BIENNIAL REPORT

OF THE

FISH AND GAME COMMISSION

OF CALIFORNIA

1922

State *of* California
FISH & GAME COMMISSION

"ON GUARD" COURTESY OF EDW. M. MUSE

27th Biennial Report
1920-1922

—*From painting by Louis Agassiz Fuertes*

VALLEY QUAIL *(Lophortyx californica)*

STATE OF CALIFORNIA

FISH AND GAME COMMISSION

TWENTY-SEVENTH BIENNIAL REPORT

For the Years 1920-1922

CALIFORNIA STATE PRINTING OFFICE
FRANK J. SMITH, Superintendent
SACRAMENTO, 1923

22634

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DEDICATION.

TO THE STATE OFFICIALS AND THE LEGISLATURE WHO HAVE STOOD FOR A WISE CONSERVATION POLICY WITH REGARD TO NATURAL RESOURCES AND TO THOSE TWO HUNDRED AND FORTY THOUSAND HUNTERS, ONE HUNDRED AND SEVENTY-FIVE THOUSAND ANGLERS AND FIVE THOUSAND COMMERCIAL FISHERMEN WHO HAVE REAPED THEIR SHARE OF THE STATE'S FISH AND GAME, AT THE SAME TIME ANNUALLY PAYING A FEE FOR THEIR SPECIAL PRIVILEGE, THIS BIENNIAL REPORT OF ACCOMPLISHMENTS AND PROGRESS IS DEDICATED. MAY ITS PERUSAL RESULT IN A FIRMER ALLIANCE OF THOSE WHO BELONG TO THE ARMY OF DEFENSE WHICH GUARDS THE WILD LIFE RESOURCES OF CALIFORNIA.

LETTER OF TRANSMITTAL.

FISH AND GAME COMMISSION
OF CALIFORNIA

COMMISSIONERS
F. M. NEWBERT
M. J. CONNELL
E. L. BOSQUI

EXECUTIVE OFFICER
GEORGE NEALE

Sacramento, California,
September 1, 1922.

His Excellency William D. Stephens,
Governor of the State of California,
Sacramento, California.

Sir: We have the honor to submit for your consideration the twenty-seventh biennial report of the California Fish and Game Commission. Perucal of this record of the activities and accomplishments of this Commission during the past two fiscal years will show that all of the functions prescribed by law have been performed and that the conservation program in operation is bringing about satisfactory results.

Additional details as to the work may be found in issues of our quarterly magazine, CALIFORNIA FISH AND GAME, which covers the current activities of the Commission.

A change in the executive officer of the Commission was occasioned by the resignation on March 14, 1922, of Mr. Charles A. Vogelsang, who was appointed in April, 1920. Mr. George Neale, who has been in charge of the Sacramento District office since 1911, was appointed to succeed Mr. Vogelsang.

Respectfully submitted.

F. M. Newbert, President.

By Geo. Neale
Executive Officer.

Board of Fish and Game Commissioners.

TWENTY-SEVENTH BIENNIAL REPORT

INTRODUCTION.

The annual take of fish and game in California is to be estimated in the millions and to be valued in millions of dollars. A census of the fish and wild life of the state, were it possible to obtain, would still better show the magnitude of the native life with which California was originally blessed. To allow the use of this resource and yet make this native life an asset for all time is the function of the Fish and Game Commission. This is no easy responsibility to assume nor can satisfactory accomplishment be expected unless a large and capable personnel is retained and sufficient funds for the prosecution of the various projects made available. With impartial judgment let each reader make a mental estimate as to the measure of success the Commission, with resources at hand, has attained in its earnest endeavor to achieve the end set forth above. The following pages record the outstanding accomplishments of the past biennium, department and district reports furnishing important details follow and an appendix contains statistical records.

ADMINISTRATION.

The duties of the Commission as provided by law continue to be effectively administered by a department organization and by three district offices located respectively at Sacramento, San Francisco and Los Angeles. In March, 1922, with the appointment of Mr. George Neale as executive officer the head office was transferred to Sacramento.

