the rise of each commodity show as it would if reduced to a percentage basis, and the slope of the lines is therefore comparable and truly indicative of the relative rise in value. An increase of a dollar a case of Maine sardines would plainly be a larger proportionate rise than a dollar a case of French sardines, yet the ordinary charts would show the two increases as identical amounts, but the logarithmic chart shows them as considered in relation to the first price, namely, a greater rise for the Maine than for the French in proportion. The figure demonstrates that the Norwegian sardine did not rise as fast as the Portuguese, save for a brief period in 1920, and that the Maine sardine fluctuated in price much as did the Norwegian. In so far as the French sardine is concerned, the sudden rise in price in 1914 and the subsequent practical disappearance we have not been able to analyze. We have no data on the California pack of quarter oil sardines which is comparable to these shown, because such a pack was not placed on the market until 1917. But there are shown the changes in value of Booth's Crescent one-pound oval pack, from

Monterey, and this shows much less relative rise than the others utilized below.

Just as the first flush of war prosperity and high prices in Norway in 1915 and 1916 resulted in the starting of eighteen new canneries, so in California the tuna canneries turned suddenly to sardines and

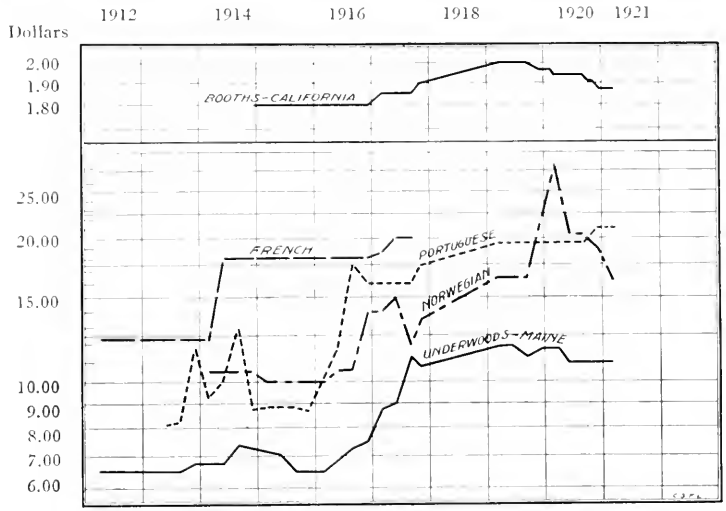

FIG. 60. Fluctuations in wholesale price per case of quarter-pound-oil sardines in Los Angeles during and shortly before the war. Above, price per dozen of Booth's Crescent, pound oval size. Given on logarithmic scale to show relative rather than absolute fluctuations in price. Data from Commercial Bulletin of Los Angeles.

new ones were constructed. To illustrate this point, we have attempted to tabulate the canneries and the time of their construction or diversion to sardine packing, according to the year, with the following results:

1894— 1 cannery built.
1903— 1 cannery built.
1906— 1 cannery built.
1915— 1 cannery built.
1916—14 canneries start packing, 11 previously tuna.
1917—11 canneries built.
1918—10 canneries built.
1919— 5 canneries built.
1920— 2 canneries built.

Of course, some of these are no longer existent or have ceased operations, but the point we desire to make is obvious, that there was a very considerable increase in canneries due to the value of the canneries, both for Monterey and for southern California, as contrasted with the much more modest rise in the pack produced, especially in southern California. It will be remembered that somewhat the same sequence of events occurred in Maine, when during the early days of the industry the canneries multiplied faster than the pack increased, until consolidation and elimination took place.

But there was another parallel with the Norwegian pack perhaps not less important, although perhaps not due to the same causes. And that was the emphasis upon quantity rather than quality. Previous to the outbreak of the war the pound oval held the field, but for a time the round can cooked inverted and by steam took a very prominent

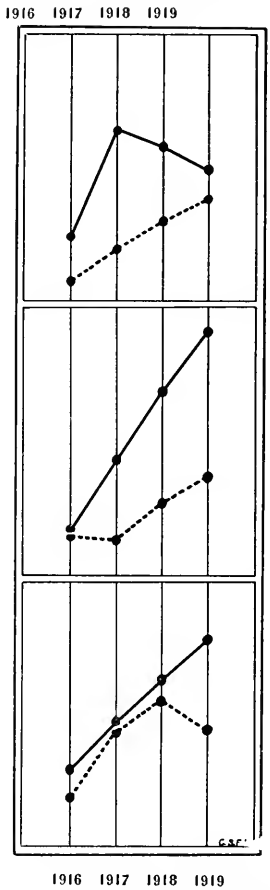

FIG. 61. Comparison of number of cases canned, value of packing plants and number of employees.

ALL FISH CANNED IN CALIFORNIA BY CASES

	Northern	Southern
1916--	196,104	522,609
1917--	480,111	1,538,122
1918--	729,100	1,385,202
1919--	905,206	1,166,435

VALUE OF FISH PACKING PLANTS

	Northern	Southern
1916--	$860,590	$948,702
1917--	786,197	2,573,453
1918--	1,569,330	4,089,660
1919--	2,272,514	5,436,357

NUMBER OF EMPLOYEES IN FISH PACKING PLANTS

	Northern	Southern
1916--	1,573	2,289
1917--	3,090	3,261
1918--	3,829	4,210
1919--	3,123	5,119

place. Introduced in 1916 by the Van Camp Sea Food Company, and widely adopted, this round can pack proved economical, and large amounts were shipped to Europe. But due to the emphasis upon quantity production its reputation was entirely lost. Other packs were subject to the same criticism, and far-sighted canners and brokers began to insist upon quality, foreseeing the failure of their markets under the more normal conditions sure to return in time. The National Canners' Association was asked to establish an inspection service and in 1917

this was done, as is related in another part of this issue. Under the stress of our entry into the war, the government for a time put the whole force of its influence back of this inspection service, in addition to a campaign of price fixing. At present the majority of southern California packers belong to it.

By-products.

An interesting part of the war demand was the high prices paid for oil, for fertilizer and for fish meal. Many of the canneries installed plants of their own for handling their offal, producing therefrom oil, and fish meal. But ultimately so much whole fish was diverted to these plants when the profit was greatest that the matter became serious and attracted attention. The California legislature therefore passed a law in 1919 placing the control of the matter in the hands of the Fish and Game Commission. The effect was to decidedly reduce the percentage of fish diverted to this use, but in 1920 the market for such by-products had in part declined so that there was less temptation to utilize fish for that purpose specially.

Competition within the state.

The three canning districts of Monterey, San Pedro and San Diego have to a certain extent competed with each other in the past, and the history of this is interesting, although only brief analysis of this can be made. There existed, previous to the war demand, two successful sardine canneries at Monterey, packing the larger sized sardines so readily obtained there. But the single sardine cannery in the south after intermittent operations finally turned exclusively to tuna packing.

The seemingly superior vitality and success during the prewar period of the Monterey packers may have been due in part to the greater ease of fishing in Monterey Bay, with the resultant cheapness yet excellent condition of the supply of raw fish, and the use of a larger, more economical type of pack than the quarter-pound square cans of the imported brands. It is said that the larger type of pack finds its principal market in such countries as Cuba and the Philippines, as well as the United States. How far foreign sardines are able to compete for this market we have not ascertained. But it may well be that an essential element in the history of the southern and northern packers has been the greater reliance of the former upon goods fitted for export and for competition with foreign brands.

The following table illustrates the differing styles of pack made in northern and southern California, due to the larger fish which prevail at Monterey. It is said that occasionally there is a year when sizes of fish suitable for quarter-oil packs are present at Monterey in numbers sufficient to render them easily caught, but that does not seem to be often enough to establish a quarter-oil pack there:

Sardine Pack in Three Statistical Districts, According to Percentage Packed In Various Sized Cans.

District	Quarter pound, per cent	Half pound, per cent	One pound, per cent
San Diego	55.5	17.9	26.6
San Pedro	16.7	37.8	45.6
Monterey	.8	2.8	96.3

It will be seen from this table that the Monterey district has packed more of the pound sizes, while the San Diego packers have depended very largely on the small sized fish for quarter-pound cans. Whether this will explain the greater steadiness of the price, as shown for Booth's sardines (Monterey) in Figure 60, and of the quantity packed as shown in Figure 62, we do not venture to express a decided opinion.

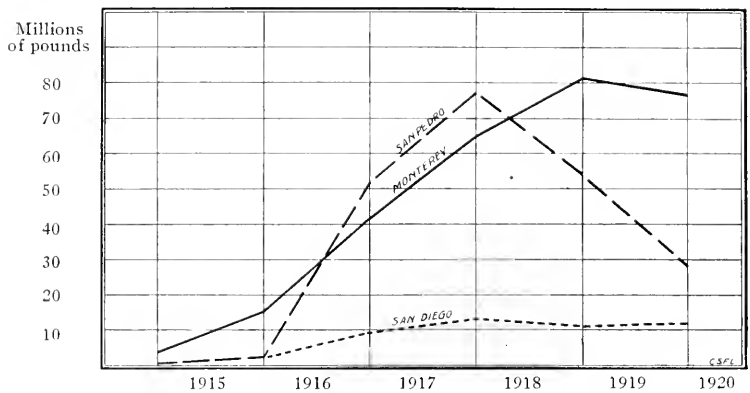

FIG. 62. Catch of sardines in three statistical districts of California. Data from California Fish and Game Commission, save for 1915, which is from Federal Bureau of Fisheries. (Note that pack of San Diego sardines is largely the valuable smaller sizes, and of Monterey of larger sizes.)

(Figure 62 shows the relative amounts packed in the three principal sardine districts of California.) This characteristic of the Monterey pack was shown also in 1915. At all events it would seem that the problem of maintaining the sardine industry in competition with foreign and Maine sardines more largely concerns the southern packers than the northern.*

It will be seen that we have not considered in detail the effect of the Maine sardine pack, as we have not yet material which bears upon the matter. But that the competition from Maine may be serious is easily ascertained from the figures for past production, in so far as we have them. In Figure 56, we have shown the pack value of Maine sardines as isolated circles for those years for which data are available.

Nor have we dealt with the appearance of the sardine, or rather the adult called a pilchard, in British Columbia. The salmon canneries there packed in 1917 a total of $11,810 worth, in 1918, $413,853, and in 1919, $371,871. These were sold as pilchards, according to the

*NOTE.—In so far as foreign competition is concerned, southern canners have recently expressed considerable concern over the effect of the rate of exchange upon the selling price of Norwegian sardines in this country.

As has been said by an official of a San Pedro corporation, with all foreign exchange at a low level, the tariff on canned fish no longer gives any protection, and Norwegian sardines are being sold to jobbers at $9.75 a case. Pacific Coast canners are compelled to ask $12 a case to pack. The Norwegian canner gets in his own money what is under normal conditions the equivalent of $20.20 for this $9.75.

This is, of course an aftermath which might have been expected from the changes in the rate of exchange, and the low level maintained by the disturbed conditions of Europe. It is one of those evidences of the desirability of restoring conditions in central Europe which are coming to light in increasing numbers.

English style of terminology. It yet remains to be seen whether the run was sporadic or not.

And, finally, we may add that it has not been our intention to in any way indicate an opinion of the future, for there is little of positive value in prophesying. Yet one may surmise that the increase of population in this country would of itself greatly enlarge the markets. From 1900 to 1910 the inhabitants of the United States increased about 21 per cent, while from 1910 to 1920 the increase was about 14 per cent. Yet the consumption of sardines, including the "fish packed in oil" and imported, increased over 40 per cent from 1900 to 1910, taking value as a criterion. The emphasis during the war upon the eating of fish could not help but have benefited the sardine industries. And added to these favorable facts, one may bear in mind the depletion in part of the salmon fisheries, and the general high cost of other foods. Indeed, despite the distinct evidence that war conditions had much to do with the birth of our sardine industry an optimist might find much to comfort him.

FERTILIZER, STOCKFOOD AND OIL FROM SARDINE OFFAL.*

By W. L. Scofield.

Introductory.

Although the fishing industry in California is new and by no means fully developed it is duplicating the experience of older industries and is giving more attention to the development of by-products. Of the hundreds of tons of fish caught in California each year, less than three quarters can be used for human food because over 25 per cent of the weight of fish is inedible. In our leading fishery industry, the canning of sardines, about 50 per cent of the catch goes into cans and roughly 50 per cent of the original weight is discarded as heads, entrails and broken and under sized fish. In mild curing king salmon, about one third of the original weight is lost in head, intestines, and backbone. In the past this great quantity of inedible fish material was thrown away as a complete loss. First in Europe and later in America this discarded material was found to be valuable and its conversion into a usable form proved to be financially profitable. A California sardine packer states that the profit derived from utilizing his sardine offal is sufficient to pay the running expenses of his cannery so that the return from the canning plant is "velvet." Although this case may be exceptional it indicates that the by-products of the industry have already assumed great importance and there is every indication that more and more fish waste will be utilized. There are at present several firms in California that make the utilization of waste fish their only business. A much larger number of reduction plants are operated in connection with fish canneries so that at present California stands well toward the top in the utilization of fish waste. The inedible or waste portion of the fish is now being converted into forms that indirectly serve as human food. Waste fish is reduced to fish meal which serves as food for animals and plants that are used as food by man. In other words we are now eating, directly or indirectly, nearer 100 per cent of the sardine than the former 50 per cent. The discrepancy in this 100 per cent consumption as human food lies in the fact that fish oil, a by-product of fish meal, is used for commercial purposes other than food. The edible oil refined from fish oil has as yet proven unsatisfactory although there is constant experimenting at present and a palatable salad oil may result.

Uses of fish meal and oil.

Fish waste was first dried and ground into fish meal to be used as a fertilizer for plants and its value as fertilizer has long been recognized. There was in the past a prejudice against using the meal for stock food because the oil in the meal was said to impart a fishy flavor to the flesh of the animal eating the meal. This has been overcome by extracting the oil from the meal before feeding it to stock. In fact the oil has been found to be so valuable that the cost of extracting it is unimportant compared with its sale value. Fish meal, by experiment and tests on a large commercial scale, has been found to be

*California State Fisheries Laboratory, No. 32.

exceedingly valuable as a stock food, equaling and exceeding tankage and grains as an animal food. Fish meal is now in demand as a food for swine and cattle but the largest demand is as a chicken food. Chicken raisers claim that fish meal has been found to be far superior to any other meaty food, as meat scraps or blood. Its value lies in its high percentage of protein, or more properly speaking, in its high nitrogen content in the form of ammonia and in phosphoric acid as bone phosphate. These are also the elements so much valued in fertilizers and fish meal now competes with the high grade nitrogen materials (as ammonium sulphate) and the cheap bone phosphates in commercial fertilizers. The chief demand in this state for the meal as a fertilizer comes from the fruit growers, especially the orange growers. The meal therefore has two chief uses, as stock food and as fertilizer. So far, the high price of the meal has largely confined its use to the more intensive growing of oranges and chickens and most of the sales are made to orchardists of southern California and to the Petaluma chicken raisers. Meal sold in the open market brings about the same price when sold either for fertilizer or for chicken food.

Sardine oil (as well as other fish oils) is used extensively in the leather tanning industry but the chief use of the clear oil is in the making of paint and the heavier fatty materials are used in the manufacture of soap.

Reduction process in general.

Fish contain a high percentage of oily fat, varying from 5 to 20 per cent in fresh sardines. This oil is not only valuable for other uses but it is a detriment in a stock food or fertilizer. The oil and fat are therefore extracted before the fish material is marketed as a fish meal. There are two general methods of removing oils from either vegetable or animal material. When the oil is to be used for human food it is usually pressed out. Oil to be used for commercial purposes other than as human food, is frequently removed by the use of a volatile solvent which takes up the oil. The solvent may then be volatilized and the oil recovered. The first fish reduction plants used the pressing method and this principle is still the one commonly used in the fish reduction plants of California. At present there are in the state but two plants using the volatile solvent method of extracting fish oil. This method will be described later. The usual practice (press method) is to cook the fish material sufficiently to loosen the flesh from the bones and break up the fish skeleton. The oil is then pressed out and later refined. The meal is then dried, cooled, and run through a grinder to break up bony particles. The meal is then sacked ready for shipment. There are minor variations in the application of the press method but the chief differences between plants are in the method of drying the meal rather than in the manner of pressing out the oil. One of the variations in method of drying will be described later. In order to give a more consecutive idea of the different steps in the reduction of fish to meal, it will be helpful to consider a description of a typical plant using the common press method for sardine offal.

A typical plant of the press type.

The plant selected for description as a typical fish reduction plant, is one operated in conjunction with a Monterey sardine cannery. The reduction plant normally receives 30 tons of sardine offal per day, although it is capable of handling much larger amounts if operated continuously through the day. The fish material is almost entirely sardine offal from the cutting tables of the cannery with the broken and under sized whole fish that naturally result from canning operations. The offal from the cannery is collected in a large storage bin from which a belt and bucket conveyor transports it to the top floor of the reduction plant building. The offal is about 45 minutes in passing through the plant from this storage bin to the drying floor as finished meal, but only a small amount may be run through at a time. Therefore the belt conveyor from the bin has small buckets that feed in only the proper amount of offal.

Cooker.

The older plants of Europe used to cook the fish in vats over a wood or coal fire but steam cooking is the common method now used in California. The cooking is done in a steam chamber or stationary horizontal cylinder roughly two and a half feet in diameter by 18 feet long and insulated with asbestos packing to conserve the heat. Offal is carried through this steam chamber at a uniform speed by means of a revolving auger action conveyor shaft whose revolutions are so timed that the fish remains in the chamber about 15 minutes. This revolving conveyor carries the cooked fish to the press.

Press.

The common form of press used in this state is a horizontal continuous screw press said to be a modification of the French olive press. The press is an auger shaped screw working into a metal jacket which is perforated with openings about the size of a pin hole to allow the water and oil to escape. The screw press is about seven feet long. The first three feet of the press casing or jacket is of lighter construction, with relatively larger holes for the purpose of draining off the free water. In the last four feet, or press proper, there is another screw revolving more slowly, and the distance between the auger flanges is reduced so that the material moves forward more slowly. This slowly revolving screw works against a deeply beveled stationary disk which blocks the forward progress of the material and allows it to escape very slowly in the form of a coarse paste scraped from the beveled edges of the disk. The escaping oil and water are caught in a drip pan and piped to tanks.

Dryer.

The pressed material, now in the form of a paste-like mass, must be dried to prevent moulding and souring. Drying is done by hot air. In this particular plant the drying is done by passing the fish through two horizontal stationary drums or cylindrical chambers each 30 feet long. A circulation of hot air from the furnace is forced through these drums or "dryers" by means of a rotary blower. A vent up the smokestack, provided with rotary section fan, carries off the moist air.

The fish paste drops from the end of the press into an auger conveyor and is carried through the first dryer. It then drops to the second reversed conveyor and passes back through the second drum, which is situated directly under the first. The material is now in the form of a somewhat moist, steaming hot meal. From the end of the dryer the meal enters a piped cold air blast which serves primarily in cooling the meal, but also transports it to the grinder. The press and the dryer break up the fish very thoroughly so that very little grinding is necessary except for occasional bones. The meal passes through a small motor driven grinder and drops on the floor where it is spread out for two or three days to complete the cooling process and to dry out more completely. It is usually shoveled over two or three times on the floor before being sacked in 90-pound sacks for shipment.

Oil recovery.

The oil and water which drain from the press are separated by gravity. The drippings from the press are run through a series of five settling tanks. In the first tank the water and refuse particles are allowed to settle to the bottom and are drained off into the ocean. The oil is syphoned over into the next tank in the series where the gravity separation of the fat from the oil is begun. The top or first oil in the last settling tank is a fairly clear oil but the complete clarifying of the oil by settling out the fat may require several weeks and is unnecessary. The clear oil from the top of the last tank has been used successfully as a paint oil without further refining or the use of a drier in the paint, but this is not the usual practice. The oil is shipped in barrels to paint factories where it is processed for use in paints. This fish oil sells for about one-third the price of linseed oil.

Below the clear oil in the tanks is found the cloudy fatty oils and thick fat material called stearine. The heavier stearine is called "foots." The stearine is sold for use in the manufacture of soap. As stearine contains from 40 per cent to 50 per cent oil it is sometimes heated and more oil drawn off but it usually goes direct to the soap manufacturer.

A modification of the press type.

In the typical plant already described, the fish material, after cooking and pressing, was dried by being carried through stationary drums through which was forced a circulation of hot air from the furnace, by means of rotary blowers. We will consider briefly a plant in which a very different form of dryer is used. In this case the dryer is a revolving drum without a conveyor through the center. A cylindrical drum (five and a half feet in diameter and forty feet long) is placed on a slight decline from the press (pitch of one-half inch to the foot). The hot air is provided by a blast of burning mixture of oil and steam in a firebox so arranged that the flame blast strikes a lattice work of brick allowing only the heated air to enter the drum. A direct flame is not introduced into the drum for fear of scorching the fish. At the opposite end of the drum the necessary air suction is provided by a tall smokestack (four feet in diameter and 60 feet high). On the sides of the drum are a few longitudinal cleats or "channel irons" which serve to tumble the fish material as the drum is rotated. The strong

draught of air and the pitch of the drum from the horizontal, serve to carry the fish waste forward as it dries out. The heavier particles of the dried material tumble out of the back end of the dryer and are caught and conveyed away by a large cold air suction pipe. There are about 200 feet of this air pipe with two rotary blowers so that the material is not only cooled, but is further broken up into fine meal. To prevent the lighter particles from passing up the smokestack, there is a series of three catching, or dust chambers, the operation of which will be described later when considering the volatile solvent method. The meal from the cooling pipes is spread on the floor for several hours for further cooling and is then sacked without grinding. The pressing and tumbling in the dryer and conveyor pipes reduce the material to a fine meal containing only a few bones that have not been completely broken up. In this form the meal is ready for use as fertilizer but it should be ground before used as a chicken food.

Anchovies difficult to press.

It frequently happens that a sardine catch contains a large percentage of anchovies, especially when small sardines are being taken. This is an important consideration because the ordinary screw press will not operate properly with a high percentage of anchovies, especially when the anchovies have been more than eight or ten hours out of water. The soft anchovies churn up in the press as a jelly-like mass that will not feed out and clogs the oil holes and the screw of the press. Anchovies may be used when mixed with sardine offal to lend more body to the material and thus pass it through the press. It is claimed that a mixture of half anchovies and half sardine offal will press fairly well but a lower percentage of anchovies is preferable.

Yield in meal by press method.

The solid flesh of the whole fish yields more meal than a like weight of offal, so that the percentage of whole fish in the offal effects the amount of meal recovered. The degree of fatness of the fish also affects the yield of meal since there is relatively more oil in a ton of offal from fat fish, but there is far less variation in the amount of meal than in the amount of oil recovered. In the typical plant already described the number of tons of sardine offal necessary to make one ton of fish meal varies from five and a half to seven and a half, with six tons as the probable average. The weight of the recovered meal is roughly estimated at one-sixth that of the offal in this plant. Other plants with somewhat different methods estimate the meal at one-fifth to one-fourth the weight of the offal. The remaining five-sixths of the weight is partially recovered as oil and stearine but most of it is water of which the greater per cent is driven off by evaporation. The water content of fresh sardines is high (probably 60 to 75 per cent) and canned sardines are about 60 per cent water but a low moisture content is desirable in both fish meal and oil. The meal contains less than 10 per cent moisture and the oil less than 2 per cent water.