The inauguration of quarterly meetings of department heads has been instrumental in bringing about better cooperation between departments and more complete knowledge of important problems. There is still needed a satisfactory budget system which will allow each department head to know what new projects are possible with the funds available.

There is probably no department of our state government having as many employees with as long terms of service as the Fish and Game Commission. The chief of the Fishcultural Department comes of three generations of this skilled art, with more than thirty-five years of service. The heads of other departments and deputies of the Commission have terms of service ranging from twelve to twenty-five years. Emphasis on experience and upon the merit system has greatly aided in bringing about efficient management of the Commission's affairs.

An attempt was made at the 1921 legislature to make the Fish and Game Commission a subsidiary division of the State Department of Agriculture. Other bills were introduced providing for the deposit of all license funds in the general treasury and for state appropriations from the treasury for the carrying on of conservation work. These proposals brought such a protest from the sportsmen of the state that no change was made. A defense of the present scheme of administering fish and game resources was based on four points:

1. No economy is to be gained by consolidation as the Commission is entirely supported by a direct tax on those who hunt and fish.

2. Fish and game is one of the natural resources of the state which is distinct and apart from growing crops. It is more efficiently administered separately.

3. The California Fish and Game Commission is an old established institution, being one of the two oldest commissions in the state, having been created in 1870.

4. The entire funds from the sale of fishing and hunting licenses should be used for fish and game conservation and for no other purpose.

FINANCES.

Since 1910 the Fish and Game Commission has received no appropriation from the state. Its support has been dependent upon the hunting and fishing licenses paid by the thousands who make use of the state's fish and game resources and by fines exacted from violators. It seems reasonable that those who profit most should be responsible for the conservation program. This system also has the advantage that the greater the number of hunters and fishermen, with consequent increased difficulties in law enforcement, there is increased returns

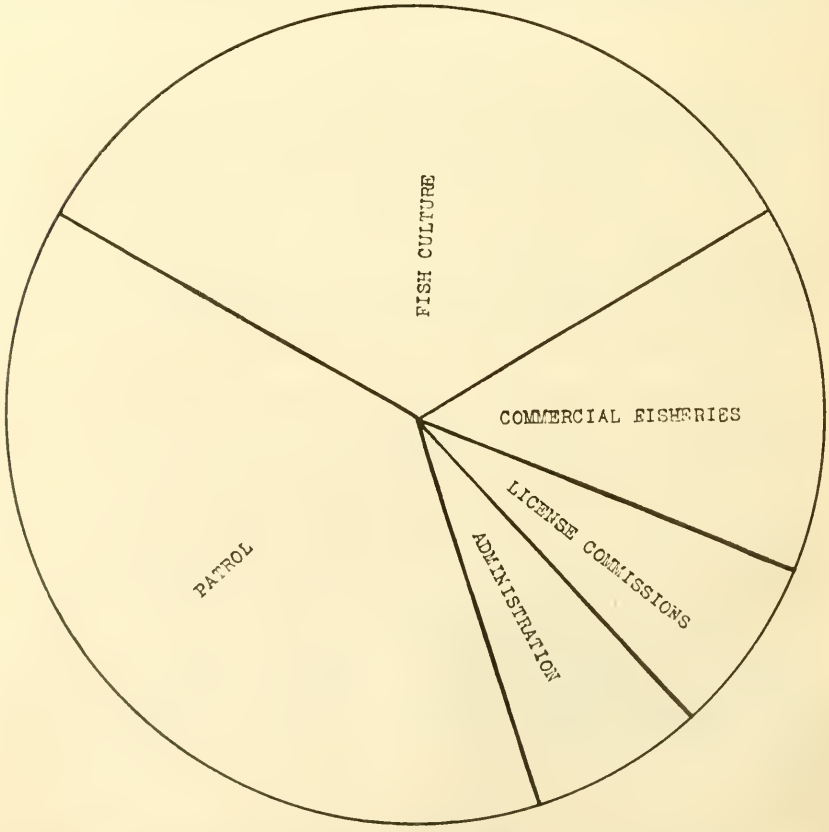

FIG. 1. Graph showing proportionate expenditures for various projects during the fiscal year 1920-21. Administration expenses were pleasingly small and needed emphasis was placed on two of the main functions of the Commission, patrol and the hatching and distribution of fish.

from the licenses. Although most states have increased their license fees, California still allows a man the privilege to hunt or to fish a whole year for the paltry sum of $1. With the increased cost of fishcultural operations and warden patrol, the sum secured from so small a fee is becoming insufficient to properly support the work of the Commission.

The Commissioners themselves receive no salary and their individual expenses barely average thirty dollars per month. Overhead expenses are kept at a minimum, no extravagant salaries being paid. The greater proportion of the funds are spent in law enforcement and a comparison of the statement of expenditures with those of any corporation will show that the Commission's funds are efficiently and economically handled. The following graph shows the proportion of funds spent for the different projects. A full accounting of all funds received and disbursed will be found on page 138.

Beginning with federal control of railroads, the Commission has shouldered the additional burden of railroad transportation and fish distribution, which before that time was assumed by the various railroads as acknowledgment of the benefits they derive from the planting of fish. The charges for hauling the fish cars about the state mount into thousands of dollars. This money could be better spent in the rearing of fish if the railroads would again assume hauling and transportation connected with fish distribution. The matter has been placed before the various railroad officials and favorable action is expected.

FISHCULTURE.

The Fishcultural Department reports a most successful two years. The total output from the state's thirty hatcheries and egg-collecting stations amounted to 40,974,000 trout fry and 18,037,000 salmon fry.

The greatest problem of the department, and really of the Commission, also, is that of supplying the increasing demand for trout fry for stocking streams. Carloads of fry are demanded where only a few cans can actually be supplied. Difficulties in the securing of eggs are always great. The spawntakers often have to pull their supplies to the hatchery on sleds and must work in deep snow to uncover or install traps. Racks and traps are often washed out by high water. Last and most important is the lack of funds for extending operations and increasing the output. It seems quite impossible to further increase the output of trout fry with the present financial resources of the Commission.

The valuation of property now under the control of the department is $350,000. Necessary improvements and repairs form an important item of expense. During the past two years it has been found necessary to renew the underpinning of several of the hatcheries and in several instances improvements of the water supply have been necessary. Concrete foundations for racks and traps have proved helpful in preventing loss at times of flood water and such foundations are being gradually installed at every important egg-collecting station. At several of the hatcheries better means of transporting eggs and fry to and from the hatchery have been necessary. At the Wawona Hatchery a bridge has been constructed across the river, and at the Fort Seward Hatchery a tram and cable line now connects with the railroad station

and saves the expense of keeping and hiring teams. Owing to a lack of water supply during the late summer, the Almanor Hatchery was abandoned in the fall of 1920. The Johnsville Hatchery on the Feather River was moved to a new site because of the deep snows which hindered operations in its former location. Scott Creek Egg Collecting Station, which heretofore has belonged to Santa Cruz County, was purchased by the Commission in 1920. This was in line with the policy to own and maintain all of the hatcheries rather than repair and improve leased property. Two hatcheries, the Ukiah Hatchery and the Brookdale Hatchery, are still under lease, respectively, from the city of Ukiah and the County of Santa Cruz.

TROUT.

The success of the pond system is evident when it is known that breeders from hatchery ponds furnished 18,000,000 trout eggs during the last biennial period.

One means of augmenting this system would be the setting aside of an area above the Cape Horn Dam on the south Eel River, as a fish preserve to be used as a source of supply for trout eggs. The lake impounded by this dam is known as Lake Pillsbury and several tributary streams would furnish successful breeding places for trout.