Composition of meal by press method.

Fish meal sells on its chemical composition and frequent samples are subjected to chemical analysis. The chief value of fish meal lies

in its nitrogen and phosphoric acid content. The nitrogen as ammonia is the most important element and the price of a fish meal on the open market is largely determined by the percentage of ammonia present. The ammonia content varies between 8 and 14 per cent, but a high grade meal usually has between 10 and 12 per cent ammonia. The phosphoric acid content as bone phosphate is the next most important consideration in fixing the price. A low moisture content is desirable as the buyer does not care to pay for useless weight in water. The water content is not run below 6 or 8 per cent, not only because of the cost of further reducing the per cent, but also because the sacked meal will absorb sufficient moisture from the atmosphere to bring it up to 6 or 8 per cent. The moisture content of meal varies from 8 to 13 per cent but is usually about 10 per cent. The pressing method does not extract all of the fish oil from the offal and the resulting meal from this process contains from 7 to 10 per cent of oil (ether extract). The chemist's analysis of the meal produced by the typical plant we have considered gives the following results expressed roughly:

Nitrogen	9 to 10 per cent
Phosphoric acid	5 to 10 per cent
Nitrogen as ammonia	10 to 14 per cent
Phosphoric acid as bone phosphate	10 to 22 per cent
Moisture	9 to 12 per cent
Oil (ether extract)	8 to 10 per cent

The term protein is often used in the analyses of meal to include the proteids or nitrogenous matter of the soft tissues of the fish body. Such classifications divide fish meal into protein, oil or fat (ether extract), water and mineral ash. In such cases the protein content ranges from 50 to 60 per cent, a much greater percentage than in fresh fish with its higher moisture content. A rough rule of thumb sometimes followed when the nitrogen content of the meal is given, is to multiply the percent of nitrogen by 5.25 to give the protein content. In judging a fish meal it is essential to know the percentage of (1) ammonia, (2) phosphoric acid, (3) moisture, and (4) oil (given in the order of their importance).

Yield of oil by press method.

In sardines there is a great deal of oil in the flesh just back of the head but the fat about the entrails and the liver itself is especially rich in oil. In cutting sardines for canning, the fish is cut in two near the back of the body cavity and only the posterior half of the fish is canned. Thus the head and entrails are discarded as offal. Therefore a ton of offal will yield more oil than a ton of whole fish and the per cent of whole fish in the material will affect the yield of oil. The greatest source of variation is the periodic fluctuations in the fat content of the sardines themselves. At some seasons of the year they are very fat with a high oil content, while at other seasons, especially in the spring, the fish are thin and have relatively little fat and oil in their bodies. The fat content of sardines varies roughly from 5 to 20 per cent. As anchovies have much less oil than sardines a quantity of anchovies mixed in the offal reduces the oil

yield per ton of material. For the above mentioned reasons the yield of oil varies greatly from day to day and from month to month. In the typical plant we are considering, the oil yield varies from 7 to 27 gallons per ton of offal, with a rough average yield of 10 to 12 gallons of oil and fatty material (stearine) per ton of offal.

Composition of oil by press method.

Fish oil, like fish meal, sells on its chemical analysis. The oil with a small per cent of free fatty acids or unusable material is the high-grade oil bringing the best price. The impurities are referred to in the trade as free fatty acids and M. I. U. The M. is moisture and other volatile matter, the I. is insoluble impurities and the U. is unusable or unsaponifiable matter. The amount of impurities in an oil varies naturally with the method and care used in the refining or settling process. As more care is now being given to this phase of the subject, some of the west coast oils are finding ready sale locally and in the Eastern States. In the past the lack of care in refining and looseness in grading the oil has caused much of the west coast oil to be classed as inferior grade and accepted at a poor price by eastern buyers. For years the Newfoundland and American cod oils were the favorites till salmon oil was found to be equally good. The whale oil business, having been so long established, now has definitely established grades. The sardine oil, being new from this coast, has not yet come fully into its own. The use to which the oil is to be put largely determines the purity of oil necessary. A leading dealer in fish oils makes the general statement that fish oil for use in paints should not have over 5 per cent free fatty acids and not over 2 per cent M. I. U. For tanning purposes the oil should be from 5 to 7 per cent acids and 1 per cent M. I. U., but clear settled (tanked) oil for use in the better grades of soap should not exceed 3 per cent acids and 2 per cent M. I. U. For a No. 1 grade of sardine oil the limit of impurities is usually set at 2 per cent free fatty acids and 2 per cent M. I. U. The press method, with proper care in operating the settling tanks, yields a sardine oil low in acid content and well within the limit as to other impurities. The chemical analyses of the sardine oil produced by such a plant show the following results:

Free fatty acids	.5 to 1.5	per cent
Moisture and volatile matter	.1 to .7	per cent
Insoluble impurities	a trace to .03	per cent
Unsaponifiable matter	.2 to .9	per cent

Volatile solvent method.

In this method there is no press, the oil being recovered by the use of gasoline as a volatile solvent. The elimination of the press permits of the reduction to meal of almost any kind of fish material without readjustment of machinery or extra labor. Fish scraps, trimmings from the fish and abalone markets, offal, meat scraps, whole fish, sharks, squid and anchovies are reduced with equal facility. In the two California plants there is no separate cooking cylinder, but the cooking and drying are combined in one machine. In the press method the oil and water are pressed out and the material then dried. In the gasoline process the material is dried to eliminate the water and later the oil is

extracted from the dried meal. The two gasoline plants of this state are not connected with a fish cannery, but are operated as an independent business, purchasing the raw material from other firms. One plant uses mostly fish scraps and the other, located in one of the sardine canning centers, operates on sardine offal purchased from the canneries. A brief description of the latter plant will better illustrate the method. This plant has a capacity of about 35 tons of offal per day when employing five or six men. With seven or eight workmen the capacity can be increased to 50 or 60 tons per day. The sardine offal is transported to the plant by auto truck and dumped into a storage bin from which a belt conveyor with small buckets carries the material to the dryer. The conveyor is filled by hand so that the amount fed in may be varied according to the directions given by the man operating the dryer.

Dryer.

The dryer (cooker and dryer combined) is a large revolving horizontal cylinder, 40 feet long and 4 feet in diameter, operating on the same general principle as the dryer described above, under "Modification of the Press Type of Plant" which merely dried the cooked and pressed material. This dryer first cooks and then dries the fresh offal from the storage bin. The heat is provided by a burning spray blast of mixed steam and oil, the draught being created by a tall stack. In this case the flame is shot directly into the dryer. The conveyor empties the offal directly into this flame and the four or five longitudinal cleats of the revolving dryer keep it tumbling. The amount of flame and heat may be delicately regulated by adjusting the amount of oil and steam sprayed in. When fairly dry material is being received, the flames extend only two or three feet into the cylinder, but with particularly wet material the flames may be shot into the dryer a distance of eight or ten feet. The wet offal is tumbled in the flame during several revolutions of the cylinder till the material is sufficiently heated to cook the flesh free from the bones. As the moisture is absorbed by the hot air blast and the flames, the dried fish material, being lighter in weight, is blown toward the back end of the dryer. The cylinder is set up with only a very slight pitch downward, the draught being sufficient to carry the fish through. The fish remains in the dryer about thirty minutes from the time of entering the flames till it is blown to the back end of the cylinder as dry meal. The offal is not only cooked and dried in the cylinder, but the tumbling of the dried material breaks it up into a coarse meal, the chunks of which are usually no larger than a pea. In this drying process it is essential that the supply of material being fed into the dryer be uniform, in order to reduce as much as possible the readjusting of the flame. When a great amount of wet fish is fed in rapidly, the drying is not complete and the product is too moist. If the supply of raw material is reduced suddenly, or is much dryer than the preceding supply, the excessive heat burns the fish into hard cakes and extracts free oil, which collects in the bottom of the cylinder and sometimes catches on fire.

Recovery of meal from dryer.

As the back end of the cylinder is open, the meal is blown out into a small catching passage way which has a small hole in the floor to

allow the heavier particles of the meal to escape, but much of the meal is in the form of dust and is carried past this opening by the air current. In order to recover this dust, the air current is led through three dust chambers before it escapes up the stack. The opening into the first chamber is near the top and the outlet near the floor, so that the heavier dust settles to the floor. In the second dust chamber the intake is near the floor and the outlet near the top, so that the finer dust settles in this second chamber. The air current then drops again in a third chamber before escaping up the stack, so that all but a negligible amount of very fine dust is recovered. The dust chambers are emptied once or twice a day by opening a door in the side wall and shoveling up the accumulated fine meal. The dried meal is known as "unfinished stuff," as it has yet to be processed to remove the oil. This unfinished stuff is spread on the concrete floor to cool before it is elevated to the second story of the building in readiness for the next step in the process, the extraction of the oil.

Extraction tank.

The extraction tank is a heavy cylindrical steel tank about nine feet in diameter and about fourteen feet high. The tank is filled through a door in the top to within eighteen inches of the top with the dry unfinished meal. Gasoline is then sprayed in from the top through a perforated pipe till the tank is filled with gasoline sufficient to cover the meal. The tank full of meal and gasoline is then heated by introducing steam at the top of the tank. The heat is said to be about 325 degrees and is continuous for an average of about eight hours. The gasoline begins to take up the oil of the fish meal even before the meal is thoroughly heated, so that the process of draining off the mixed gasoline and oil is begun soon after the steam is introduced. The bottom of the tank is a sheet of steel perforated to allow liquid to drain through it. Under this metal sheet there are alternating layers of charcoal and gunny sacking to catch and hold particles of meal, so that the liquid may be drained off as pure as possible. After this oily gasoline is drained out, the tank is again flushed with a fresh supply of gasoline, which is also drained off. A small door in the side of the tank, even with the metal floor, is then opened and the meal pulled out.

Screening.

The meal that has been removed from the extraction tank is then screened or sifted to remove any of the larger particles that have not been broken up by the process so far. The sifted meal is then ready for sacking. The screenings or tailings consist of pieces of backbone, bones of the skull, especially the cheek plates or opercles, small hard lumps formed by a portion of the intestine, and a few chunks of meal that remain packed or were burned somewhat in the dryer. These tailings may be ground up and resifted, or, as is frequently done, may be run through the dryer again, which breaks up most of the chunks and saves grinding so much material. The tailings, after being ground up into fine particles, are mixed with the sifted meal and sacked. It is essential that the meal be quite dry before sacking. If there is much moisture, the meal will mould and heat in the sack. In case the final meal is found to be too moist, it is run through the dryer again before

sacking. The sacked meal should not have much over 10 per cent moisture.

Recovery of oil.

The liquid drained from the extraction tank is carried by pipe into a smaller tank called the evaporating tank, which is about 12 feet long and 5 feet in diameter. It is provided with a large steam coil capable of heating the liquid to 300 or 325 degrees. The heat volatilizes the gasoline and a pipe at the top of the tank carries off the gas thus formed. After about four hours practically all the gasoline is driven off, leaving only the fish oil remaining in the tank. If much gasoline is left in the oil and the oil is later refined, a serious explosion is apt to result, so that it is essential to drive off all the gasoline possible. The oil is then blown out of the tank by steam pressure and conducted by pipe to a storage tank. The oil is later deodorized by heating to about 600 degrees, which also removes practically all of the moisture and other volatile impurities. The oil is then ready for shipment to the paint manufacturer.

Recovery of gasoline.

The volatilized gasoline escapes from the evaporating tank in a pipe that is run through a condenser or coiled pipe in a bath of running cold water. Ocean water is particularly good for cooling the condenser pipe. The condensed gasoline drains into a storage tank and is ready for use again in the extraction tank. This distilled gasoline is referred to as "high power gas" because of its greater strength in taking up fish oil in the extraction tank. The high power gas has been freed from many impurities and is much more volatile than ordinary commercial gasoline. In fact the commercial gasoline is usually run through the evaporating process to refine it before it is used in the extraction tank.

Composition of meal.

The meal resulting from the gasoline method has practically the same moisture, phosphoric acid, bone phosphate, nitrogen and ammonia content as in the press method. The meal has about 10 per cent each of nitrogen and moisture. The phosphoric acid content is 7 to 8 per cent and the bone phosphate is in the neighborhood of 16 per cent, although quite variable. The ammonia content is 8 to 12 per cent. The chief difference in the two meals is in the oil content. The volatile solvent method removes more of the oil than the press. The final meal by the gasoline method has about 3 per cent of oil as contrasted with 8 to 10 per cent of oil by the press method. Therefore the oil yield per ton of offal is higher by this method than by the press method, the yield being about 20 gallons per ton of offal. The yield of meal is said to be about 23 per cent of the weight of the offal. This yield is as good or better than the percentage of meal recovered from pressing. Practically all of the meal from this plant is sold for chicken food and is shipped to Petaluma.

Quality of oil by gasoline method.

By the gasoline extraction process the resulting oil, although relatively of greater quantity, is not the high quality oil obtained by methods of pressing. When the fish first enters the dryer and is tum-

bled in the flame blast, the oil in the fish is sufficiently scorched so that the resulting oil is black or dark brown, and up to the present time has not been refined to a clear oil. For this reason its use is almost entirely confined to the manufacture of paints, where its color is no drawback except that it is unfit for use in white paint. This dark oil seems to give good satisfaction in colored paints, other than white, even in cream colored paint. The recovered oil has very little of the heavy fatty materials as foots or stearine. So little saponifiable material is recovered that it does not, at present, pay to separate it for sale to the soap manufacturers.

The following are a few of the many bulletins published by the U. S. Department of Agriculture, and may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.:

Bull. 378. Fish Meal: Its use as a Stock and Poultry Food. (1916.) 5 cents.
Bull. 150. Utilization of Fish Waste on the Pacific Coast. (1915.) 15 cents.
Bull. 2. Fish Scrap Fertilizer Industry of the Atlantic Coast. (1913.) 10 cents.
Bull. 635. Commercial Freezing and Storing of Fish. (1918.)
Bull. 908. Maine Sardine Industry. (1921.) 50 cents.

FIG. 63. Hauling in a sardine net. The wings have been hauled in and the lead line raised, impounding the fish in the bunt of the net Photograph by Messrs. Higgins and Holmes.

METHODS OF SARDINE FISHING IN SOUTHERN CALIFORNIA.*

By Elmer Higgins and Harlan B. Holmes.

It is a fixed purpose of the California Fish and Game Commission to maintain a system of fishery statistics so complete and so continuous that the varied and changing conditions of the fishing industry may be compared year by year in order to determine its actual condition and future prospects. As a partial supplement to the statistical records of the catch, collected and compiled according to law, these notes on methods and practices are prepared to aid the investigator in future years to reconstruct in his mind the actual conditions in 1921, enabling him to understand and interpret the figures of the catch.

LOCAL CONDITIONS AND GEAR.

Local conditions have their natural effects upon methods and gear, producing in southern California an industry unique in many ways. The sardine fishery is not an independent industry, for the fisherman engaging in it spends fully half of the year fishing for albacore, tuna, sea bass, mackerel, halibut, or rock cod, and hence his boat and gear are modified to meet the requirements of these other fisheries. By far the greater number of boats fishing sardines are typical albacore boats which are converted for use during the winter sardine season by the removal of bait-boxes and poles. Many, however, of a different type, were built before the albacore fishery became so profitable, and are used, during the off season for sardines, in fishing with trammel nets for halibut, or with set lines for rock cod. These two distinct types of boats are manned, respectively, by the two nationalities which dominate the fishery, the Japanese and the Italians.

Weather conditions also have influenced the type of boats used. Although the boats are perfectly seaworthy and capable of traveling several hundred miles, the uniform character of winds and absence of sudden storms has permitted the development of a type of fishing boat poorly adapted to a short choppy sea, being long and narrow and having a wedge-shaped bow with little flare.

THE LOCATION OF THE FISHERY.

The California sardine, *Sardina caerulea* (Girard), occurs in considerable abundance along the entire west coast of the United States, including Alaska and British Columbia, and southward on the coast of Lower California, but the chief centers of the fishery are Monterey, San Pedro, and San Diego. In southern California sardine canneries are located at San Pedro, Wilmington, Long Beach, Newport Beach, and San Diego, the areas fished covering a radius of fifty miles or so from these points. In the San Pedro district, deep water fishing off a rocky coast is found from Point Firmin north to Redondo and off sandy beaches from Point Firmin south to Newport. At San Diego similar conditions are found to the north, about La Jolla, or from Point Loma south to the Mexican border. The winter sardine fishery is chiefly in

*California State Fisheries Laboratory, Contribution No. 33.

deep water two to ten miles from shore, but in the summer, fish are caught inshore near the sandy beaches.

FISHING SEASON.

The sardine canning industry, which utilizes practically the entire catch in the San Pedro district, depends a great deal upon the large fish 20 to 30 centimeters long, known as "pound-oval" size, from the cans in which they are packed. The fish approach the coast in December and are taken in great quantities until April or May, when smaller sizes become relatively more numerous, but canning sometimes starts early in November, utilizing the smaller sizes of sardines known to the trade as "quarter-oils." (Fig. 64.) The same sizes are taken at San Diego, but a larger proportion of the pack consists of the smaller fish, and the season is therefore somewhat extended.

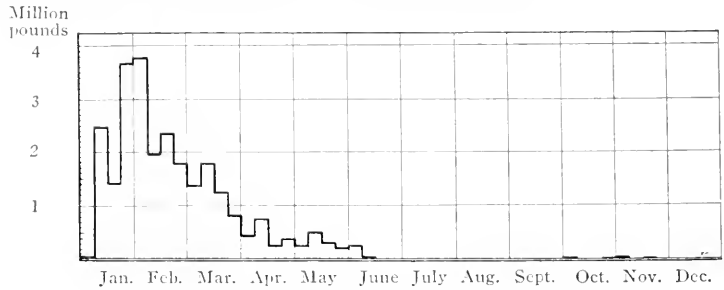

FIG. 64. The 1920 sardine season at San Pedro as shown by the Commission's reports of amounts of sardines received weekly at the canneries.

A summer sardine fishery, scarcely less important economically than the winter fishery, although yielding no statistical record and having no money value, is pursued from Santa Barbara to San Diego. It is the bait fishery, an essential factor in the summer albacore industry. Small sardines of "quarter-oil" size or smaller are highly prized by the albacore fishermen as live bait, and one-half to three-quarters of a ton per boat are taken in the morning whenever possible off sandy beaches before proceeding to the albacore fishing grounds. It is true that anchovies serve as a substitute, but they are not as desirable nor as much sought after as are the small sardines. This bait fishery continues throughout the albacore season, *i. e.*, from June to October. Modified sardine nets called "bait nets" are used and will be described later.

TYPES OF GEAR.

Boats.

As mentioned above, there are two chief types of boats employed in the sardine fishery: one operated by the Italians and the other by the Japanese. Americans (native born), Scandinavians, and Austrians also

engage in sardine fishing, but only in small numbers,* and they use boats which may be classed with one or the other chief types.

The Italians were probably the first sardine fishermen on the coast to use the present style of round-haul nets, and introduced their methods and gear from Italy. Their boats reflect an adaptation to trammel-net or set-line fishing after the sardine season, being smaller than the Japanese boats and having less power and speed.

A typical Italian sardine boat (Figures 65 and 66), carrying a crew of five or six men, is 35 feet long, of 10-foot beam, and 4-foot draft, with a wedge bow and fantail stern. A 20-foot mast is stepped in near the

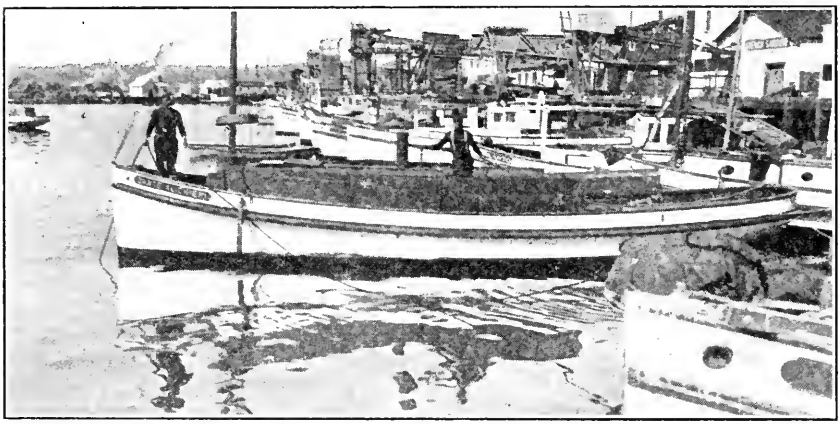

FIG. 65. A typical Italian sardine boat. These boats are also used for fishing halibut with trammel nets and barracuda with gill nets.

bow, and a low trunk cabin runs aft from this half the length of the deck. The space below is occupied by a two- or three-cylinder distillate engine of 20 to 30 horsepower and sleeping quarters for four. In the afterdeck is a hatch opening into a hold where nets or gear are stored

*The following table gives the nationality of fishermen in southern California, as compiled by the Commercial Fisheries offices of the Commission at San Pedro and San Diego from fishing licenses issued for 1920-21:

Nativity	Aliens	Citizens	First papers	Total	Per cent of total fishermen
Japan	1,025			1,025	42
Austria	357	31	104	492	20
United States		328		328	13
Italy	257	9	15	281	12
Dalmatia	66	5	13	84	3
Scandinavia	51	17	13	81	3
Balkan States	22	4	8	34	1
Russia	16	4	1	21	1
All others (10)	78	15	5	101	4
Total	1,872	423	159	2,447	99
Per cent of total	76	17	6	99	

Austrian fishermen engage almost entirely in purse-seining for tuna, barracuda, and sea bass, while native Americans and many Japanese fish chiefly in the summer for albacore. This leaves the Japanese and Italians dominant in the sardine fishery.

and where rock cod or halibut may be iced or stored fresh, when set-line or trammel-net fishing. The operator stands in the open cabin hatchway amidship, his hands on a small steering wheel inside the cabin and his feet operating the controls of the engine. On some boats a movable box-like hood with glass windows in its sides is placed over the open hatch to protect the head and shoulders of the operator from the weather. The speed of such boats is from six to eight miles per hour and they are relatively economical in operation. Their small size, however, reduces the capacity and their speed limits the radius of operation in the sardine fishery. It also unfits them for the more strenuous duty of catching albacore.

The Japanese type of sardine boat is a modification of the earlier market fishing boat and is built primarily for the catching of albacore. It is longer, speedier, and more powerful than the Italian boats, and more comfort is provided for the operator by building an enclosed pilot house amidship. It is thus adapted to traveling greater distances in search of schools and returning with the catch in less time.

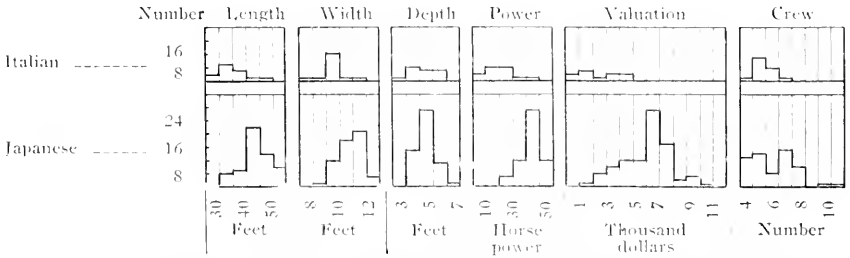

FIG. 66. A comparison of Italian and Japanese types of sardine boats at San Pedro, 1920–21. Data from boat registration records.

A typical Japanese sardine boat (Figures 66 and 73), carrying a crew of seven or eight men, is 45 to 50 feet long, of 12-foot beam, 5-foot draft, and powered with a three-cylinder distillate or crude-oil engine of 40 horsepower, which drives the boat at a speed of from 9 to 12 miles per hour. The vertical bow is wedge-shaped and the stern of fantail type, but broad and rather square. A low trunk cabin with a hatchway on the side runs from near the bow to the pilot house amidship, which is placed directly over the engine. The controls are arranged in the pilot house so that one man operates the boat. The forward cabin is small, having bunk space for two or three men, but extra bunks are fitted in the hold beneath the afterdeck and may be reached through a raised hatch just aft of the cowl or extended roof of the pilot house. A take-down mast set at the forward end of the cabin is carried in a horizontal position, one end resting on the pilot house. The catch of fish is piled all over the afterdeck and along the sides of the cabin as far forward as necessary, and is confined by side-boards which may be built up on the gunwales three or four feet high, according to the size of the load. A space about six feet wide and running athwartship is reserved in the stern of the boat for piling the net and for standing when paying it out or hauling it in again. The

fish are kept out of this area by a low transverse bulkhead or partition which may be built up in the same way as are the sideboards. In the center of this bulkhead is erected a standard bearing an electric light on a swinging arm to light the deck for night hauling.

This is the newer type of boat representing three-fourths of the fishing craft in southern California, and is now being built for fishermen of all nationalities, Japanese and Italians alike, for use in the albacore and sardine industry.

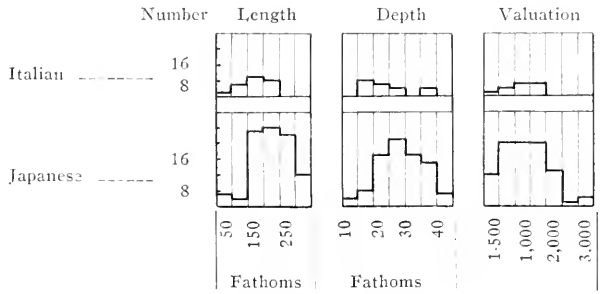

FIG. 67. A comparison of Italian and Japanese types of sardine nets at San Pedro, 1920–21. Data from boat registration records.

Nets.

Sardines are caught entirely in huge nets laid out in circles and hence called "round-haul" nets. Italian and Japanese nets are alike in principle and general plan, but differ in details of design as completely as do the types of boats (Figure 67). Any round-haul net is made in three sections; a right wing, a left wing, and a bunt or bag. The wings are long strips of large meshed net attached at each side of the bunt and are used to encircle the fish and drive them into the bag. The bag is the sacklike center portion of the net, made of fine meshed webbing and used to hold the fish until they may be landed on the boat. The webbing of wings and bunt is fastened to a light rope called the "cork line," buoyed with numerous corks so that the whole net floats in the water with the cork line on the surface. The lower edge of the net is fastened to a similar line—the "lead line"—weighted with leads at frequent intervals. These two ropes, in addition to floating and ballasting the net, take much of the strain of hauling and serve as reenforcement for the edges of the webbing.

Webbing manufactured in Japan is more popular in southern California for making sardine nets than the American or European product, partly, at least, on account of its lower cost. Hard-laid cotton seine twine is preferred for wings and landing sack, and cable-laid twine for the greater part of the bunt, particularly the fine mesh; but notions of economy lead some to use the cheaper and less durable medium-laid twine in the wings.

Each fisherman or boat owner builds his net after his own pattern and according to his latest ideas, producing a diversity of design which no doubt makes for progress in the developing of perfect gear. This great diversity makes it difficult to select a type, and when once

selected it is almost impossible to draw up specifications which could serve in building a net like the original, for net making is an art and can be learned only by experience. Two nets apparently of the same design will fish with different success, due to the individual skill of the makers expressed in the "hang" of the webbing; hence, the accompanying diagrams must not be considered as working drawings, but only as sketches sufficiently detailed, it is hoped, to portray the characteristic points of the types.

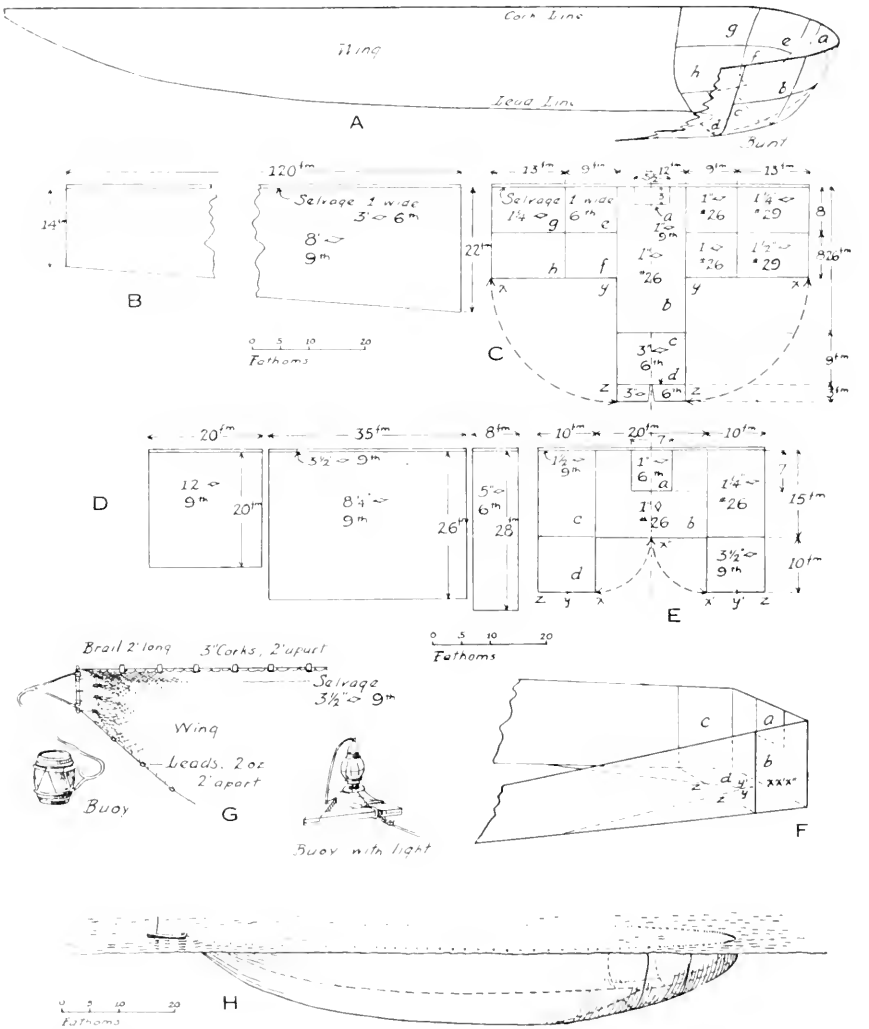

FIG. 68. Diagrams of Italian type of sardine round-haul net or Lampara. A, a perspective diagram of a large Lampara. The right wing only is shown. B, and C, wing and bunt respectively of same, showing pieces of webbing used. The pieces *a*–*h* are lettered the same in A and C to indicate their relation. The lines *x*-*y* and *y*-*z* in C are brought together to form a bag. D, the wing and E, the bunt of a smaller net. F, the bunt of the same net showing the relation of pieces in E. The points *x*, *x'* and *x"* are brought together and the lines *x*-*y* and *x'*-*y'* are joined as in F. In all diagrams, *a*, is the fine meshed landing sack of heavier twine than the rest of the bunt. G, end of wing and buoys for day and night fishing. H, a large net in operation showing relative length and depth compared with a forty-foot fishing boat.

The "Lampara" or Italian round-haul net.

A typical Italian sardine round-haul net or "Lampara" (Figures 67 and 68) is between 150 and 200 fathoms long, and between 15 and 20 fathoms deep, although some reach 300 fathoms in length and 28 fathoms in depth. The webbing is $\frac{3}{4}$- or 1-inch mesh of six-thread or sometimes nine-thread twine in the landing bag, and 1-inch to $1\frac{1}{4}$-inch mesh of No. 26 and No. 29, cable-laid twine in the sides of the bunt. The bed of the net is made of a piece of 1-inch No. 26 cable-laid mesh next to the landing bag and pieces of $2\frac{1}{2}$- and $3\frac{1}{2}$-inch mesh of six-thread hard-laid twine next to the lead line. A strip of heavier webbing about a foot wide, of $1\frac{1}{4}$-inch mesh and nine-thread twine runs the entire length of the bunt and serves as a selvage to which the cork line may be more firmly hung. A similar piece of selvage runs the length of the wings, but is usually $3\frac{1}{2}$-inch mesh of six-thread, hard or medium-laid twine.

The wings are commonly made of three sizes of mesh, the smallest being near the bunt and the largest at the ends. In a 200-fathom net the bunt is 40 fathoms long and each wing twice as long as the bunt, or 80 fathoms. Of this length, about 10 fathoms is 3-inch mesh, six-thread twine, 45 fathoms of 8-inch, six-thread, and 25 fathoms of 12-inch mesh, nine-thread twine. The piece of 3-inch mesh is fastened to the bunt of the net and is the same depth, *e. g.*, 28 fathoms. Each succeeding piece is reduced somewhat in depth so that the wing tapers to 15 or 18 fathoms at the end. This amount of webbing at the end of the wing is, however, gathered into bunches and fastened to a 2-fathom rope or to a wooden brail 2 feet long. Some prefer more pieces in the wings, beginning with smaller mesh, such as $2\frac{1}{2}$-inch, and running 3-inch, 5-inch, and 8-inch mesh at the end of the wings. Others use 8-inch mesh throughout the whole wing (Figure 69).

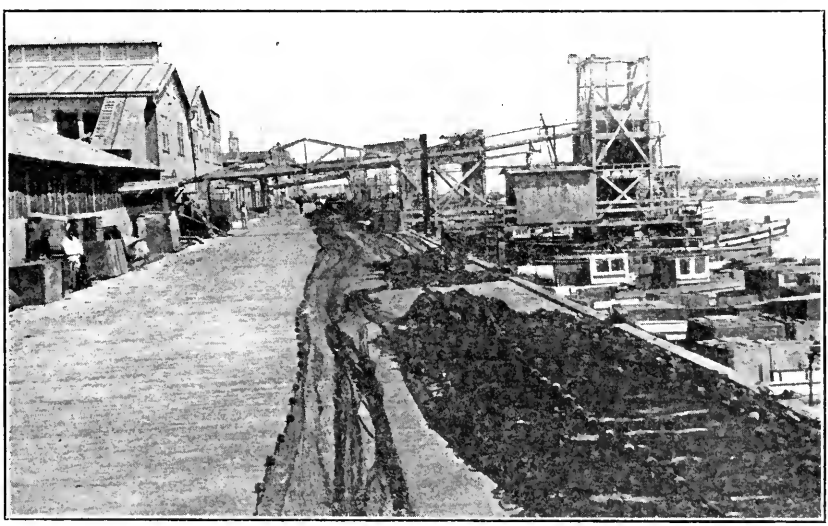

FIG. 69. Lampara net stretched on the dock for drying and mending. Fish Harbor, East San Pedro.

The cork line from which the whole upper edge of the net is hung is a ¼-inch manila line carrying 3-inch corks strung through their centers. Double corks four or six inches apart are placed the entire length of the bunt, and single corks, four, twelve, and eighteen inches apart are used on the wings. The corks are placed close together in the bunt and on the first sections of the wings to add greater buoyancy so that the weight of the fish in the sack, when making a haul, is less likely to pull the net under water and thus allow the fish to escape. The mesh of the bunt and wings is "hung full" on the cork line—*i. e.*, the cork line is shorter than the stretched webbing so as to allow for bagging of the net, by that means giving more room inside the bag and making it pull more evenly in the water. The amount of fullness left in the webbing depends upon the ideas of the individual maker. One method is to stretch the cork and lead lines by soaking them all night in water and then hanging the dry webbing upon them evenly the next day. The webbing will then stretch relatively more than the cork and lead lines when in use, relieving it of excessive strain and permitting sufficient bagging of the mesh. Another method is to first stretch the dry cork line, fastening in position temporarily at intervals the required amount of dry webbing, and later hanging permanently. In this way about 45 or 50 fathoms of webbing are hung on 40 fathoms of cork line to give sufficient fullness.

The lead line is also a ¼-inch manilla rope, like the cork line, but is strung with two-ounce leads one or two feet apart along its entire length. This amount of lead is just sufficient to make the bottom of the net fall readily and straighten out in the water.

The Japanese round-haul net.

The Japanese type of sardine net, although introduced into California later than the Lampara, has grown in popularity and now far exceeds the latter in numbers used. The Japanese net resembles the Lampara in a general way, but differs from it in size—both length and depth—in the shape of the bunt, and in the relative proportions of the bunt and wings.

A typical Japanese sardine net is from 200 to 250 fathoms long and from 25 to 30 fathoms deep, although many are 300 fathoms long and from 35 to 45 fathoms deep (Figures 67 and 70). The bunt is from 30 to 50 fathoms along the cork line, and the wings from three to three and one-half times this length. The mesh is commonly 1-inch, nine-thread in the landing bag; ¾-inch No. 26, cable-laid, in the sides of the bunt; 1-inch No. 26, cable-laid, lower down; and 3½-inch, six-thread, hard-laid, in the bed. The wings are made up of three or five pieces of webbing of different size, of from 3- to 8-inch mesh, arranged as in the Lampara and tapering in depth. A strip of heavy mesh or selvage runs the entire length of the cork line, as in Italian net, but, in addition, a strip of two or three heavy 3-inch meshes runs down the sides of the bunt, making a firm selvage for the attachment of the wings.

A special feature used in some Japanese nets is the purse-line or quarter-rope, a ¾-inch rope, one end of which is fastened to the middle of the lead line by a short halter, and the other end to the lead line of one wing about 15 fathoms out. This line is used to raise the middle of the lead line of the bunt more rapidly than could be done by hauling

only on the wings. This is a desirable feature, for as soon as the lead line is raised the catch is made certain, the fish being then confined in the fine-meshed portion of the net.

It is difficult to discuss the relative merits of the two types of sardine nets, as both Italians and Japanese seem equally successful in catching

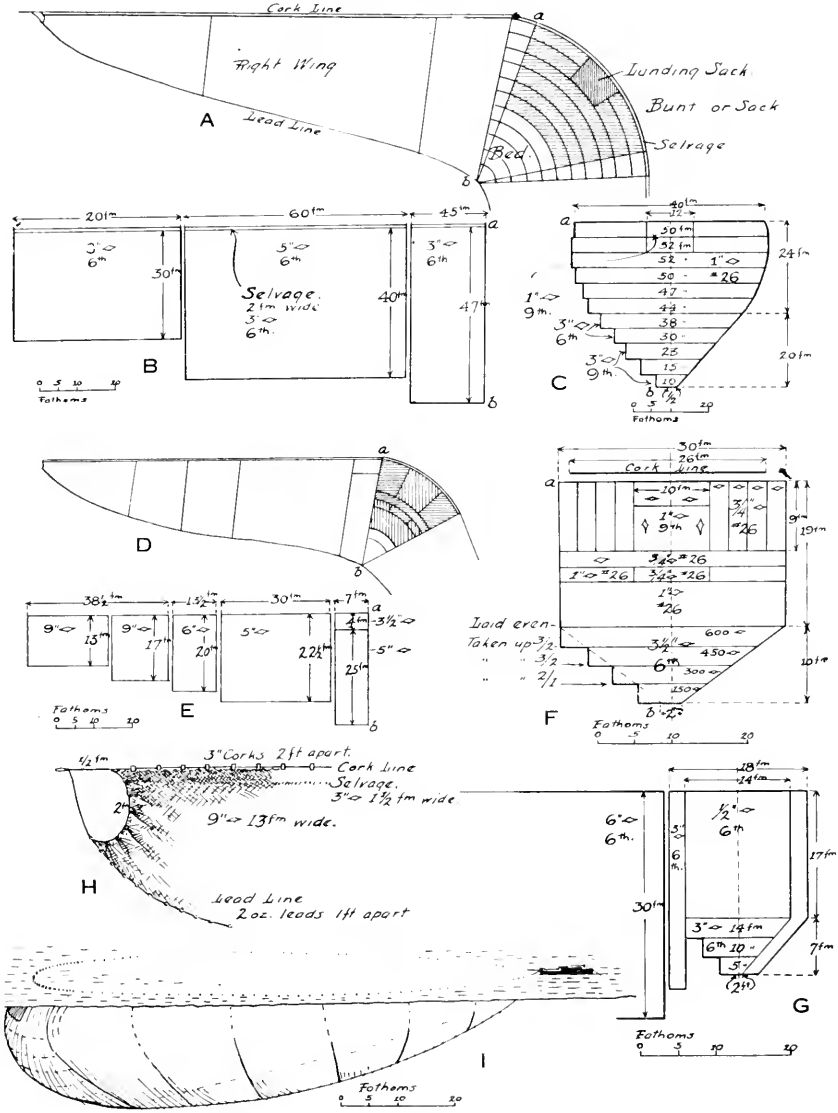

FIG. 70. Diagrams of Japanese type of sardine round-haul nets. A, a large net showing wing and bunt. B, and C, wing and bunt respectively of same, showing pieces used in making. The adjacent edges are brought together evenly by taking up the longer into the shorter lengths. The left side of C shows the pieces stretched and the right side after being taken up. D, a smaller net; E, and F, wing and bunt of same. Many more pieces than indicated may be used in the wings to produce the proper taper. G, the bunt and part of the wing of a bait net. H, method of fastening the end of the wing. I, a net in operation showing relative length and depth compared with a fifty-foot fishing boat.

fish. The popularity of the Japanese nets may be due to the great increase in the number of Japanese fishermen who naturally use their own methods, and the acceptance of this type by other nationalities may be due to its relatively simple design. It is argued that the greater depth of the Japanese type makes the net more generally useful than the Italian, since it can be used in deeper water away from shore. It is further said that the smaller amount of fine-meshed web in the Japanese net reduces the cost of construction and allows the building of a larger net with greater fishing capacity without corresponding increase in cost. Other fishermen declare that it is less difficult to operate a Japanese net, as cross currents are less likely to close the bag than is the case with the Lampara, and that the greater proportion of large mesh makes the net easier to pull. Whatever the facts may be, the fisherman of each nationality stoutly maintains his belief in the superiority of his gear, and both types will probably exist as long as Italians and Japanese continue to fish for sardines.

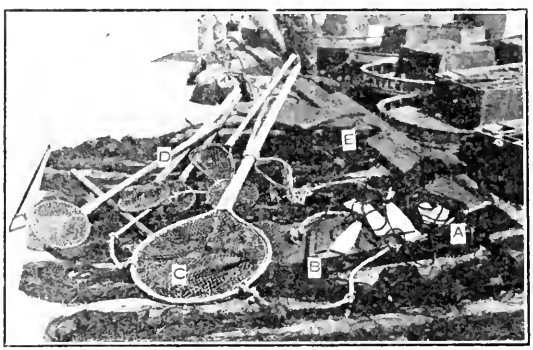

FIG. 71. Miscellaneous gear. A, and B, line and weight of the seare, with paddles piled between; C, dip-net for landing the fish; D, shovels used in unloading; E, side boards and checks for confining the catch on deck.

Bait nets.

The bait net is an important modification of the standard sardine gear. It is an almost necessary piece of equipment for the albacore boat, for live bait is required daily during the summer season. Some fishermen, moreover, make a practice of supplying small sardines to the market to be used as bait for the mackerel and set-line fisheries, and for this, bait nets are used. Bait nets are small sized Lamparas or Japanese style round-haul nets ranging from 75 to 150 fathoms in length and from 12 to 20 fathoms deep. They are usually more simple in construction, fewer pieces of webbing being used. The webbing in the bunt is of $\frac{1}{2}$- or $\frac{3}{4}$-inch mesh, but the mesh of the wings is about the same as in the larger nets.

Miscellaneous gear.

Many other kinds of gear may be mentioned which are used directly in catching or handling sardines, such as buoys, skiffs, plungers or seares, and dip-nets (Figure 71). A brief description of each will be given here, but details of their use will be left until later in this paper.

The Italian fisherman uses a red-painted, five-gallon keg as a buoy to float and mark the end of his net when fishing in the daytime. For night fishing, either a similar keg, weighted, and carrying a lantern, or a simple buoy made of crossed pieces of wood so as to float level and carry a light, is used. The Japanese, however, tow a twelve-foot skiff, lighted with a lantern at night, behind their fishing boat, to be used in place of the buoy.

The scares or plungers used in driving the fish back into the net are of many kinds. The simplest form is a weighted board two or three feet long, fastened to a ten- or fifteen-fathom line. Another kind used on some boats is a two- or three-foot length of iron pipe, open at the lower end but fitted to a short wooden pole at the other. This is also fastened to a light line so that it may be thrust down and rapidly hauled in again. Still another type is made by weighting one end of a long rope with a ten-pound window weight and fastening eight or ten white-painted wooden paddles about ten inches long and four inches wide at fathom intervals along its length. This seems to be a very efficient scare, as the paddles dash about irregularly when the line is jerked up and down in the water.

Two kinds of small ring nets are used: one is a dip-net for bailing the fish out of the water, the other really a shovel for unloading the catch. The dip-net is a shallow bag of heavy 2-inch webbing fastened to an iron ring two or three feet in diameter which is fixed on a heavy pole or handle about eight feet long. Short lengths of rope are fastened to either side of the ring to help in lifting the net filled with fish on board the boat. Another rope is fastened to the bottom of the net and is used in dumping the fish by raising the bag. The small nets used as shovels are made of heavy mesh stretched tightly over iron rings ten inches or a foot in diameter, with wooden handles four feet long. They may be circular, square, or semicircular, with the flat side away from the handle to make it easy to shovel up the fish from the flat deck. These particular implements are used instead of iron shovels to avoid cutting or bruising the fish more than necessary in unloading.

Care of gear.