Continued efforts are being made to increase the output of the Tahoe black-spotted trout. A new egg-collecting station has been established on the upper Truckee, which will make use of trout, many of which would eventually lose their lives on returning to the lake because of flooding operations carried on by the ranchers.

Experience has shown the golden trout to be a delicate fish and much subject to disease. As a consequence, the hatching of this species has been discontinued pending reports as to the success attained in stocking Sierran streams.

SALMON.

Klamath River egg-collecting stations furnish most of the salmon eggs for the hatcheries. Operations of the United States Bureau of Fisheries at their station on the Sacramento River were hindered by lack of water and by the fact that spawning salmon did not succeed in passing the Redding Dam and consequently spawning operations could not be carried on at the Baird Station. Low water was largely responsible for the failure of the attempt to secure additional eggs on the south fork of the Eel River at Branscomb.

FISHWAYS AND SCREENS.

During the past two years forty-one inspections of and twenty-eight surveys for fishways were made. Surveys to the number of 187 were made for screens. Splendid progress has been made in the enforcement of the screen and ladder laws.

RECOMMENDATIONS.

Recommendations of the Fishcultural Department include:

1. The establishment of more hatcheries and egg-collecting stations to meet the demand for fry.

2. Improvements and repairs on the present hatcheries and the purchase of two still under lease.

3. An increase of the pond system as one of the surest methods of increasing the egg supply.

4. The distribution of trout fry by trained men in order to obtain better results in the planting of fish.

5. A survey to determine the food of fish and those species of insects best adapted for introduction in places where a food supply is scarce.

6. Prohibition of the spearing of salmon throughout the state.

7. The shortening of the open season for angling in certain districts.

8. Creating a fish reserve on the Klamath River from Klamathon to the coast and the prohibiting of the building of dams in this area in order to furnish a permanent supply of salmon eggs for hatchery purposes.

9. Cooperation with the Division of Water Rights in order to prevent the total utilization of a stream for irrigation purposes irrespective of the need for conserving the fish therein.

10. Amendment of the law prohibiting introduction of fish in order to eliminate such dangerous introductions as that of black bass into Bear Lake.

COMMERCIAL FISHERIES.

Upon our entry into the war, our fish packers responded to the government's call for an increased production of food by greatly increasing the output of the canneries. Many new canneries were built and nearly all were enlarged. Unfortunately, the large pack of sardines and tuna intended for European trade was held in this country for speculative purposes, with a consequent fall of prices and a great loss to the packers.

The biennial period has been one of readjustment. Many canneries ceased to operate because of the unsold stock in hand. Several canneries failed financially, and practically all have had difficulty in surviving the depression. The past year, however, has shown a rapid recovery and there is hope that the industry will again become stable. However, the present rates of exchange are still a great handicap to foreign trade. There is hope that with better times ahead, additional fisheries will be developed. Our larger fisheries, with the exception of the salmon, have only recently been developed, and a great future for them is assured.

Although the condition of the fisheries is of importance in our work, the duty of the commercial fisheries department is to look out, primarily, for the conservation of the fisheries and the safeguarding of them against over-fishing. Following there will be found a report of the investigations undertaken to secure dependable data as to the status of the fisheries, data useful as a basis of legislation looking toward their preservation.

Under the direction of Professor J. O. Snyder of Stanford University, an investigation to ascertain additional information regarding the life history and distribution of the king salmon has been begun. A series of marking experiments instituted has made it possible to deter-

mine whether Sacramento salmon are taken along the Mendocino Coast. The returned marked fish, through microscopic examination of the scales, have furnished additional evidence as to the age and growth of king salmon. Much data has also been gathered at the various salmon fishing centers. Six-months-old salmon, marked at the Mount Shasta Hatchery by the removal of certain fins, have been taken three and four years later along the northern California coast.

The information obtained from this investigation comes at an opportune time for there is every evidence that the salmon fishery is depleted and that present laws are inadequate to conserve the fishery.