Sardine nets are continually in need of mending. Defective meshes giving away causing small tears, large fish becoming entangled or plunging through the net, hidden snags—a hundred causes—keep the fisherman mending and mending before and after hauls and while waiting to unload the catch. Frequently the weight of the fish caught in the net is so great that rents are made great enough to allow the whole catch to escape. If possible, the repairing is done on the boat, but if the damage is too great the net must be spread out on the dock, and the whole crew goes to work with full-wound seine needles to repair the tear.

The standard method of preserving net material is by tanning the webbing in a hot decoction of red-oak tan-bark (Figure 72). Two sacks, or 120 pounds of bark, is placed with 100 gallons of water in a large tank and boiled for one hour. The fluid is allowed to cool somewhat and the net is put in and soaked for two hours or more, at a temperature less than boiling. Care is exercised to avoid heating too much, as the net is said to burn, causing quick "rotting" of the fabric.

Many canneries provide vats for tanning, heated with steam coils, but where the fisherman does not have access to such equipment he heats his tanks of tanning solution with a wood fire built in a pit in the ground. Nets are never tanned before storing away at the close of the season, but only while in actual use, for it is believed that rotting is more rapid when an excess of tan is left in the fabric.

Nets are dried as frequently as possible as a precaution against rotting, and windy days or periods when fish are scarce are always occupied with spreading nets on the docks or on the sandy ground for drying and mending. Rotting of the net when wet is also guarded

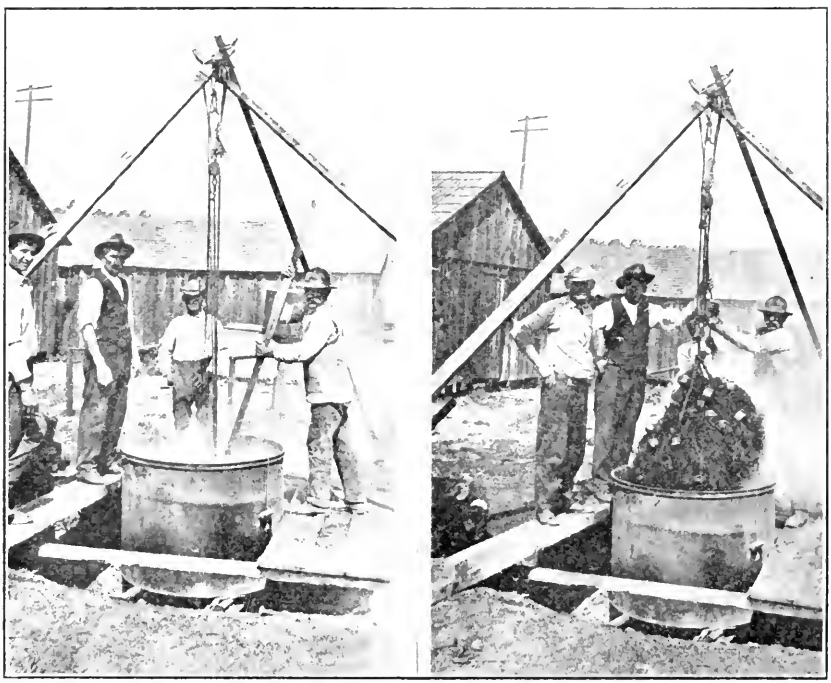

FIG. 72. Tanning nets. The nets are preserved from mildewing by soaking for several hours in a hot decoction of tan bark.

against by careful protection from the sun. As soon as the day's catch is made, the net is piled in order and covered with a tarpaulin made of heavy canvas.

Cost.

With ordinary care, a sardine net will last for two fishing seasons, but during the third season it is usually necessary to replace so many pieces of webbing that the net can hardly be called the same as the one at the start. A sardine net at the prevailing prices of the last two years, represents an outlay of from $1,000 to $3,000, but the cost of continual repairs makes the annual cost of operating a net from $300 to $1,000.

METHODS OF FISHING.

Time.

It is the fixed opinion of some that day fishing yields more mixed or small sizes of fish than night fishing; others notice no difference. Large and small fish are caught both day and night, but it may easily be true that differences in the schooling of the fish make the larger fish more accessible at night and so increase the average size of the fish in the total catch. At any rate, the demands of the canneries for large fish—pound oval size—combined with the greater accessibility is responsible for the greater part of the sardine catch being taken at night. The fish are most easily located on the darkest nights, hence, the two-week period during the dark phases of the moon is most successful. Day fishing is only resorted to when less than two or three hours of darkness is left between nightfall and moon-rise or moon-set and dawn. When fishing in the day time, the hours of early morning are the most favorable as the schools of fish can be most easily located when the water is calm.

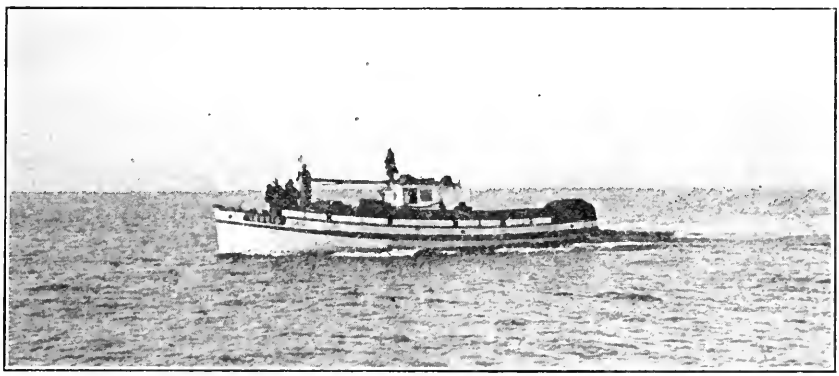

FIG. 73. Searching for schools of fish. The crew on the bow and the man on the pilot house anxiously scan the sea for birds, darkened areas of water, or ripples on the surface which indicate the presence of fish. A typical Japanese boat.

Locating the school of fish.

The schools are located at night by the phosphorescent light produced by the movement of the fish in swimming. This explains the dependence of the fisherman upon the phases of the moon, as even a small amount of moonlight, or even bright starlight, makes it difficult at times to see the pale light of the phosphorescence. The running lights of the fishing boats are even darkened by covering them with cloth so that they may be seen at a short distance by other boats but will not give enough light to obscure the evidence of fish. Very dense schools may often be located at some distance by the dull "fire" but when the fish are more scattered it is necessary to pass over them to discover their presence.

Smelt and anchovies school closely enough and are near enough in size to be mistaken for sardines by the ordinary observer, at least at night, but the fisherman distinguishes between them readily by the courses of the fish as they dash away from the boat. Smelt swim away

in undulating courses leaving wavering, snaky trails of light. Anchovies, being feebler swimmers, dart away in short, curved dashes. Sardines are more powerful and dash away, leaving long slightly curved trails resembling the luminous paths of sky rockets.

There are several ways of locating sardines in the day time (Figure 73). A school may be discovered at a distance by seeing the gulls, fulmars, and shearwaters flying in circles and feeding upon the splashing fish. The water may also appear dark from the mass of fish below, and at close range the fish may be seen splashing on the surface. The character of the splash serves to distinguish sardines from anchovies, the former throw their tails above the surface without a marked silvery flash, while the latter flip over sidewise on the water showing their silvery sides and reflecting flashes of light. Some fishermen locate deep-lying schools in quiet water by the "bead"—minute bubbles which come up from below and bead the surface of the water like rain drops.

Making a haul.

Having located a school of fish dense enough to warrant an attempt, the crew stands in readiness to lay out the net while the skipper, noting the wind and current, circles and maneuvers the boat into proper

FIG. 74. Hauling in the wings. The activity here shown is accompanied by the excitement one feels before actually landing any other kind of fish.

position. The net is always laid out in relation to the direction of the wind so that the boat may not blow back over the net, and to the direction of the current, so that the net may not be swept shut or prevented from opening fully.

In making a haul, the net is laid out in a huge circle about the school of fish, the ends brought together and hauled in, impounding the fish in the bunt of the net. Running ahead at full speed, the skiff is released or the buoy thrown overboard, and its weight drags the end of the net into the water. The net is piled in the stern of the fishing boat so that one wing is paid out first, cork line and lead falling far apart in the water so as not to tangle. When one wing is paid out, the whole pile of bunt is thrown overboard at once, and the second wing is then dragged out by the weight of the net and speed of the boat. When the net is nearly all overboard the boat slows down in preparation for picking up the skiff, but should all of the net be paid

out before the skiff or buoy is reached, a one-inch line already attached to the net is slacked away under strain as far as necessary, and then hauled in again when the other wing is reached.

As soon as both ends of the net are recovered, the launch is anchored at once, if in shallow water, with a light kedge anchor, the skiff tied

FIG. 75. Sardine fishing in the black obscurity of midnight. This is the typical condition under which ninety per cent of our sardines are caught. Above, hauling in the bag; below, dipping the fish from the net.

forward out of the way, and all hands immediately begin hauling in the net with all possible speed (Figure 74). Care is taken to pull both wings at the same rate, cork line, lead line, and webbing coming in evenly; and as an aid, marked corks are placed on each wing at equal distances from the center. While the wings are being hauled in, one man operates the scare or plunger described above. This scare is

jerked vigorously up and down at the stern of the boat to frighten the fish back into the net and prevent their escape from the open side beneath the boat.

The wings of the net are hauled in until the lead line, being shorter than the cork line, is brought on deck. Thus far all work has been performed in absolute darkness, every light on the boat being entirely darkened so as not to attract the fish toward the boat and out of the net, but as soon as the lead line is brought on deck making escape impossible, the deck lights and running lights are turned on (Figure 75). The weight of a large catch of fish in the bag is sometimes sufficient to pull the cork line under water, allowing many of the fish to escape. The Japanese prevent this by one man rowing with the skiff to the outer side of the net and supporting the cork line. (Figure 63). He later helps operate the dip-net in landing the fish.

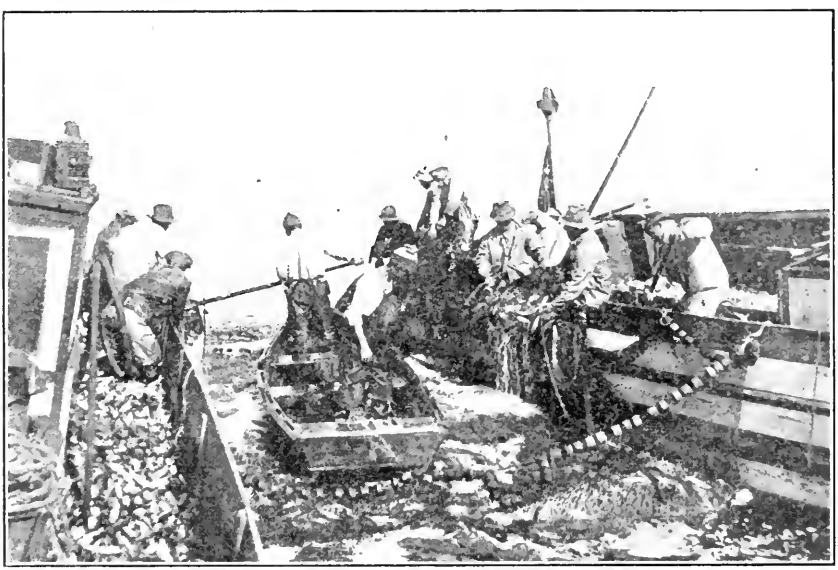

FIG. 76. Bailing the fish from the net. Two boats have come together to load from one successful haul. The men in the skiff dip the fish from the water while two men on each fishing boat hoist the nets on deck and dump them.

The hauling in of the mesh of the bunt continues until the fish are crowded into the landing bag and their weight makes further hauling too difficult. The cork line is drawn up into a circle about ten feet in diameter and partially supported by boat hooks. The fish are then bailed from the net with a large dip-net, dumped on deck, and shoveled forward to make room for subsequent hauls. Three men work together with the dip-net in landing the catch, the others holding the net by sitting on the webbing and spreading the cork line with boat hooks. Often two boats will come together and take their loads from one successful haul (Figure 76).

Preparing for the next haul.

As soon as the catch is landed and disposed of on the deck, the bunt is sometimes roughly washed to remove excess scales and slime, serious tears are temporarily mended, and the wings and bunt piled on deck in preparation for the next haul. It is the practice of most fishermen to circle to the right in laying out the net. When this plan is followed, the left wing of the net is carefully coiled on the port side of the stern, cork line and lead line well separated. The bunt of the Japanese net is piled on top of this, but the bunt of the lampara is piled separately next to the wing so that the whole pile may be thrown overboard at once, avoiding strain on the webbing which might tear the net. The right wing is then coiled to the starboard so that when the skiff is released or the buoy thrown out, the net will pay out freely. On boats which circle to the left, this arrangement of the net on the deck is reversed.

Size of hauls.

The quantity of fish taken in a single haul varies between the many, many weary hauls containing nothing, and the rare streaks of fortune containing over one hundred tons. The capacity of the larger Japanese boats does not greatly exceed twenty-five tons, and when such large hauls are made other boats are called and loaded from the overabundance. During the present season, limit catches of ten to fifteen tons could frequently be taken in one haul, but at times boats whose weary crews had made eight or ten hauls would return from a night's fishing with a ton or even less.

The Fish and Game Commission has legal authority to prevent wastage by limiting the size of the loads according to the tonnage of the boats, for if the fish are piled too deep on the deck, heating and pressure on

FIG. 77. An "idle" moment while waiting to unload. Seine needles are busy with never-ending repairs on the net.

the lower layers renders a large part unfit for canning. During the past season, however, the amount used for canning was small and the surplus was converted into fish meal. The only limits imposed on the catch, therefore, were those required by cannery practices.

Disposing of catch and washing net.

As soon as the night's catch is taken, the run to port is made without loss of time, as the first boat to tie up at the cannery hoist is the first to unload. Most of the canneries start receiving fish at seven o'clock in the morning, but by daylight a long row of loaded boats is tied up, side by side, waiting their turn at the hoist. If the boat gets in before morning, the entire crew will turn in for a few hours sleep on the boat, or if living near the water front, will go home, estimating by the position of their boat in the waiting line the hour to return. But if the boat arrives late and is required to wait but a short time before unloading, the crew sets to work with ever-ready seine needles mending holes in the net (Figure 77).

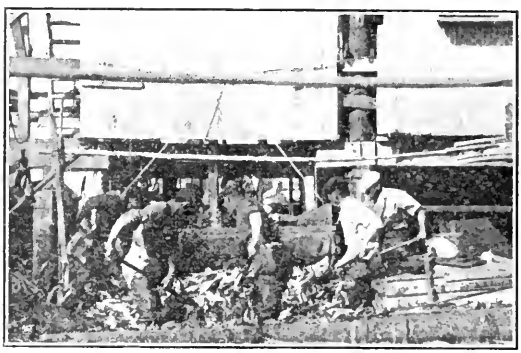

FIG. 78. Unloading the catch. The fish are shoveled into the hopper where they fall into buckets to be hoisted into the cannery.

The boat is unloaded by shoveling the fish into the cannery hoist with the small net-like shovels described above. The fish from the after-deck space are first unloaded and when these are gone, the ones piled forward along the sides of the cabin are sluiced down to the after-deck with running water from a hose. Six or seven men are able to discharge an average load in about a half hour at canneries using a continuous conveyor, but more time is required where a single bucket hoist is used (Figure 78).

As soon as the boat is unloaded, the deck and deck houses are thoroughly scrubbed with running water and the side boards thrown into the water to remove scales and slime. The boat then backs out of line to allow the next boat to be pulled up to the unloading hoist, and runs outside away from the canneries to wash the net. The pieces of kelp and occasionally gilled fish are carefully picked out of the webbing, and the bunt thrown overboard and dragged through the water for some distance to wash out the slime. The crew then slowly hauls it in, shaking

and sousing the webbing repeatedly to complete the cleaning. Thoroughly washed nets last much longer than carelessly cleaned ones, and thrifty skippers are very particular about the amount of shaking and rinsing their nets receive after each day's work.

Thus it may be seen in following the course of operations, that sardine fishing, even under the mildest and most favorable of natural conditions, entails long hours, heavy labor, and uncertain returns. Only those who are born to following the sea are attracted by the possibilities of fishing, and hence the industry has fallen into the hands of those from foreign lands where fishing is a profession, and not a mere means of living.

CALIFORNIA SARDINE FOOD PRODUCTS AND THEIR PREPARATION.*

By Harry R. Beard.

The outbreak of the World War in 1914 brought about a large increase in the demand for food products. Normal production of most foods require time and the use of valuable raw materials. The world's fisheries, however, were furnishing large quantities of excellent food without such serious drawbacks. Moreover, this supply could be greatly increased and, by using methods of preservation, it could be

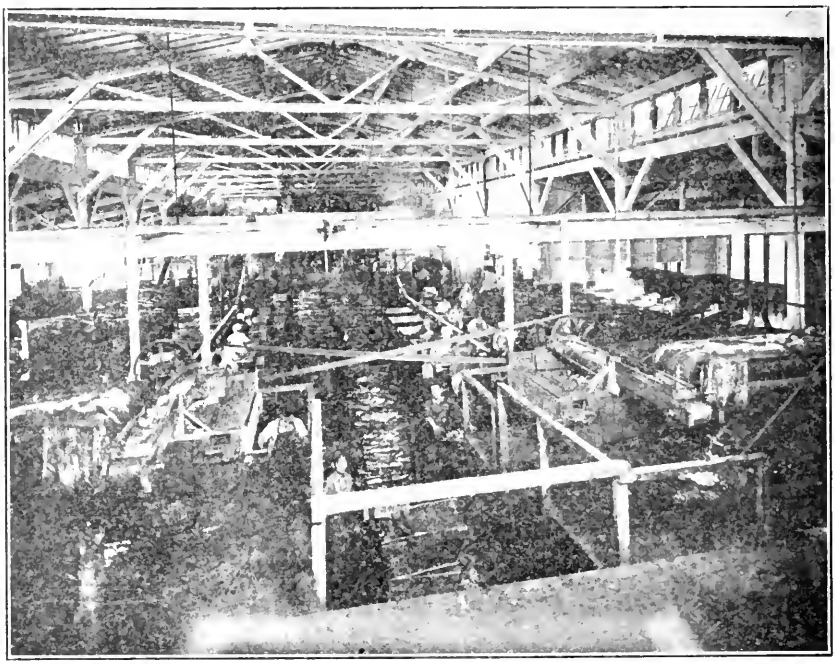

Fig. 79. Sardine cannery.

made available anywhere. In addition, the increased quantity of by-products from fish would be of almost equal importance. This is obvious when one considers the things which may be derived wholly or in part from fish wastes. Some examples are: fertilizers, stock and chicken food, glue, oil, glycerine, soaps, explosives, paints, waterproofed fabrics, lubricants, medicinal products, salad oils, butter substitutes, candles, artificial jewels, and ornaments for hats and dresses. Demands for food and for these products naturally led to a vast expansion of the fish industry.

An excellent example of this expansion is shown by the rapid growth of the California sardine industry during the war period. In 1920

*Contribution from Preservation Laboratory, Fish and Game Commission of California, San Pedro.

California's production had risen to a place where it was almost leading in the race for world supremacy. In addition it can be said, that California canneries are second to none in sanitation, equipment, methods of packing, and in the variety and quality of food products produced.

A short description of these products, their preparation and food values follow.

FOOD PRODUCTS.

The sardine packer offers to the trade excellent food products put up in ways various enough to suit any taste. Moreover, most of these products are sold at prices low enough for everybody. The canned products enjoying the greatest popularity are the so-called "pound oval" and "quarter oil" packs.

A can of "pound oval" sardines usually contains four to seven large sized fish which have either been steamed in the can or fried and then packed into a flat oval can with tomato sauce. This is the cheapest and most popular pack put up by the industry.

Next in order of importance is the "quarter oil" pack. Here one finds fried "baby" sardines tightly packed with olive oil into quarter-pound flat cans.

Many other products are put out in smaller quantities. These depend upon the resourcefulness of the packer and the demands of his trade. For instance, the size and shape of the can is varied as well as the size of the fish put into it. Sauces placed in the can include, in addition to tomato, mustard, souse (vinegar and spices), and soy for the orientals. Fancy packs are prepared by making fillet of sardine, by smoking to add the delicate flavor obtained in that manner, by grilling, by packing in glass, and by making mixtures with other foods. Considerable quantities of salted, pressed sardines are sold to the foreign trade.

PACKING.

Sardines are canned in modern packing establishments situated on the waterfront close to the fishing grounds. The size of different plants varies greatly. Some are able to handle only a few tons of sardines a day while others can easily care for 100 tons in the same period of time. The internal arrangement of space and equipment differs in most canneries, yet in each case the arrangement was planned to expedite the process.

Mechanical equipment of the latest type is used wherever possible, making the procedure mostly automatic in the larger plants.

Particular attention is paid to sanitation in all canneries. Cement floors are used to a great extent, as they are easily washed after a batch of fish has been cared for. The fry-baths, trays, and packing tables are cleaned after use by treatment with a solution of soap or caustic soda followed by plenty of water. The women who pack the fish into cans wear white aprons and caps. They are required to keep their hands clean and their nails manicured. Precautions of a like character are required of all personnel who handle the fish.

The methods used in preparation and canning of fried "pound oval" sardines are representative of those generally used in California for preparing most canned sardine products. These methods will,

therefore, be given in detail. Following this description, a few general statements will be made concerning the preparation of steamed "pound oval" sardines and of the other packs which have been described above. In these connections, it is to be kept in mind that the methods given here are subject to considerable variation in the many canneries. These changes, however, are only different means of attaining the same end.

Description of a process is probably made clearer if it is treated according to the steps into which it naturally divides itself. This plan is used here in describing the preparation and canning of the "pound oval" pack.

Preparation and canning of the "pound oval" pack.

Receiving. Sardines are received fresh from the fishing grounds, having been rushed to the canneries to prevent decomposition. They are shoveled from the boats into a mechanical hoist which raises them to an elevated platform where they are weighed. Water and gravity then carry the fish from the weighing vat through a trough into the cannery proper.

Scaling. The first operation in preparing sardines for canning is to scale them. This is accomplished by passing them through a large cylinder of heavy screening, which is rotating in a tilted position. Most of the scales are removed by the rubbing of the fish against each other and against the screen wall of the cylinder. Water is sprayed on the fish at the same time to help remove the scales and to wash the fish. The sardines are discharged on the cutting tables.

Cutting. In at least one cannery in the state an attempt is being made to cut sardines by a specially devised machine. However, this is an experiment. Cutting is usually done by Japanese women. They are paid by the number of buckets of cut fish delivered to the checker, who keeps score by punching a card, which hangs on the cutter's back. Cutting, therefore, develops into a sort of race: each cutter trying to make more money than anyone else. In some cases a cutter makes as high as a dollar and even more per hour when the price paid is thirty to thirty-six cents per hundred pounds of cut fish.

This sort of a race is desirable, as the fish do not tarry long on the cutting tables. In addition, a large number of cutters are employed, so the period only lasts a few hours.

The cutting operation is carried out in the following manner: The fish is taken from the table with one hand and held belly down on the cutting board. One cut with a sharp knife suffices to remove the head and part of the body from the sardine. A sideways motion with the knife removes the entrails and forces all the refuse through a hole in the table. At the same time, the other hand drops the cut fish into the bucket. The refuse from this operation goes to the by-products plant, where the oil is removed and the residue is made into fish meal.

Brining. The cut fish are placed in a large wooden vat containing an almost saturated solution of salt in water. The fish remain immersed in this brine for about thirty to sixty minutes. The time used varies according to the strength of brine, the temperature, and the size of the fish. A man skilled in brining determines when the fish have been brined sufficiently by observing their appearance.

Brining accomplishes several things. Some water, blood, and soluble proteins are extracted. Salt goes in the other direction, penetrating the flesh and making it firmer.

Drying. Brined fish normally contain too much moisture to fry and can well, so the excess is removed by means of hot air.

The apparatus usually used is a tunnel drier. This consists of an elongated chamber, varying from the size of a small, narrow room to

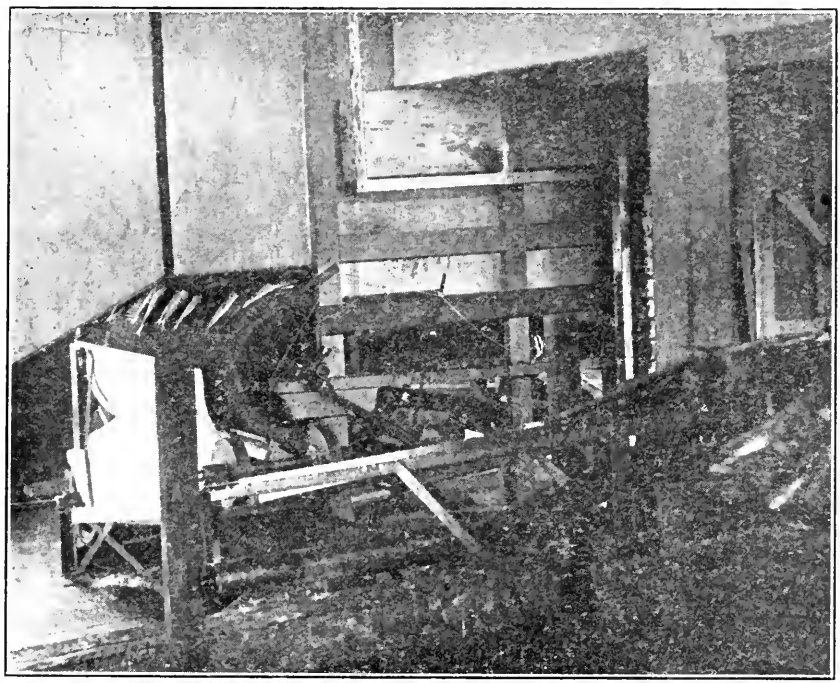

FIG. 80. Sardines coming from the dryer.

the size of a large hallway. Large fans rapidly blow or suck air through a series of steam coils, then through the chamber. In one popular type of drier the sardines pass through the chamber once on an endless wire belt. In their passage they are subject to hot dry air forced down onto the fish by baffle plates. In another type an endless wire belt carries the sardines to the top of the drier and through it. They then fall on a belt traveling in the opposite direction. A set of belts placed one below another repeats this operation several times before the fish leave the drier. In some types belts are not used. Instead of such apparatus, tiers of trays containing sardines are wheeled on trucks into the chamber and allowed to remain until the degree of drying is complete enough.

The time necessary for sufficient drying depends mainly upon: the rate, temperature, and moisture content of the air used; and upon the size of the fish. The time is easily controlled by changing the speed of the belts. Where trays are used the method of control is obvious.

In most cases an hour or less of drying is sufficient. The appearance of the fish is used as a guide in determining the sufficiency of this operation.

Frying. The sardines are conducted from the drier to the fry-bath, where preliminary cooking is accomplished.

Shallow wire trays are partly filled with the dried sardines (if they are not already in trays) and slowly passed through cottonseed oil heated to a temperature ranging from 215 to 240 degrees Fahrenheit.

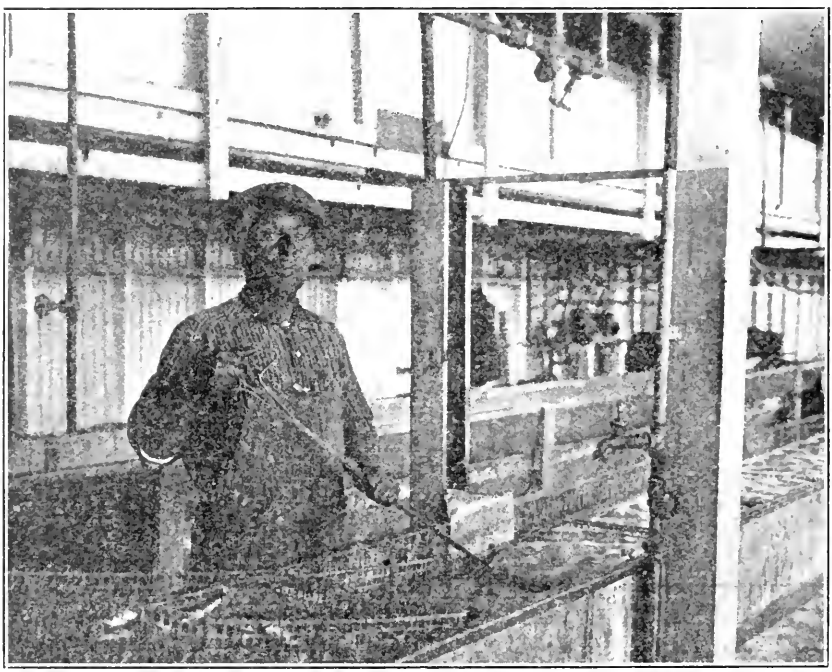

Fig. 81. Frying sardines.

The apparatus used consists of an elongated metal vat, inside of which is placed, midway of its depth, a horizontal set of steam coils. An endless chain conveyor runs just above the steam coils, carrying the baskets of fish through the length of the bath. Water is added to the bath until it almost comes to the bottom of the steam coils. Enough oil is then floated on top of this water to cover the baskets of fish which are to be carried through it. At times this amount of oil is over a thousand gallons. The temperature is controlled by varying the amount and pressure of the steam which is sent through the coils immersed in the oil.

Frying in pure oil brings out the excellent sardine flavor. In addition, part of the oil is carried on by the fish and this adds to the delicacy of the final product. This operation removes considerable moisture and some soluble extractives from the fish. Part of this water goes off as steam. The rest sinks with the extractives and solid particles coming from the fish. These collect in the layer of water

under the oil. After a day of frying the oil is separated from the water and other waste materials. The bath is then cleaned before the oil is returned to it.

The condition of the fish is used in determining the correct amount of frying. If, after removing the tail and holding the fish in one hand, the backbone can be removed easily and cleanly and shows no uncooked blood, then the process is deemed sufficient. Around eight minutes is the time needed for frying "pound oval" sized fish when the temperature of the oil is close to 230 degrees Fahrenheit.

The trays coming from the hot oil are placed on trucks and allowed to remain there until the fish drain and cool.

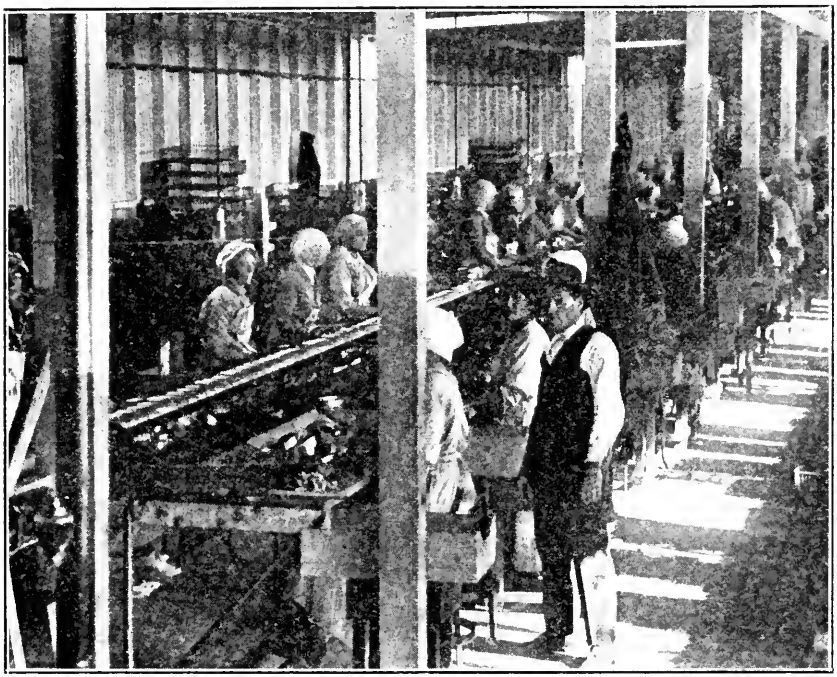

FIG. 82. Packing sardines.

Packing. After sufficient cooling the trays of sardines are placed on the packing table where women discard the broken fish and pack the others into clean cans.

The packing table is in a clean, light, airy part of the plant. It is arranged so as to give individual working space to each woman who has a tray of fish and a box of cans within her reach.

The cans come through a chute from a different part of the plant or they are brought in in cases. Each woman has a card which is punched every time she receives a case of cans. This is used as the unit of pay for her work. Some of the women make as high as a dollar or more per hour when the price paid is thirty cents per hundred cans packed.

The women carefully pack the fish into cans and then place them on a belt conveyor which carries them past an inspector, who discards the poorly packed cans. They then go to the sauce distributors.

The steady stream of cans on the belt conveyor passes under a mechanical sauce distributor which adds the correct amount of tomato sauce to each.

Exhausting. When cold sauce is added to the cans they are heated before they are sealed. This is necessary to prevent trouble later. Explanation of this is easily given. Cans sealed cold on a cold day have all empty spaces full of cold air. Later when a hot day comes the air expands and the cans swell. Addition of hot sauce followed by

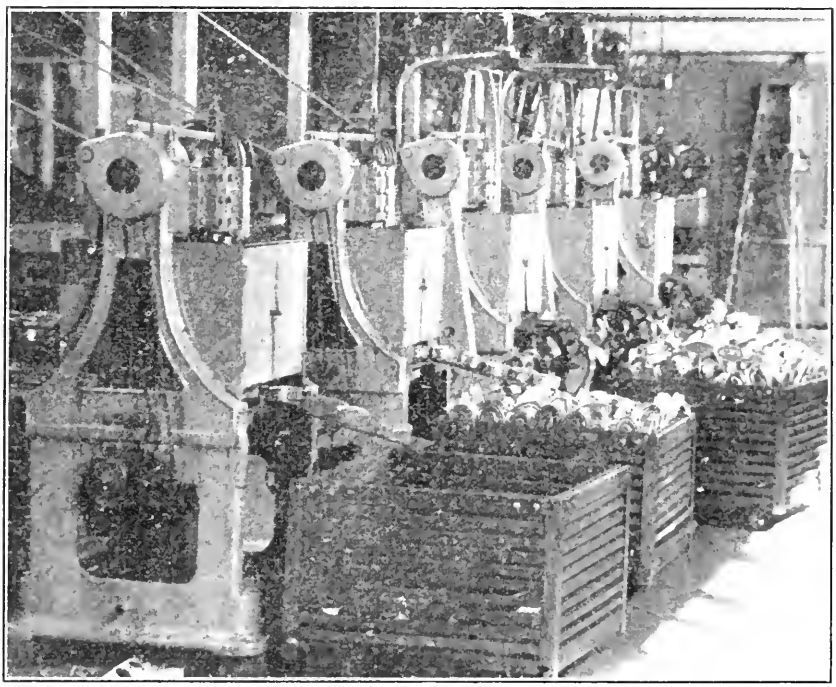

FIG. 83. Sealing cans of sardines.

immediate sealing cares for this difficulty. Another method of accomplishing the same end is to exhaust the cans by heating them after the sauce is added. This is brought about by allowing them to continue on the belt conveyor through a narrow chamber long enough to permit the steam pipes contained therein to heat the contents thoroughly.

Sealing. The cans are carried on the belt conveyor to an automatic sealing machine, which literally picks one of them up, puts a lid on it and with a whirl seals the lid to the can. Some machines do this forty or more times to the minute. The can carries a flange which fits into a groove in the lid having an extended edge bent downward. In sealing, the flange of the can and the edge of the lid are interlocked so as to form a double seam. The groove in the lid carries a very thin

layer of a sort of rubber compound, which serves as a gasket between the seams.

The cans fall from the machine into a large metal truck. This truck, which holds a very large number of them, is made to fit the retort used in processing.

Processing. Sterilization of the contents of the can is necessary to insure its keeping qualities. In addition more cooking is desirable. Proper heat treatment accomplishes both of these steps at one time.

The truck containing the cans from the sealing machine is wheeled into a large steel retort. The door is then tightly closed. Live steam under pressure is turned into the retort. This heats the contents of the cans to a temperature above the boiling point of water. Various

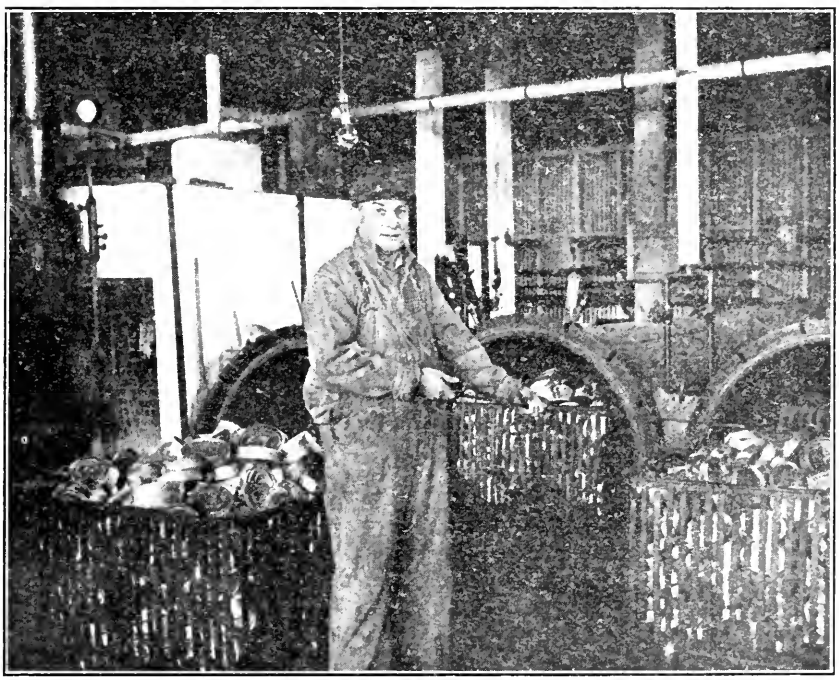

FIG. 84. Processing canned sardines.

temperatures and times are used in this step; however, it is certain that a temperature of 240 degrees Fahrenheit applied for two hours is sufficient. Further, it leaves a margin for safety. The cans are water cooled after processing (or retorting as it is often called).

The high temperature and time used, sterilizes and thoroughly cooks the sardines. Even the bones are made soft and edible.

The cans are next washed in soap solution and allowed to dry. They are then conducted to a room where they go into temporary storage.

Testing. The cans are allowed to remain in temporary storage for about two weeks. At the end of this period each one is examined and those which were not tightly sealed thrown out. These cans are easily

discovered as they have a distorted appearance. They are called "swells." Such condition is brought about by bacteria which enter and act upon the contents. The other cans are then labeled and packed into cases, ready for shipment anywhere.

Preparation of steamed "pound oval" sardines and of other packs.

Steamed "pound oval" sardines are prepared in a manner quite similar to the fried pack. After brining the fish are packed into the cans without drying. Preliminary cooking is accomplished by inverting the filled cans and steaming them. The inverted position permits drainage of the oil and extractives cooking out of the fish. After steaming the same procedure is followed as after frying. This pack can be made more cheaply than the fried one and many people prefer it, too.

"Quarter oil" sardines are prepared and packed in the same way as the fried "pound oval" pack, except for variations in the procedure necessitated by their small size.

Kippered sardines are prepared by placing the fish in chambers where they are treated with hot smoke. This cooks and smokes the fish in the same operation. They are then packed into the cans with or without sauce, sealed, and processed.

FOOD VALUES.

Sardines, like other fish, are excellent food. One could replace all other meats in one's diet by sardines every day in the year and be just as healthy, because they contain as much body-building material and are as readily digested as their more expensive rivals.

A list is given below of important food products having high protein content. The current price of these articles and the food value per pound of each as purchased are included. The food value of the amount of each article which can be purchased for twenty-five cents is given in the last column.

Comparative Costs and Food Values of Some Common Sources of Protein.[1]

Food	Current price	Food value per pound as purchased	Food value purchased for 25 cents
Sirloin steak	35 cents per pound	975 calories	698 calories
Mutton, leg	35 cents per pound	890 calories	636 calories
Ham, fresh	40 cents per pound	1,320 calories	825 calories
Veal, cutlets	30 cents per pound	745 calories	465 calories
Eggs	50 cents per dozen	635 calories	423 calories
Milk, whole	11 cents per quart	310 calories	1,107 calories
Cheese, full cream	30 cents per pound	1 885 calories	1,566 calories
Chicken, broiler	60 cents per pound	289 calories	120 calories
Baked beans, canned	15 cents per 11-ounce can	555 calories	678 calories
Halibut, steak	25 cents per pound	475 calories	475 calories
Salmon, canned	25 cents per No. 1 can	915 calories	858 calories
Tuna, canned	35 cents per No. 1 can	960 calories	643 calories
California sardines, "pound oval," 4 to 7 fat fish per can	25 cents per can	938 calories	880 calories
California sardines, "quarter oil"	20 cents per can	1,101 calories	275 calories

[1]From an unpublished table prepared by Mr. L. D. Elliott of the National Canners' Association Laboratory, San Pedro, California.

Examination of the table shows twenty-five cents to have higher purchasing value for cheese and milk than for "pound oval" sardines. For other articles its purchasing power is lower. "Quarter oil" sardines are even higher in food value per pound than "pound oval" sardines, but they are more expensive. Anyway, they are hardly comparable with the other foods listed as they are classed more as a delicacy than as a staple article of food.

In considering food values it is important to realize that canned sardines are especially high in mineral constituents. Few foods have as high edible content of phosphates and lime as they have. For "pound oval" sardines this value is around two per cent.[1]

[1]From analyses made by the author in the Preservation Laboratory, Fish and Game Commission of California, San Pedro.

INSPECTION IN THE SOUTHERN CALIFORNIA FISH CANNERIES.

NORMAN HENDRICKSON, Director, Southern California Fish Investigations, National Canners' Association.

Four years ago in November the fish canners in southern California entered into an agreement with the National Canners Association by which the canners volunteered to submit to a systematic investigation and to abide by rules and regulations to be provided by the association, the cost to be paid by assessment on the cans at the time of purchase. The original contract was for a period of three years. This has expired and a new one has been executed which terminates December 31, 1922. It seems probable that the inspection service will become a permanent institution but that its functions and methods of operation may be varied from time to time to suit the constantly changing business conditions of the industry. Though lacking the authority of a governmental agency, a private institution of this kind is unhampered by direct responsibility to the public and consequent red tape. It can act quickly in any emergency, and need not be as cautious about offering opinions or advice or risking errors in judgment, as is necessary in a public servant. It should be especially serviceable for trying out new projects which are not sufficiently conservative or safe, or which are too closely allied to private enterprise to be undertaken by any public or semi-public agency.

At the time the inspection was established the sardine and tuna industry was growing very rapidly on account of the stimulus given to food production as a war measure. This was responsible for the erection of a considerable number of new canneries and the operation of some of them by men lacking in experience in the canning of sardines and tuna and unfamiliar with the principles involved. The demand for fish was so keen that the fishermen were having things more or less their own way. Prices were advancing and some canners had become rather careless about the quality of fish accepted for canning.

The scope of the inspection in the beginning included a close supervision of the fish from the arrival of the fishing boats until shipment of the final product, and sometimes even further. Every load of fish on arrival at a cannery was carefully examined and passed upon by a competent inspector before acceptance by the buyer. A number of loads were condemned and diverted to reduction plants at a lesser price than would have been paid had they been accepted for canning. This, of course, led to some wrangling and ill-feeling on the part of a few fishermen and inspectors, but the need for such measures was shortlived and all concerned are apparently agreed that they have been benefited by the resultant improvement in the quality of the pack. Excess supplies of fish at any cannery were diverted, whenever possible, to other canneries where there was a shortage, resulting in a considerable saving of food supply.

A close supervision was maintained over the processes involved in the canning, and over the sanitary conditions of the plants, the workers, and the product. A number of invitations have been issued to canners

to clean up certain parts of their plants and equipment. A considerable number of changes in process have also been recommended. Both of the above have been, in all cases, promptly complied with.

A very complete chemical laboratory has been installed and a competent chemist employed. Samples of oils, sauces, and other materials used in sardine and tuna canning are examined before purchase by the canners. A considerable number of instances of adulteration and poor quality in the supplies have been discovered in time to prevent their use by the canners. The time of the chemist, when not employed in testing materials, is devoted to scientific investigation of questions constantly arising relative to canning or the preparation of by-products.

The authority conferred by the United States Food Administration was of very material assistance in enforcing the regulations at the beginning and very extensive use was made of it. Fortunately, before this authority was withdrawn the need for it had entirely disappeared. Both canners and fishermen took very kindly to the regulations as soon as they became familiar with, and accustomed to them.

The most friendly relations with local, state, and federal officials have been enjoyed at all times and have been a wonderful assistance in attaining the desired results without compromising these officials in any way in their official relations.

For two years samples were examined from the daily pack of each canner and certificates issued to such as met the requirements. This issuing of certificates has now been discontinued, partly on account of the expense involved in safeguarding the use of the certificates, partly because the improvement in the pack as a whole makes it less necessary, and partly because there is danger that the issuers of certificates may become partly responsible for the quality of the product. After very careful consideration, all interested are agreed that the responsibility for a product should rest solely upon the manufacturer.

On the whole those in charge of the inspection feel that they have accomplished fairly well the purpose for which the inspection was started. The canneries as a group are quite modern and though there is considerable room for improvement in many of them the state of California has good reason to be proud of them. The quality of the product, the appearance and sanitary condition of the canneries is unquestionably as good as any in the world.

The California sardines of "quarter-oil" size, that is, those packed in olive oil in the familiar small flat tins, lend themselves to the preparation of a very superior article, equal to, if not superior to the best packs of French sardines. The large "pound oval" size packed in various sauces makes an excellent and cheap article of food.

Constant improvements in the handling and packing of the product are being evolved through the enterprise of the canners and the investigations of the various agencies studying the problems of the industry.

NOTES ON THE SEA LIONS.

By Edwin C. Starks.

The sea lion rookery (breeding place) of Ano Nuevo Island seems to be increasing in size, or perhaps it would be better to say, regaining its former size. Whether this is a local or a general increase in number of the sea lions, I have no means of knowing at this time. Neither do I know whether or not this indicates a temporary condition of the rookery; a maximum number, perhaps, of a fluctuation that may have taken place at periods for years without having been commented upon.

An increase of one rookery need not at all indicate an increase among the sea lions in general. It is supposed that the animals always resort to the same rookery, coming back from year to year at the breeding season. If this be so, it would be reasonable to expect a protected

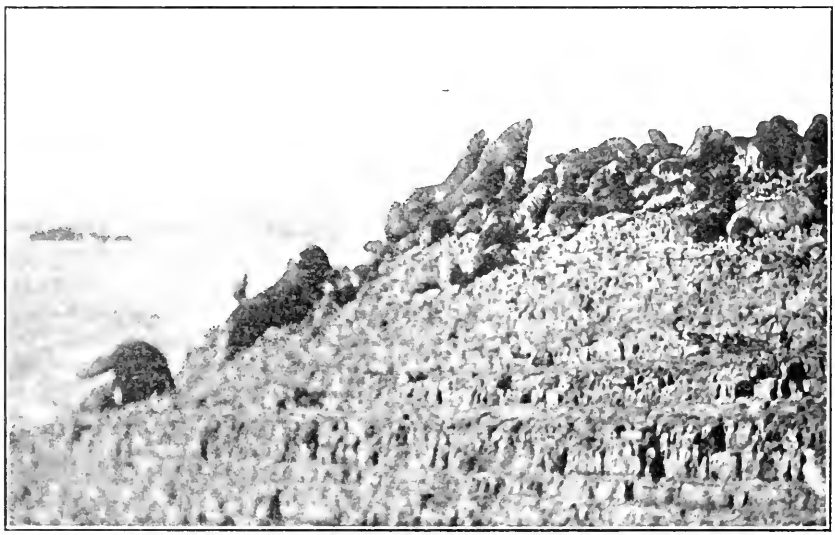

Fig. 85. Ano Nuevo Island rookery, showing cows and pups, Steller's sea lions. Photograph by Edwin C. Starks.

rookery, such as Ano Nuevo is, to increase in size. Certain individuals that bear scars or other marks of identification have been observed to appear at the same rookery year after year.

As further proof of this, and showing what may happen to an unprotected rookery, the conditions of some of the California sea lion rookeries may be cited.* On some of the Santa Barbara Islands several years ago the sea lions, at least the young, were killed for their skins. Sealers landed at the rookeries and clubbed the pups. The most accessible rookeries rapidly grew smaller from year to year, and at last completely ceased to exist as rookeries.

The number of young ('pups') indicate the size of the rookery. Each female ('cow') of breeding age has a single pup each year. Hence

(*Ano Nuevo Island is a rookery of Steller's sea lion.)

each pup on the rookery represents a breeding cow. Each male ('bull') has a 'harem' of from 3 to 18 or 20 cows, or an average, perhaps, of 8 or 10. So by counting the pups on a rookery the size of the rookery may be ascertained with considerable accuracy. This, however, does not take into consideration a more or less indefinite number of individuals not yet breeding ('virgins' and 'bachelors') that are always to be found about the edges of the rookery. But however accurately the number of pups may indicate the entire size of the rookery, they certainly may be used as an accurate index to the fluctuations in size of the rookery. As the pups, until they are a month or six weeks old, do not leave the rookery when the adults are frightened away, they may be counted with considerable ease and exactness.

I spent several days at various times on the Ano Nuevo rookery in the years 1901 and 1902. The rookery was then confined to either one

FIG. 86. Steller's sleeping pups. Adults in the distance. Ano Nuevo Island rookery. Photograph by Edwin C. Starks.

of two outlying rocky islets, known as Flag Rock and Sea Lion Rock, respectively. It was then a rookery of about 150 pups. Stories were current, however, of how in former years the rookery was much larger and not only covered the two outlying rocks, but also a part of the main island.

I recently (June 25, 1921) visited the island and found the latter condition. Both Flag and Sea Lion rocks were occupied and there was a considerable overflow onto the main island. I was informed that the number of pups at the last count (last year) was about 500.

The desirability of thinning out the sea lions is being continually brought up by the fishing interests. Before such a course is thought of, it should be ascertained with great certainty whether the sea lions are increasing or diminishing in number. Even if an increase is found, it should be made certain that it does not indicate a more or less normal fluctuation. If it can be proved that there is a steady increase, the animals may well be kept down to reasonable numbers.

This may most easily be done by killing a predetermined number of the pups on the rookery and carefully watching results. Shooting the

adults from a boat when they are in the water is uncertain, cruel and wasteful. One never knows the percentage of wounded animals, for when shot they usually sink at once. The young nurse for the greater part of the year, so killing a cow usually means the slow starvation of her pup. In killing the pups on the rookeries the skins may be saved.

If nearly any sort of animal were thinned in number, one might naturally suppose that, if there were left a few of each sex of that animal, it would in time increase until it regained its former number. Such does not always appear to be the case. Often when an animal reaches a certain low level in number, it seems unable to recover, but becomes extinct. Hence the question of thinning out the sea lions should be approached with extreme caution. There is an intricate balance maintained between animals that seldom can be disturbed

Fig. 87. Steller's sea lion, after being frightened from the rookery, Ano Nuevo Island. Photograph by Edwin C. Starks.

with impunity. Aside from purely sentimental reasons for wishing to preserve the sea lions on our coast, it may develop in time that they have as much value as many other products of the fisheries.

It may be pointed out in this connection that the cormorants, shearwaters and other sea birds, keep themselves pretty well gorged with fishes. As there are thousands of these birds along the coast, the total number of pounds of fishes per year that they consume must amount to considerable. But no one, I hope, will want to, or be allowed to, kill the sea birds on this account. The leopard seal is surely equally as great a fish eater as the sea lion, as are also the several porpoises. Sharks, too, may well cause much of the damage that the sea lions are blamed for. Lastly, destructive methods and waste in the fisheries may well receive consideration for depleted fisheries.

The sea lions of both species deserve study. A census should be made of the rookeries from year to year. Though the number of pups on the California rookeries indicates the number of sea lions on the coast at the breeding season, it is not at all certain that it indicates the number for all of the year.

Steller's sea lion breeds from the Santa Barbara Islands northward into the Arctic Ocean. The California sea lion breeds from the Santa Barbara Islands southward to some point on the Mexican coast. It is supposed that there is considerable migration among them, but there is no very good direct evidence of this. It may be, for instance, that the animals from Alaska spend a part of the year on the California coast. At any rate it is known that the California sea lion, that does not breed north of the Santa Barbara Islands, migrates at least as far north as the Columbia River.

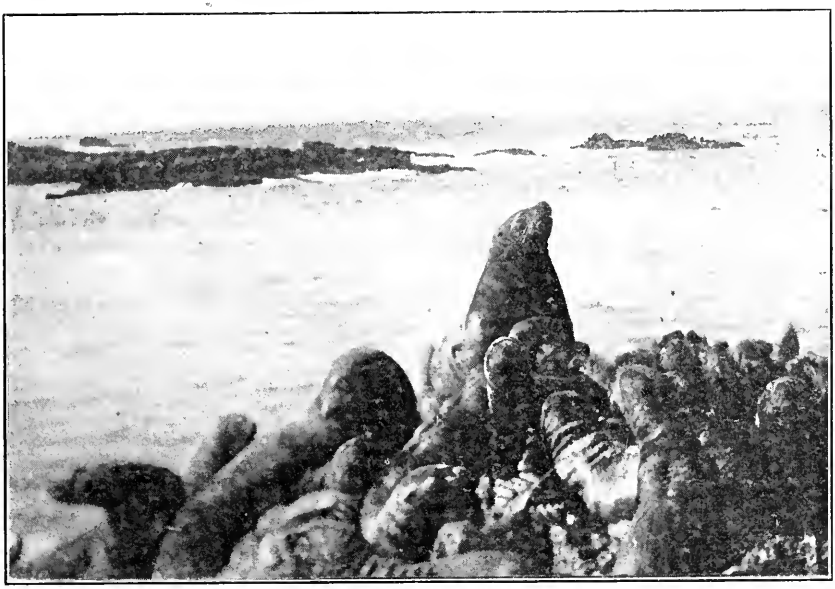

FIG. 88. Steller's cows and pups on Ano Nuevo Island rookery. Photograph by Edwin C. Starks.

The fur seals, that are rather closely related to the sea lions, breed only in the Arctic Ocean, but they migrate southward along our coast, and have been killed in former years on our mainland, and within my own memory on the Santa Barbara Islands. As the sea lions have many of the habits of the fur seals, we may argue that they, too, migrate from the place they were born. We do not know how far north the California sea lion extends its range, nor how far south Steller's sea lion goes.

Though a census of the California rookeries may not show the number of sea lions that may visit the coast, nevertheless such a record should be kept from year to year if only to show the number born on the coast and to preserve important data for future study of the life history of the animals.

Pups should be marked or branded with a distinctive mark for each rookery, and records made of the subsequent movements of such marked individuals. Thus it may be known whether animals born on one rookery ever breed on other rookeries. By this means, also, the extent of migrations could in time be learned. By a system of marks changing from year to year, the approximate breeding age as well as the entire age could be ascertained.

A DISTRIBUTIONAL NOTE ON HALIOTIS.

By S. Stillman Berry.

In his useful paper on "The Abalones of Northern California," in Volume 6 of this journal, Thompson ('20, pp. 45, 50), while recording the northern green abalone (*Haliotis walallensis* Stearns) from Monterey, a station which a small, rather poor specimen in my own collection apparently confirms, is inclined to reject the Alaskan white abalone (*H. kamtschatkana* Jonas) from the California list. However, a small form of it does undoubtedly occur at least as far south as Monterey Bay. Cooper, who states that he picked up a single dead shell on the beach at Monterey, affirmed this half a century ago ('70, p. 61), while another dead shell dredged by me in 15 fathoms, off Monterey, in 1906, was recorded some years ago (Berry, '07, p. 46) as *H. gigantea*, authorities differing then, as they still do, as to whether *kamtschatkana* and *gigantea* are practically separable. Present reexamination of the specimen does not cause me to alter this opinion of its identity.

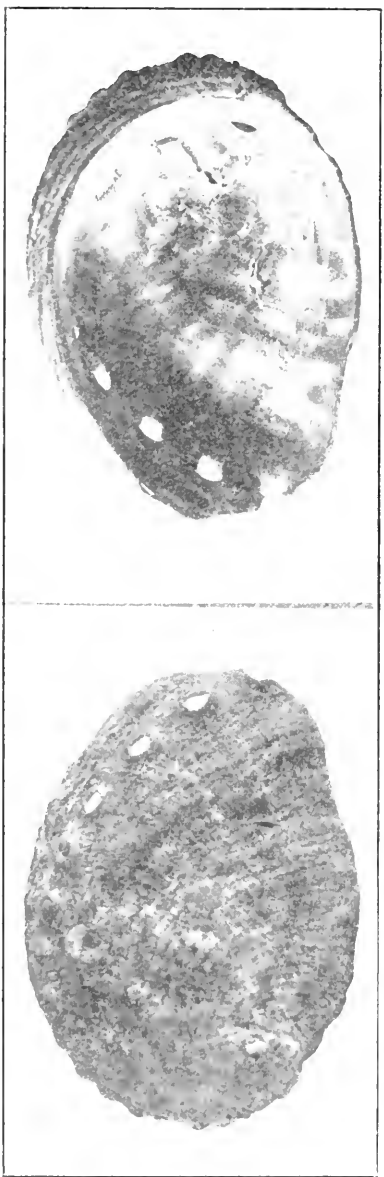

Fig. 89. *Alaskan white abalone* (*Haliotis kamtschatkana* Jonas), from Monterey Bay, California. Natural size. Photographs by S. S. Berry.

On a recent visit to Monterey, Mr. Carl Dolter showed me a small series of dead abalone shells which he had picked up along the sandy shore just north of Del Monte. All proved to belong to this northern species. One of these, which Mr. Dolter kindly gave me, and which is here figured for the sake of completing the valuable series of illustrations given by Thompson, is practically perfect, and measures, length 61.5, width 44.0, height (est.) 17 mm. None of the specimens is in any way commensurate with the ordinary Alaskan examples. *H. kamtschatkana* is far and away the smallest known species of California abalone.

Other authorities to record the Alaskan white abalone from Monterey have been Carpenter ('64, p. 541) and Campbell ('91, pp. 103, 104). Quite recently Dall ('21, p.

184) has recorded *H. kamtschatkana* from as far south as Redondo, but throughout this paper credence is unfortunately given to many poorly authenticated or doubtful extensions of geographic range, so that even where they seem perfectly reasonable, it would be easy to show too much precipitance in copying them until the supporting data can be placed on record.* Incidentally it may well be mentioned that the taxonomic recognition of no less than twelve Californian abalones in this paper is a little misleading to the general reader, for at least two of the subspecies of *H. cracherodii* there recognized are based upon characters which seem certainly pathologic (*holzneri* Hemphill and *imperforata* Dall), while the other two are likewise of extremely uncertain value racially. Eight distinct forms of *Haliotis* is the only safe maximum we can claim at the present time.

H. kamtschatkana has figured but scantily in the literature of our fauna, and although by no means the rarest, is one of the least known of all our species. By all odds the best available account of it is that of Thompson (:14), which concerns itself mainly with the economic aspects of this mollusk in British Columbia. Over much of the western coast of North America it is the only discovered species of abalone.

*Carpenter's record of the species from "near San Pedro" ('64, p. 541) is equally doubtful, but perhaps can never be certainly confirmed or rejected. His record of it from the Farallone Islands (op. cit., p. 651) is probably safer.

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A SELECTED BIBLIOGRAPHY OF CHEMICAL LITERATURE PERTAINING TO THE FISH INDUSTRY.

By Harry R. Beard, Preservation Laboratory, Fish and Game Commission of California, San Pedro, California.

This laboratory's cooperation with the California fishing industry has shown the need of a selected list of recent references for chemists in this industry who have neither the time nor facilities for making an exhaustive search of the literature bearing on their work. The following list was assembled as an endeavor to meet this need and to furnish a foundation for a more complete working bibliography. It is hoped that publication will extend its usefulness. The references cited were selected from a much larger list collected in a search of Chemical Abstracts, U. S. Bureau of Fisheries' publications, reference works and papers on the subject. The attempt was made to cite only a very few articles which appear in standard reference works or which appear in bibliographies given as a part of articles listed here. The publications of the U. S. Bureau of Fisheries have purposely been omitted, except in a few instances. The annual reports of the Commissioner of Fisheries contain a wealth of excellent material, any part of which can now be found easily by consulting the subject index, the title of which is given as the last reference in the list.

Although prepared primarily for technical men, the list will be found to be equally useful to others.

The importance of the foreign references, coupled with the lack of American articles, made their inclusion advisable.

Much credit is due Mr. Harden F. Taylor of the U. S. Bureau of Fisheries, Washington, for his criticisms and additions.

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*The Division of Fishery Products, U. S. Bureau of Fisheries, Washington, issues a series of memoranda on the capture, preservation and utilization of fishery products. These memoranda, copies of which can be obtained upon application, contain a wealth of information. Number 8200 of this series gives the titles of the numbers issued to June 1, 1921.

CALIFORNIA FISH AND GAME

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All material for publication should be sent to **H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.**

December 12, 1921.

A SARDINE NUMBER.

Commercial fisheries in California first came into prominence in early days with the salmon industry, which was the first fishing industry of any importance in the state. Then developed the tuna industry, and in the last few years the sardine industry has come to be recognized as the most important of the fishing industries. These fisheries mean an annual return to the state of many millions of dollars. The total pack of all varieties of fish canned in 1920 was about 1,941,984 cases. In view of the constantly growing value of these industries, and the part played by the Fish and Game Commission in their development, we are issuing this "Sardine Number." The excellent and well illustrated articles on the sardine industry, methods of catching and of canning, and of the various uses for these fish and their by-products, have been prepared by the staff of the State Fisheries Laboratory, and are designed particularly for those readers who are interested in fisheries in general. Nevertheless, they should prove of value to the trade because of statistics which appear in print for

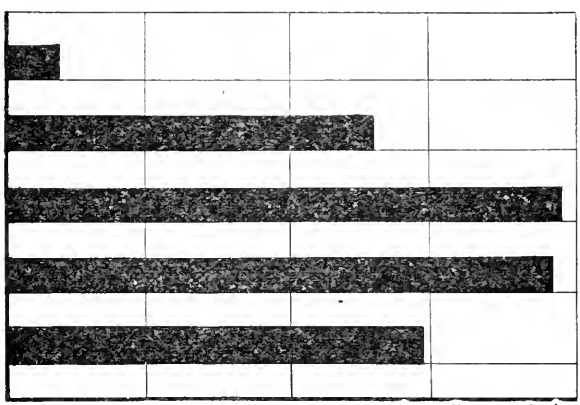

FIG. 90. Chart showing comparison of sardine catch in California, years 1916 to 1920. Prepared by S. H. Dado.

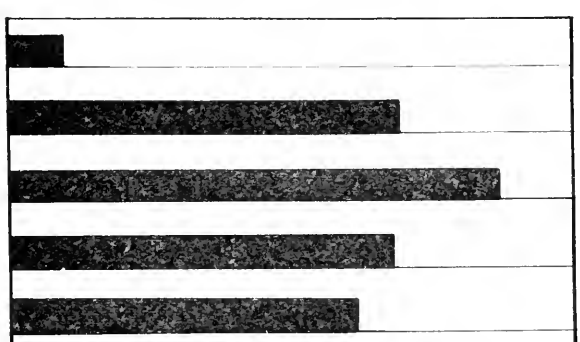

FIG. 91. Chart showing comparison of yearly production of California canned sardines. Prepared by S. H. Dado.

the first time. The accompanying diagrams (Figure 90 and Figure 91) will show the rapid growth of the industry, and the yearly production from 1916 to 1920.

COMPARISON OF SARDINE CATCH.

The United States Bureau of Fisheries has furnished us with a comparison of the output of the sardine fisheries of Maine, Norway, Portugal, and France, together with the relative number and value of the plants, the number of employees, the total quantity of fish caught, and the quantity of sardines caught, the quantity canned, and the value of the sardines. A glance at the following table, covering the year 1919, will show how the output and value of the California industry compares with that of the other countries:

Comparison of the Catch of Sardines for the Year 1919.

	California	Maine	Portugal	France	*Norway
Number of plants	41	[1]52			
Value of plants	$7,708,871	[2]$3,680,218			
Number of employes	8,242	5,457			
Quantities of fish, lbs.	262,260,000	[3]123,940,635			
Quantities of sardines, lbs.	153,880,000			[4]16,388	[5]185,515
Quantities canned, cases	2,071,641	2,426,132	[6]39,264		
Value of sardines	$11,813,156	$843,163	[7]21,329,695	[8]37,085	

*Commercial report, November 21, 1919 for 1916.
[1]Sardine plants.
[2]Sardine.
[3]Herring and sardines.
[4]Metric tons (16,718.83 long tons).
[5]Metric tons (182,575.55 long tons) exported.
[6]Tons.
[7]Escudos.
[8]Francs.

SUMMER RESORT EDUCATIONAL WORK, 1921.

Continued along the same lines as last year, the Yosemite Nature Guide Service reports increased interest on the part of the public and improved service rendered visitors to Yosemite National Park. That the Fish and Game Commission, cooperating with the National Park Service, has taken advantage of the opportunity to teach natural history and fish and game conservation to summer vacationists is evidenced by the following figures: Attendance at the 52 illustrated lectures and campfire talks given totaled 31,545. Attendance on the 105 field trips given totaled 2211. All day field trips numbered five. Innumerable questions were answered during the office hours. Increased interest in the field trips offered is reported, the numbers in attendance on several occasions exceeding fifty. Splendid opportunity of bringing home conservation lessons was afforded on the field trips by first hand study of trout, deer, tree squirrels, grouse, mountain quail, and band-tailed pigeons, as well as the common song birds. That this educational campaign will react favorably on the development of a useful sentiment as regards the conservation of natural resources, appears inevitable.

STATE FAIR EXHIBIT, 1921.

The general consensus of opinion by visitors to the State Fair (September 3–11) was that the Fish and Game Commission's exhibit was "the best thing on the grounds." It was so well advertised by enthusiastic visitors that practically everyone entering the gates saw the display. Three years ago the Commission installed a permanent exhibit consisting of a panorama of the Sierra Nevada showing three of the state's hatcheries in miniature and lighted in such a way as to give the changing colors of sunset, night and sunrise. Pleasing additions were made this year in the form of Mount Lassen in eruption and a small electric train that formed a special attraction to the children. The floor space was nearly doubled by the addition of a well arranged exhibit by the Commercial Fisheries Department. The increase in the fishing industry was graphically shown and fishery products of all kinds from abalones to tuna were on display. Equipment for whale fishing and abalone fishing were particularly enjoyed by the crowds, as

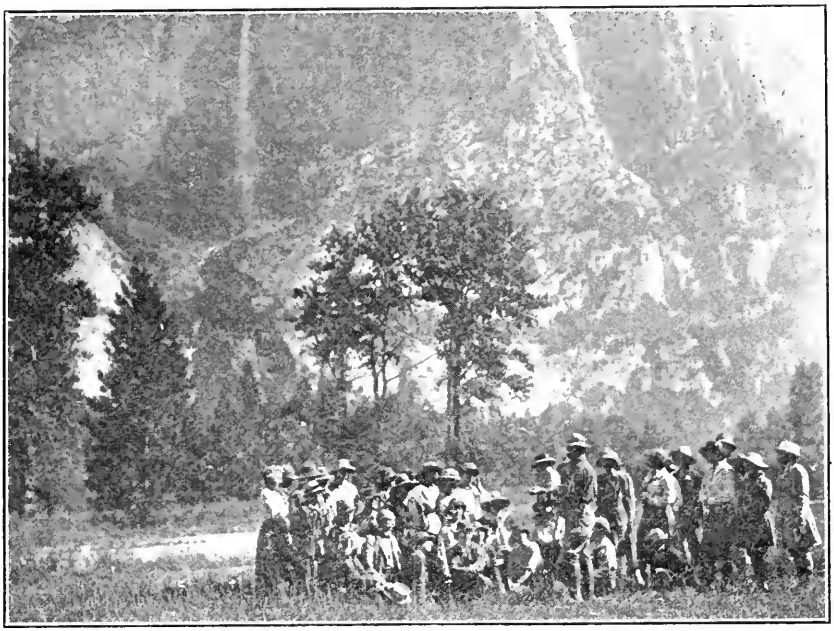

FIG. 92. Field study class in Yosemite, 1921. Nature walks are part of the summer resort educational program of the Fish and Game Commission. Photograph by H. C. Bryant.

were also the materials manufactured from kelp. Educational films shown twice daily attracted large crowds also. Through the medium of this exhibit many thousands of people have become intimately acquainted with the work of the California Fish and Game Commission.

HUNTING ACCIDENTS.

With the opening of the deer season came the usual number of hunting accidents. One San Francisco hunter was critically hurt in Trinity County when a companion mistook him for a deer, a professor at Stanford University was seriously wounded near Redding, and another man met death at the hand of his hunting companion near Gilroy under similar circumstances. Several other accidents of the same kind might be cited. There should be less danger in going hunting than in traversing rattlesnake country, and yet it is quite the reverse. It is very doubtful whether one man a year dies from the bite of a rattlesnake, and yet anywhere from five to fifteen hunters lose their lives annually. The only excuse that a hunter has who kills his companion is "carelessness," if that can be considered an excuse. Certainly it is not a satisfactory excuse! The spiked buck and doe law has been found helpful in decreasing hunting accidents. This is the state's contribution. The thing now needed is the following of the "look before you shoot" motto by the individual hunter.

PUBLIC SHOOTING GROUNDS.

The usurpation of most of the best wildfowl shooting grounds by gun clubs has caused increased demand for public shooting grounds. Although the desirability of such public shooting grounds appears to be admitted by both state and federal officials, the first real attempts to secure them have only recently appeared. Included in the New-Anthony bill is provision for the purchase, or rental, and maintenance of marsh and water areas especially suitable for migratory wild fowl, which shall be used as free public

shooting grounds in the open hunting season and safeguarded as breeding and resting places for these birds in the close season; and second, the administration of the migratory bird treaty act in order more adequately to maintain and increase the supply of migratory birds, including not only the ducks, geese, and others classed as game, but the great host of smaller species which are so vitally essential to the agricultural interests of the country through their unceasing war on injurious insects.

The most needed step at present is the conservation and perpetuation of a sufficient number of small inland lakes, as well as inland and coastal swamp and marsh areas, to provide our migratory wild fowl necessary feeding, resting, and breeding places within the United States. Many of them should at the same time be set aside as public shooting grounds. Under proper conditions many lakes, ponds, swamps, and marsh areas will yield a distinctly larger return than would the same areas drained for agricultural purposes.

Louisiana is one of the first states to adopt the broad policy of protecting its citizens against monopolization of the desirable hunting grounds by exclusive clubs. In the setting aside of the Pass-a-l'Outre Public Shooting Grounds, a tract of 60,000 acres at the mouth of the Mississippi River, the first public shooting grounds have been established. Here the sportsman of moderate means can enjoy all the opportunities for wildfowl shooting enjoyed by wealthy members of the exclusive clubs in that region.

UNNATURAL NATURAL HISTORY.

Much of the misinformation which prevails among the general public can be traced to the false reports published in our prominent newspapers. We sometimes read of the attacks of mountain lions upon people passing their haunts; or of the attacks of eagles or other large birds upon children and grown people. These stories, when traced to their source, are usually found to be entirely without foundation of truth. Nevertheless, the prejudice left in the minds of those reading such stories is leading to the destruction of many of our large birds, which are fast disappearing and yet are a relatively harmless species.

For example, our attention was recently called to the following item, which appeared in the *Oakland Tribune* of June 8, 1921:

EAGLE KILLS BOY WHO CLIMBS TREE TO LOOK AT NEST.
(By Associated Press.)

Ventura, Cal., June 8.—Juan Gonzales, 11, was killed by an eagle on a stock ranch twelve miles north of here last Sunday, it was announced in a report received today. The boy climbed a tree to look at the bird's nest and was attacked before he could escape. His skull was punctured in three places by the bird's beak.

After reading this item, Mr. Emerson A. Stoner, of Benicia, California, undertook an investigation of the story, and received the following letter from Mr. Lewis P. Hathaway, the Coroner and Public Administrator of Ventura County:

Ventura, California,
June 10, 1921.

Mr. Emerson A. Stoner,
Box 444, Benicia, California.

Dear Mr. Stoner: Regarding the story of the horrible work of eagles in Ventura County, will say:

On June 1, a Mexican employed on Rancho Sespe between Fillmore and Santa Paula appeared at the office of Dr. Merrill in Santa Paula with his little son who was ill; had been ill for some time. Dr. Merrill informs me that in taking the "history" of the case, he asked the parent or parents if the lad had suffered injury within the past few weeks. They said the only chance he had had of being injured was when he fell from a tree several weeks ago; blackbirds had flapped about his head when he attempted to interfere with their young, and, frightened, he had fallen a short distance.

Dr. Merrill made an effort to locate bruises or breaks, but it was not until he had bathed the lad and shaved his head for the removal of cooties, that he could determine as to outward appearances; he informs me there were NO bruises and NO "holes in the skull," or even in the scalp, or indications that there had been any.

The illness was then diagnosed as "peritonitis," because, the possibility of outward injury eliminated, this seemed the only result that could be arrived at.

The lad died on June 2, and the death certificate was "peritonitis."

All of these statements were corroborated by my deputy at Santa Paula, Mr. E. A. French, who is an undertaker. It had not occurred either to Dr. B. E. Merrill or undertaker E. C. French that there was necessity (?) for a notification

of the coroner until the newspaper at the county seat published the "eagle story."

A Spanish vaquero heard the blackbird end of the yarn, proceeded to imagine the wounds on the head, and the business manager for the vaquero's employer brought the embellished story to Ventura. it needed further embellishment and a willing newspaper reporter did the rest.

Interesting, isn't it?

The yarn was only a yarn.

Yours very truly,

(Signed) LEWIS P. HATHAWAY
Coroner.

MIGRATORY BIRDS IN LATIN AMERICA.

Dr. Alexander Wetmore, who has recently returned from a year's absence in Argentina, Paraguay, and Uruguay, has collected some valuable material regarding the status of the North American migratory birds in the countries which he visited.

Among the migratory birds which Dr. Wetmore found in South America was the barn swallow. Other species noted were shore birds which were observed in the marshy pampas or on the coastal mud flats: "Some were found to winter well north in the Tropics and others to travel as far south as the Straits of Magellan. Among our game birds seen in Argentina and elsewhere were the golden plover and pectoral sandpiper."—*Weekly News Letter*, United States Dept. Agr., August 3, 1921.

One of the objects of Dr. Wetmore's trip was to secure information regarding the possibility of arranging treaties with the South American countries for protecting migratory birds, similar to the Migratory Bird Treaty Act which the United States has with Great Britain. When we consider what the protection of migratory birds has accomplished in North America, as recognized by both scientists and sportsmen, we feel that it would be a splendid attainment if their protection could be further extended to this southern country.

RAINBOW TROUT ACCLIMATIZED IN AUSTRALIA.

As has been stated before in these pages, the rainbow trout has become well established in New Zealand and also in Australia. We present herewith (see Figure 93) some visible proof in the way of a photograph of a catch of rainbows made on the Deepwater River, New

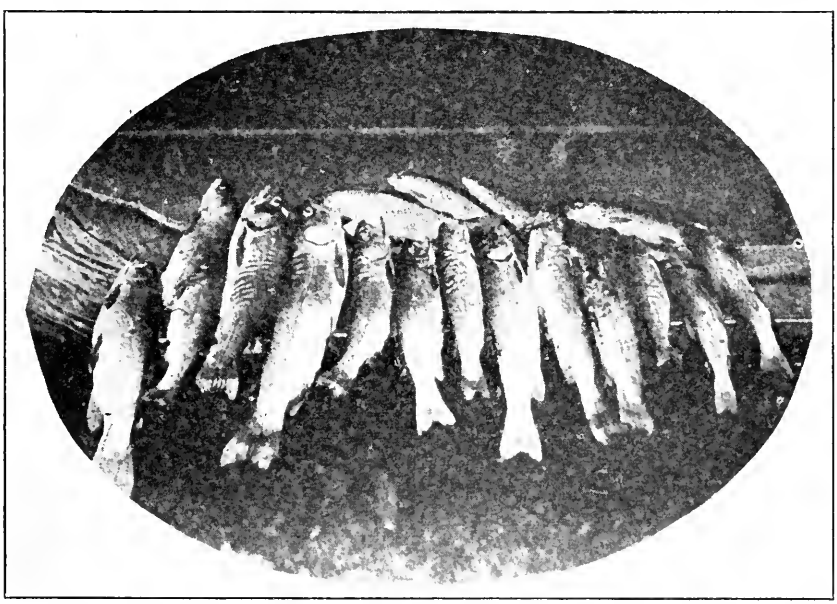

FIG. 93. Catch of Rainbow Trout made on Deepwater River, New South Wales, by Mr. J. S. Bacon. Photograph by J. S. Bacon.

South Wales. Mr. J. S. Bacon, who sends the photograph, states that the fish are doing well and breed successfully.

California's rainbow is now widely distributed over the world from Australia to the Argentine. The golden trout is now in demand and the question is: Shall we let the world have it or keep it a distinctive fish in California?

AUSTRALIA SEEKS INFORMATION ON FISHWAYS.

That Australia is confronting the same problem with reference to migratory fish occasioned by the development of irrigation systems that California successfully solved several years ago, is evidenced by the following letter received from Hon. F. Lewis, Chief Inspector of Fisheries and Game, Melbourne, Australia:

> From the frequent perusal of your splendid journal, "California Fish and Game," I note that the provision of fishways or ladders is compulsory in your state. Many large dams and weirs have been erected on our water courses during the last few years with a view to conserving water for irrigation purposes, and this work will probably extend very considerably in the near future.
>
> So far no fishways or passes have been erected on any of these weirs, although many of the streams are stocked with both brown and rainbow trout. In addition there are large numbers of native fish, mostly members of the perch family, in these waters. As it is very desirable to allow facilities for the natural movements of the fish, I shall be grateful if you can let me have full particulars of the law in operation in your state relating to the erection of fishways or ladders. I should also like to have any plans or photographs available of such works.
>
> Are the fish ladders only erected on streams where trout are found, or must they be placed on all waters irrespective of the class of fish contained therein?

Full details regarding legislation, construction and maintenance of fishways have been sent the Australian official.

NEW BIRD LAW PROHIBITS GUIDES FROM MAKING KILL.

A tendency to tighten the restrictions on the hunting of birds and big game is noted in the game laws for 1921, a summary of which, both federal and state, has been compiled by the Biological Survey of the United States Department of Agriculture, and published as Farmers' Bulletin 1235. Among the notable changes made during the present year was the amending of the Migratory Bird Treaty Act regulations with respect to bag limits.

This amendment provides that the daily bag limit of any person shall now include "all birds taken by any other person who for hire accompanies or assists him in taking migratory birds." This will put an end to the abuse of privileges under the regulations regarding the prescribed daily bag limits by persons who claim that birds were killed by guides accompanying them.

The federal waterfowl season for California was fixed from October 1 to January 15, replacing the old season of October 16 to January 31, the season now being the same under both federal and state laws. Regulation 9, governing the issuance of federal scientific permits, was amended to permit the issuance of limited and special permits.

State legislation harmonized federal and state laws on waterfowl and shore birds in Kansas and Oregon, and on waterfowl in Pennsylvania and Rhode Island; Washington prescribed a statewide open season on all migratory game birds from October 1 to January 15, thus deviating from the federal regulations, which supersede the state law, east of the Cascade Mountains, where it will now be possible to hunt migratory game birds only from October 1 to December 31, without violating either federal or state law; in Idaho the open season on migratory game birds has been shortened under state law two weeks by opening October 1, instead of September 16, and extending to December 31.

Idaho, Kansas, Montana, Nebraska, Oregon, and Washington enacted legislation similar to the federal regulation prohibiting hunting from airplanes. Colorado reduced the bag limit on ducks from 20 to 15 a day, while Kansas increased the limit from 20 to 25. In New Jersey reedbirds were protected at all times by being placed in the nongame class. The open season for woodcock was shortened 25 days in Michigan, two weeks in New York, and one month in Vermont. Doves were protected until

1924 in Colorado, and in Kansas an open season on them was provided from September 1 to October 15.

In general, seasons on big game were shortened and hunting further restricted. Buck laws were enacted in Michigan, Montana, Nevada, North Dakota, South Dakota, Vermont, and in Washington east of the Cascades. Maine protected spike bucks and prescribed that one of the two deer allowed in the eight northern counties must be an antlered buck, and provided that in two of the counties only residents may hunt deer during the last two weeks of the open season. Bull moose were protected for five years in Maine.

The summary of the laws contains the provisions relating to seasons, licenses, limits, possession, sale, and export, thereby furnishing the reader a brief and convenient synopsis of the laws of each state, territory, or province of Canada. The migratory bird treaty, the treaty act, and regulations, as well as the Canadian regulations also are appended. Copies of the bulletin, Game Laws for 1921, may be had free upon application to the United States Department of Agriculture, Washington, D. C.

WIRE HALTS BEAVER.

A barbed wire entanglement which will keep beavers from destroying property and constructing dams has been tried out by the state fish and game authorities at the A. M. Kischir ranch in the Shields valley with so much success that it is believed that it will no longer be necessary to grant any considerable number of permits to kill beaver in Montana.—*Billings Gazette*, July 15, 1921, Montana.

A SEA ELEPHANT NEAR SAN CLEMENTE.

The issue of *The Catalina Islander* of September 20, 1921, records the occurrence of a sea elephant between San Clemente and Catalina Islands on September 10, by Captain Hugh MacKay, Mr. Mankowsky and party in the launch Manana. Two interesting photographs are shown.

FACTS OF CURRENT INTEREST.

The Fishcultural Department reports that the past year has been a most successful one. Of trout fry alone there were reared and planted nearly 25,000,000.

An old violator was caught with 28 ducks during the early part of September, by Deputy Carpenter. A stiff jail sentence followed.

The Sacramento office has made several Greeks and other aliens put a higher valuation on citizenship by haling them into court on their failure to produce citizenship papers, although carrying resident hunting and fishing licenses.

The Fish and Game Commission's exhibit at the State Fair, during the first week in September, attracted wide interest. The usual display of golden trout was made, no difficulty being found in keeping these beautiful fish on display.

During the summer more than 31,000 persons heard lectures and campfire talks on wild life and its conservation in Yosemite National Park and more than 2000 availed themselves of the opportunity to go afield under a nature guide.

The kelp industry, which grew to importance during the war, is now a memory, all the plants having closed down.

NOTES FROM THE STATE FISHERIES LABORATORY.

WILL F. THOMPSON, Editor.

THE NEW LABORATORY.

This month, September, sees the practical completion of the new laboratory, regarding which an article appeared in the last issue of this magazine. It promises to exceed all our expectations in beauty and convenience, although not too large for efficiency. It is fully expected that the middle of October will see us installed in our new quarters.

THE ALBACORE SEASON.

The albacore season has been unexpectedly successful, there having been taken, according to recent estimates, nearly eight thousand tons. Considering the lateness of the start, which was due to difficulties over price, the catch has been relatively successful. The season has been characterized by a remarkably late run at the Coronado Islands.

At the present writing considerable numbers of yellow-finned tuna and skipjack have appeared. Also numbers of the smallest year group of albacore have been taken, as was the case last year. But no frigate mackerel, dolphins or other unusual fish have come into the wharf as yet. And above all, the blue-fin tuna have been noteworthy for their absence, where in previous years so many have been taken.

THE LABORATORY STAFF.

During the past three months Mr. Sette and Mr. Holmes have both been at San Pedro, but leave September 26 for Monterey, whence they go to Stanford University on the twenty-ninth for the fall term there.

Dr. Tage Skogsberg has been employed to take Mr. Holmes' place during the coming year. Dr. Skogsberg is a graduate of Upsala University, Sweden, and came to this country in order to pursue his studies on ostracods. After residence for some time at Hopkins Marine Station, at Pacific Grove, he sought permanent employment in this country, rather than to return to Sweden. The Commission was grad to obtain him, as men of his qualifications are hard to obtain.

In the place of Miss Helen Edwards, now Mrs. Bacon, whose marriage was chronicled in the last issue of this magazine, we have been fortunate in securing Miss Frances N. Clark. Miss Clark is a graduate of the Zoology Department of Stanford University and has had much experience in assisting Dr. C. H. Gilbert and others in their work on the salmon. She will have charge of the library work in the new laboratory, as well as assisting Mr. Thompson.

Mr. W. L. Scofield has been stationed at Monterey, as previously, carrying on the sardine investigations there.

Mr. Thompson and Mr. Higgins are at San Pedro in anticipation of the opening of the new laboratory. They attended the meeting of the American Association for the Advancement of Science, with which the Pacific Fisheries Society is affiliated, and Mr. Thompson read a paper on his albacore work.

THE SURF-SMELT, HYPOMESUS.

On June 28, Mr. Thompson visited Halfmoon Bay with Mr. Scofield and Mr. Dado, in order to study the run of the surf-smelt, *Hypomesus*. Unfortunately no smelt ran and inquiry was restricted to conversations with experienced fishermen and observation of the beaches on which they are said to run.

It is clear, however, that there are no grounds as yet for supposing that the species spawns on the beach, or even that it spawns in the surf. It is said to be found at irregular times, and sometimes on one beach, sometimes on another. The fishermen with whom we talked could not foretell in any way when a run would occur, and the fish were supposed to appear any time between April and September. The fact that they were usually taken on a beach with a net did not, of course, prove their absence on rocky shores.

The fishermen said anchovies were sometimes taken the same way, at night.

THE LIBRARY.

The California State Fisheries Laboratory has recently acquired the following complete sets:

Journal of the Marine Biological Association of the United Kingdom.

Report of the Lancashire Sea Fisheries Laboratory of the University of Liverpool.

Report of the Liverpool Marine Biological Committee.

Memoirs of the Liverpool Marine Biological Committee.

Transactions of the Liverpool Biological Society.

Meddelelser fra Kommission for Havundersogelser. Series: Fiskeri, Hydrografi and Plankton.

International Revue der gesamten Hydrobiologie and Hydrographie.

Norsk Fiskeritidende.

The Sea Fisheries. J. Travis Jenkins.

Publications of the Conseil Permament International pour l'Exploration de la Mer.

A NOTEWORTHY BOOK.

The library is recently in receipt of a volume, "The Sea Fisheries," by Dr. J. T. Jenkins. It describes the fisheries of England, their administration, methods and scientific investigations in as comprehensive a manner as possible within a good sized volume. It is carefully compiled, in a scholarly fashion, and the content is not marred by unduly emphasized viewpoints. The fact of depletion is stated with proper emphasis, and without distortion of evidence.

In only one particular does the author disappoint to a serious extent, and that is in his avoidance of critical treatment of research work, particularly other than England.

The book is decidedly necessary to any fisheries library, however limited in

scope, and may be obtained from the author, 16 Walton's Parade, Preston, England, at 24 shillings net, postage 1 shilling.

RARE FISH TAKEN AT SAN PEDRO.

During the past summer a brief inquiry into the usage of common names of the commercial fishes at San Pedro was started to aid in the proper interpretation of the statistical returns of the fishery. This entailed regular trips to the markets by the members of the laboratory staff and a close scrutiny of all doubtful species. In this way ninety-three separate species in the commercial catch have been recognized and their common names noted. A few of these being rare in this locality are worthy of mention.

Among surf-perches (Embiotocidae), few of which are distinguished by the dealers except as "white-, black-, and blue-perch," were several species of especial interest. *Phanerodon atripes*, which to our knowledge has never been recorded south of Monterey since Eigenmann's specimen from Cortez Bank, was represented in our collection by one specimen. *Rhacochilus toxotes*, said to be rare in this locality, was seen by us rather commonly. *Damalichthys argyrosomus*, though common northward, was found occasionally in June and September.

Of the forty species of rockfish or "rock cod" (*Sebastodes* sp.) taken on the California coast, twenty-eight have appeared in the San Pedro markets during June and July. Only two of these species occurring most commonly have well known common names, the bocaccio (*S. paucispinis*) and the chilipepper (*S. goodei*). Many fishermen distinguish between the different species, using names of their own invention, but there is little uniformity among them. Thus, *S. miniatus*, one of the most abundant species, is often called "red rock cod" and sometimes "salmon grouper," although the latter is also applied to *S. goodei*. *S. levis* is called "Harry Olesen" by some, and *S. chlorostictus* is the "chucklehead." The three small, dark-colored species, *S. atrovirens*, *S. serranoides*, and *S. rastrelliger* are frequently confused with the rock bass and included with them in the markets. All the other species are lumped together as "rock cod," by the fishermen, and this practice is extended by the marketmen to include all the rockfish.

The rarer species encountered during the summer are here listed. Two specimens of *Sebastodes cos* were taken at San Clemente I. in June, and several have since been seen in the markets. This species was reported by Eigenmann in 1892 as abundant at times at San Diego, but it has rarely been seen by naturalists since that time.

Two specimens of *Sebastodes gilli* also were taken in July. The occurrence of this species has not been recorded since the original record by Eigenmann in 1891, and it is known only from the types taken at Point Loma.

A specimen of *Sebastodes introniger*, another rare species, was taken at San Nicolas I. during June in eighty fathoms of water. It is one of the deeper water rockfishes and the few specimens known have been taken in Alaska in from 85 to 350 fathoms, on the coast of Washington, and in southern California waters in depths from 178 to 369 fathoms.

Sebastodes ovalis, another rockfish formerly supposed to be quite rare, has occurred in small numbers in the markets on several occasions during the summer. —E. H. and O. E. S.

REPORTS.

VIOLATIONS OF FISH AND GAME LAWS.

April 1, 1921, to June 30, 1921.

Offense	Number of arrests	Fines imposed
Game.		
Hunting without license	6	$95 00
Ducks (wild)—closed season—possession or hunting	3	25 00
Deer meat—closed season—possession	13	400 00
Deer—closed season—killing	4	160 00
Birds (non-game)—possession	2	75 00
Doe—closed season—killing	2	125 00
Pigeons—closed season—killing or possession	3	50 00
Quail—closed season—possession or killing	3	10 00
Geese (wild)—closed season—possession	3	25 00
Bear—closed season—killing	1	
Beaver hide—possession	1	25 00
Doves—closed season—killing or possession	5	175 00
Brush rabbits—closed season—killing	2	75 00
Cottontail—closed season—possession or killing	2	60 00
Spike buck—killing	1	100 00
Cub bear—taking	1	10 00
Discharging oil in San Francisco Bay	1	200 00
Making false statement on application	1	25 00
Failure to produce license on demand	1	25 00
Total game violations	55	$1,630 00
Fish.		
Angling without license	23	$470 00
Striped bass—undersized, offering for sale underweight, shipping undersized, possession or excess limit	22	580 00
Black bass—closed season—possession, undersized or spearing	11	175 00
Crabs—undersized, possession	5	100 00
Crab meat—detached from shell	1	100 00
Abalones—undersized, possession—closed season	38	1,535 00
Abalones—failure to bring to shore attached to shell	1	25 00
Clams—excess limit—undersized—possession	12	290 00
Trout—excess limit—selling—taking in closed season	8	240 00
Catfish—selling undersized—retaining undersized in live cars	3	60 00
Perch—closed season—possession	2	
Sturgeon—possession	1	20 00
Lobsters—undersized, possession—closed season	3	65 00
Halibut—undersized—selling	1	25 00
Fishing within 250 feet of fishway	7	175 00
Fishing for profit without license	9	100 00
Fishing for profit excess limit	1	25 00
Fish trap, using	1	
Trawl net, using in District 9	2	200 00
Dragging inside three-mile limit	1	100 00
Illegal net in restricted district	4	300 00
Saturday-Sunday fishing	2	40 00
Taking fish without hook or line	1	25 00
Total fish violations	159	$4 650 00
Grand total fish and game violations	208	$6,310 00

CALIFORNIA FRESH FISHERY PRODUCTS FOR MONTHS OF APRIL, MAY AND JUNE, 1921.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Tehama, Colusa, Glenn, Butte	Contra Costa, Alameda	San Francisco, Alameda	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Imperial	Total	Mexican, brought into California
Albacore												2,177		667		2,844	
Anchovies								57,420		489,192		6,668		228,764		781,444	
Barracuda											13,815	2,054,474	14,603	650,292		2,733,184	35 355
Bluefish									494	10,678						11,172	
Boccaccio		125						11,942	11,904	193,168						217,139	
Bonito											45	6,323	27	6,718		13,113	555
Carp			67	2,647			9,070	5,904								17,688	
Catfish		3,353		3,754	699		10,005									17,811	
Chilipepper					18,018				883							18,901	
Cultus Cod	3,209	1,293						17,301	10,267	22,482						54,552	
Dolphin																	
Eels																	
Flounders	41		56	183			4,519	70,258	10,925	431	906	1,136				88,578	
Grayfish							507	1,500				2,450	250	183,140		187,847	
Greenfish																	
Hake								22,838	488							23,326	
Halibut	11,940	2,132						3,792	538	2,990	108,926	541,365	58,071	179,818		909,572	112 661
Hardhead				32												32	
Herring			4,925								269					5,194	
Kingfish								1,245	14 995	36,057	55	81,258	534	1,031		135,175	425
Mackerel									957	20,117	2,630	449,266	8,507	130,556		612,043	1,953
Marlin																	
Mullet												301		8,574		8,875	
Perch	1,738		8,495				311	8,876	2,024	9,521	18	25,395	679	337		57,394	
Pike				736	123	27	907									1,793	
Pompano									17	138	108	4,549	52	110		4,974	
Rock Bass												51,182	13,193	58,435		123,110	1,795
Rockfish	13,628	2,248	110					55,872	21,312	61,576	17,484	198,274	5,066	112,023		487,673	12,987
Sablefish								62,196	280,213	3,541						445,950	
Salmon	42,085	995,562	497	187,537	821 868	108,439	289,025	127,618	371 753	689,084						3,025,278	
Sandabs								197,814	13,000	2 124		2,389	13			215,340	
Sardines			138					750	100	1,013,484		6,031,195		155,030		7,200,697	
Sculpin												18,635		4,836		23,471	
Sea Bass—Black											378	9,336	553	11,733		22,000	1,707
Sea Bass—White									22	23	3,427	974,202	1,870	125,739		1,105,283	10,449
Sea Trout												29	833	700		1,562	
Shad				2 109	473		6,157	16,496								25,232	
Shad—Buck				37,153	23,331		152,306									212,790	
Shad—Roe				71,094	25,919		443.125									540,138	
Sheepshead											89	1,631	67	7,496		9,283	

Skates					43,143			8,735				260	358			52,529		
Skipjack																		
Smelt	19,998		3,005				5,156	38,479	11,856	8,689	27,806	28,731	174	3,007		146,901	240	
Sole	76							761,762	111,028	22,275	8,251	16,926	596			920,914		
Splittail				46			140									186		
Striped Bass			1,332	30,028		48	76,179	48,931								156,548		
Stingaree														6,795		6,795		
Suckers																		
Surf Fish																		
Swordfish												332				332		
Tomcod								6,490								6,490		
Trout—Farm																		
Trout—Steelhead																		
Tuna												72,157		54,201		126,358	42,991	
Tuna—Bluefin												87,128				87,128	59,835	
Tuna—Yellowfin												4,205				4,205	5,558	
Turbot			73													73		
Whitebait			708					308								1,016		
Whitefish											120	1,848		752		2,720		
Yellowtail												241,918	34	83,484		325,436	7,769	
Miscellaneous		1,390					176	5,744	6,109	74,821	3,249	11,725	816			101,030		
Croakers												10,223				10,223		
Total fish	92,715	1,006,209	19,316	335,319	233,574	108,514	998,483	1,532,311	968,895	2,651,424	187,666	10,937,388	106,296	2,014,238		21,292,342	324,279	
Crustaceans:																		
Crabs (doz.)	1,388	86	27					5,277	15	1						6,794		
Ferevisse (doz.)																		
Shrimps								214,232		1,006		25				215,263		
Spiny Lobsters																	318,456	
Mollusks:																		
Abalones	3,398		405							409,342	8,212					421,377		
Clams—Cockle	320	415	1,997									83				2,815		
Clams—Mixed	3,070		13,762								46					16,878		
Clams—Pismo											73,637					73,637		
Clams—Softshell	154	4,371	125					13,771								18,421		
Cuttlefish			23					1,899	1,785	9,632		19				13,358		
Limpets																		
Mussels										60						60		
Oysters—Eastern (No.)			621,010															
Oysters—Native			6,540							985						621,995		
Snails																6,540		
Squid										116,398		26,759		86,482		229,639		
Miscellaneous:																		
Frogs (doz.)																		
Terrapins (doz.)		5														5		
Turtles																	1,690	
Scallops											735					735		

All amounts shown in pounds unless otherwise specified.

SEIZURES.

Fish and Game and Illegally Used Fishing Apparatus.

Game.

Ducks	6
Deer meat	158 lbs.
Blue cranes 11	90 lbs.
Rabbits	13
Pigeons	7
Geese (wild)	5
Beaver hides	2
Doves	6
Quail	3

Fish.

Striped bass	1420 lbs.
Striped bass	12
Black bass	4 lbs.
Black bass	4
Clams (Pismo)	1871
Clams (cockle)	284½ lbs.
Lobsters	19
Lobsters	91½ lbs.
Sole	18 lbs.
Crabs	295
Crab meat	8 lbs.
Abalones	333
Abalones (black)	15
Trout	413
Trout	2½ lbs.
Perch	4 lbs.
Catfish	35 lbs.
Barracuda	2720 lbs.
Halibut	365 lbs.
Sturgeon	18 lbs.
Shad	1
Carp	1
Illegal nets	3

FISH AND GAME COMMISSION.

Statement of Expenditures for the Period from July 1, 1920, to June 30, 1921.

Administration:		
Commissioners	$1,115 49	
Executive offices	26,443 43	
Printing	8,073 62	
Research and publicity	6,073 62	
Accident and death claims	1,754 69	
		$43,460 85
Commercial fish culture and conservation:		
Superintendence	$15,731 18	
Inspection and patrol	31,488 15	
Research	31,237 88	
Statistics	10,269 64	
Market fishermen's license commissions	535 50	
Propagation and distribution of salmon	26,164 92	
		115,447 27
Sporting fish culture and conservation:		
Superintendence	$15,058 43	
Printing	299 54	
Prosecutions and allowances	496 15	
Angling license commissions	16 879 50	
Fish exhibits	4,323 19	
General patrol (pro rata share)—		
San Francisco District (10 per cent)	39,296 85	
Los Angeles District (40 per cent)	16 961 60	
Sacramento District (40 per cent)	28,774 32	
Propagation and distribution of trout	150,405 57	
		272,515 15
Game conservation:		
Printing	$461 13	
Prosecutions and allowances	1,057 45	
Hunting license commissions	24,605 60	
Mountain lion hunting (and bounties)	8,489 98	
General patrol (pro rata share)—		
San Francisco District (60 per cent)	58,713 22	
Los Angeles District (60 per cent)	25,370 87	
Sacramento District (60 per cent)	43,158 88	
		161,856 63
Tahoe camping ground		684 04
Total		$593,963 94

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CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 7 Sacramento, January, 1921 Number 1

SALMON NUMBER

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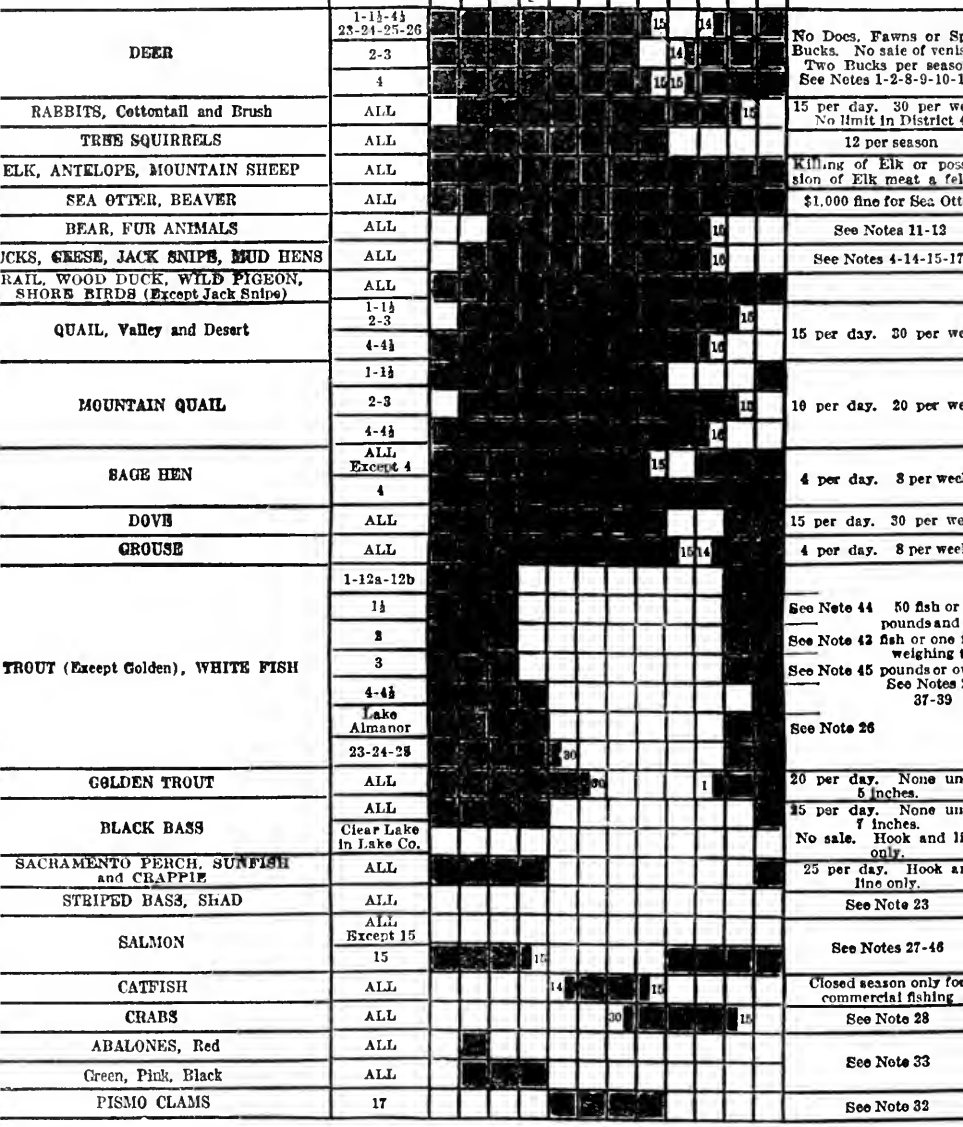
1919 ABSTRACT CALIFORNIA FISH AND GAME LAWS 1920

WHITE SQUARES INDICATE OPEN SEASON

NUMBERS IN SQUARES ARE OPEN DATES



HUNTING LICENSES

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TRAPPING LICENSES

License Year from July 1 to June 30

CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 7 Sacramento, April, 1921 Number 2

HISTORY NUMBER

BOARD OF FISH AND GAME COMMISSIONERS.

Commissioners appointed by the Governor, by and with the consent of the Senate. Term at pleasure of Governor. No compensation.

F. M. NEWBERT, President.....Sacramento
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E. L. BOSQUI, Commissioner.....San Francisco

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J. S. HUNTER, Assistant Executive Officer.....San Francisco
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G. McCLOUD, JR., Superintendent Mount Whitney Hatchery and Cottonwood Lakes Station.....Independence
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GUY TABLER, Assistant in Charge Wawona Hatchery.....Wawona
C. F. PIERSON, Assistant in Charge Brookdale Hatchery.....Brookdale
J. W. RICKER, Foreman in Charge Almanor, Domingo Springs and Clear Creek Hatcheries.....Greenville
G. McCLOUD, SR., Foreman in Charge Cottonwood Creek Station.....Hornbrook

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E. H. Ober—Big Pine
H. I. Pritchard—Los Angeles
Webb Toms —San Diego

1919 ABSTRACT CALIFORNIA FISH AND GAME LAWS 1920

WHITE SQUARES INDICATE OPEN SEASON

NUMBERS IN SQUARES ARE OPEN DATES

	DISTRICTS	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	BAG LIMITS, ETC.
DEER	1-1½-4½ 23-24-25-26								15		24			No Does, Fawns or Spik Bucks. No sale of venison Two Bucks per season. See Notes 1-2-8-9-10-14
	2-3									14				
	4								15	15				
RABBITS, Cottontail and Brush	ALL											15		15 per day. 30 per week No Limit in District 4
TREE SQUIRRELS	ALL													12 per season
ELK, ANTELOPE, MOUNTAIN SHEEP	ALL													Killing of Elk or posses sion of Elk meat a felony
SEA OTTER, BEAVER	ALL													$1,000 fine for Sea Otter
BEAR, FUR ANIMALS	ALL										16			See Notes 11-12
RAILS, GEESE, JACK SNIPE, MUD HENS	ALL										16			See Notes 4-14-15-17
DUCKS, WOOD DUCK, WILD PIGEON, SHORE BIRDS (Except Jack Snipe)	ALL													
QUAIL, Valley and Desert	1-1½ 2-3											15		15 per day. 30 per week
	4-4½										16			
MOUNTAIN QUAIL	1-1½													10 per day. 20 per week
	2-3											15		
	4-4½										16			
SAGE HEN	ALL Except 4								15					4 per day. 8 per week.
	4													
DOVE	ALL													15 per day. 30 per week.
GROUSE	ALL									16	14			4 per day. 8 per week.
TROUT (Except Golden), WHITE FISH	1-12a-12b													
	1½													See Note 44 50 fish or ten pounds and one
	2													See Note 43 fish or one fish weighing ten
	3													See Note 45 pounds or over. See Notes 24-37-39
	4-4½													
	Lake Almanor													See Note 26
	23-24-25					30								
GOLDEN TROUT	ALL						30				1			20 per day. None under 5 inches.
BLACK BASS	ALL													25 per day. None under 7 inches.
	Clear Lake in Lake Co.													No sale. Hook and line only.
SACRAMENTO PERCH, SUNFISH and CRAPPIE	ALL													25 per day. Hook and line only.
STRIPED BASS, SHAD	ALL													See Note 23
SALMON	ALL Except 15													See Notes 27-46
	15				15									
CATFISH	ALL					14			15					Closed season only for commercial fishing
CRABS	ALL							30				15		See Note 23
ABALONES, Red	ALL													See Note 33
Green, Pink, Black	ALL													
PISMO CLAMS	17													See Note 32

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CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 7 Sacramento, July, 1921 Number 3

HAWK NUMBER

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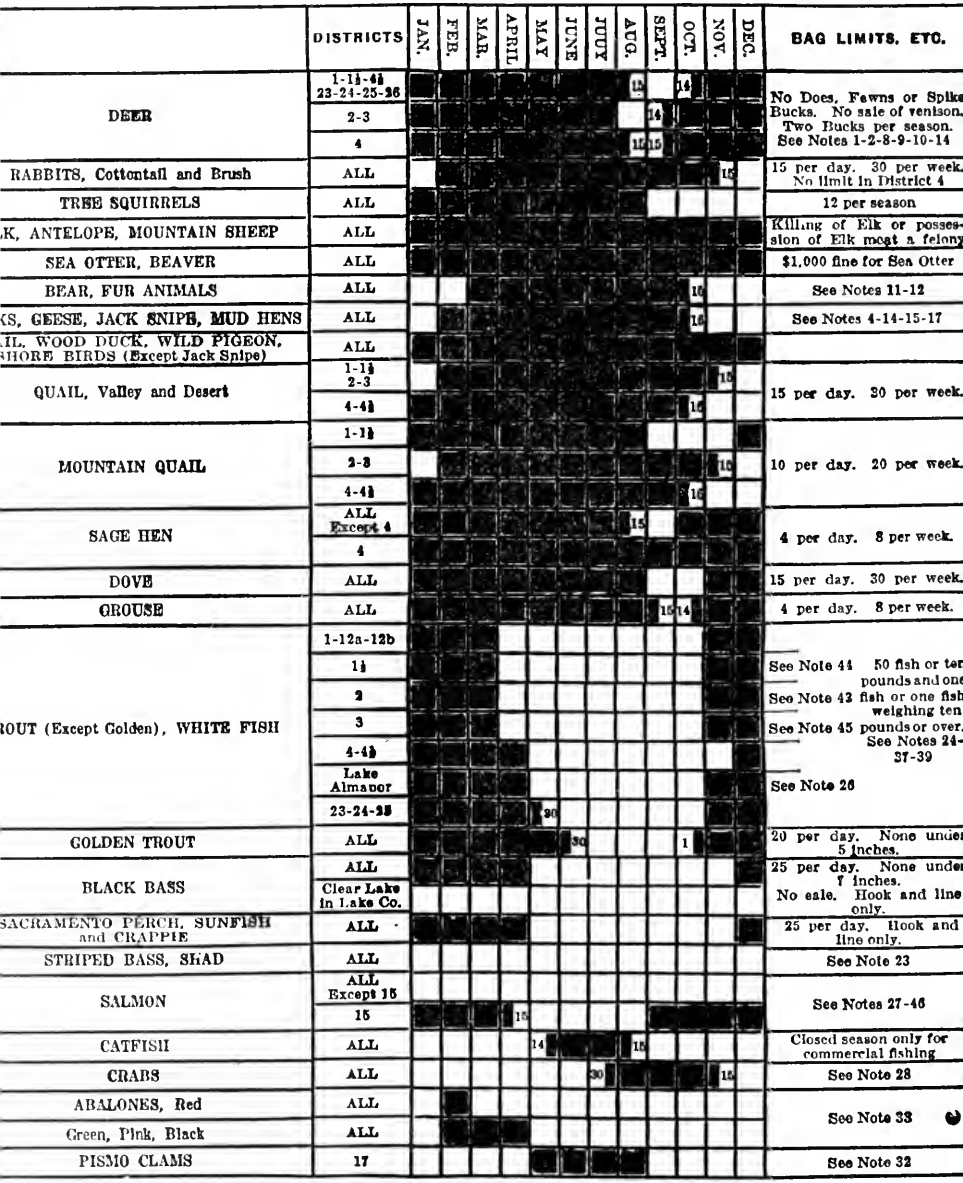

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NEW LAWS TO GO INTO EFFECT JULY 28, 1921.

CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 7 Sacramento, October, 1921 Number 4

SARDINE NUMBER

BOARD OF FISH AND GAME COMMISSIONERS.

Commissioners appointed by the Governor, by and with the consent of the Senate. Term at pleasure of Governor. No compensation.

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1921 ABSTRACT SPORTING FISH AND GAME LAWS 1923

OPEN SEASON INCLUDES BOTH DATES GIVEN

SPECIES	DISTRICT	OPEN SEASON	BAG LIMITS, POSSESSION LIMITS, ETC.
DEER	1-1½-4½ 23-24-25-26	Sept. 1-Oct. 15	Two Bucks per season. No Does, Fawns, or Spike Bucks. No sale of venison or skins.
	2-2½-3	Aug. 1-Sept. 14	
	4	Sept. 16-Oct. 15	
RABBITS (Cottontail and Bush)	ALL	Nov. 1-Jan. 15	15 per day. 30 per week.
TREE SQUIRRELS	ALL	Sept. 1-Dec. 31	12 per season.
ELK, ANTELOPE, MOUNTAIN SHEEP	ALL	No Open Season	Killing Elk a felony.
SEA OTTER, BEAVER	ALL	No Open Season	$1,000 fine for Sea Otter.
BEAR, FUR ANIMALS	ALL	Oct. 15-Feb. 28	
DUCKS, GEESE, JACKSNIPE, MUD HENS	ALL	Oct. 1-Jan. 15	25 per day, except Geese. 8 Geese Weekly Limit. See law.
RAIL, WOODDUCK, PIGEONS, SHORE BIRDS	ALL	No Open Season	
QUAIL (Valley, Desert, Mountain)	ALL Except 1½	Nov. 1-Jan. 15	Valley, Desert, 15 per day. 30 per week. Mountain, 10 per day. 20 per week.
	1½	Oct. 15-Dec. 15	
SAGE HEN	ALL Except 4½	Aug. 1-Sept. 15	4 per day. 8 per week.
	4½	No Open Season	
DOVE	ALL	Sept. 1-Oct. 31	15 per day. 30 per week.
GROUSE	ALL	Sept. 15-Oct. 14	4 per day. 8 per week.
TROUT (Except Golden), WHITE FISH	1-1½-2-3-4-4½ Lake Almanor	May 1-Oct. 31	See Game Law Abstract.
	2½	July 1-Feb. 14	
	23-24-25	May 30-Oct.31	
	Lakes, Etc.*	Aug. 1-Oct. 31	
	1½ Winter	Nov. 1-Dec. 31	
	2-3-10 Tidewater	Dec. 15-Feb. 28	
	2-2½-10 Spear	April 1-Jan. 31	
GOLDEN TROUT	ALL	June 30-Oct. 1	20 per day. None under 5 in.
BLACK BASS	ALL, Except 4e, Clear Lake	May 1-Nov. 30	25 per day. None under 7 in. No sale.
	4e, Clear Lake	No Closed Season	
SACRAMENTO PERCH, SUNFISH, CRAPPIE	ALL	May 1-Nov. 30	25 per day.
STRIPED BASS, SHAD	ALL	No Closed Season	See Game Abstract.
SALMON	ALL Except 15	No Closed Season	See Game Abstract.
	15	April 1-Aug. 31	
CATFISH	ALL	Aug. 15-May 14	Closed for commercial fishing.
CRABS	ALL	Nov. 15-July 30	See Game Abstract.
ABALONES	ALL	Mar.16-Jan. 14	See Game Abstract.
PISMO CLAMS	17	Sept. 1-April 30	See Game Abstract.
SPINY LOBSTER	ALL	Oct. 15-Feb. 28	See Game Abstract.

*Special provision see Game Abstract.

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