Dredging operations in San Pablo Bay, by destroying the food supply of the striped bass, have driven this fish elsewhere. Furthermore, it is evident that the striped bass fishery is in danger because of the decreasing number of large fish taken during the open season. Since salmon and striped bass are caught by the same fishing methods, plans are being made to give additional protection to the striped bass along with the salmon.

A report on the edible clams, mussels and scallops of California has been published as Fish Bulletin No. 4. This records the results of investigations of the shellfish resources of the state, and includes recommendations as to their conservation. Furthermore, the results of a careful study of the pismo clam, one of our most important mollusks, is ready for publication. It includes the first detailed study of the life history of this clam, together with a report on habits, age, rate of growth, and fluctuations in abundance. It is hoped that these investigations will furnish sufficient data to assure the conservation of this valuable resource.

Publication of the results of the albacore investigations, instituted several years ago, has been delayed because of the additional data which it has been found desirable to include. It has been found difficult to determine whether evidences of decreasing abundance of albacore are due to actual depletion from over-fishing or indicate simply a fluctuation due to natural causes. Important discoveries have furnished evidence as to the age and rate of growth, time of spawning and distribution of this valuable food fish. It has been most encouraging to obtain results of such great use to the fish industry.

The sardine investigation has also been productive of valuable data as to the natural fluctuation, migration, age, rate of growth, breeding season and distribution. For a period of two years, daily samples of sardines have been taken, on which careful weights and measurements have been made and the sex and maturity observed. As a result, it has been possible to work out the rate of growth during the first four or five years, information of great importance from the conservation standpoint.

The establishment of purse seine fishing in southern California created an important problem, for several of the fishermen's organizations have sought to abolish this type of net, maintaining that it was too destructive and endangered fishing institutions. An investigation has shown that the purse seine boats are not making money and a regulation of the size of nets will put them out of business. Purse seine boats are depended upon to furnish blue-finned tuna for the canneries, and for

fresh fish for the markets during the winter months. Great catches of barracuda are made in May and June which flood the markets, these catches being made while the fish are schooling, preliminary to their spawning period. It is probable that a closed season during the summer will need to be inaugurated.

The law relating to the use of food fish in reduction plants has been enforced, but not without difficulties. Several canneries, even after a warning, persisted in utilizing more than twenty-five per cent of their catch and it was found necessary to deprive these canneries of their licenses for a certain term. Several amendments should be made so as to clear up some ambiguities in the law and make it easier of enforcement.

Clashes between sportsmen, who claim special privileges about piers, breakwaters and about Catalina Island, and the commercial fishermen make patrol in southern California difficult. Most of the time of the patrol boat *Albacore* is given over to the prevention of the use of dragnets within the three-mile limit. In addition to the patrol of the Sacramento and San Joaquin rivers, attention has recently been given the Humboldt Bay area. To give an efficient patrol in this latter location it will be necessary to furnish a larger, more seaworthy boat.

STATE FISHERIES LABORATORY.

A splendid fireproof laboratory building, of reinforced concrete, with tile partitions and red tile roof, now stands on the corner of Seaside avenue and Tuna street in close proximity to the wharves and canneries of San Pedro. Here the scientific staff engaged in fishery research is satisfactorily housed.

"The aims of the State Fisheries Laboratory 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. Statistics, so detailed, so extensive, and so accurately gathered that changes in fishing ground, and many other things may be discounted, are being secured. Such data must also be examined and tested by the biologist with his criteria of overfishing. To give such proof as these data provide, is the purpose of the new laboratory. It is for the digestion and biological analysis of statistics.

"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 to 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 overfishing 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 unequally 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."

EDUCATION AND PUBLICITY.

The report of the Department of Education and Publicity shows that a greater number of persons have been reached through the medium of lectures than ever before. Over sixty thousand persons viewed the educational films utilized by the department. Especially notable work has been done in the public schools and with the game protective associations. Lectures and motion pictures visualize the work of the Commission and play an important part in developing a public sentiment favorable to fish and game conservation.

Summer resort work, which has centered in the Yosemite National Park for the past three seasons, has attracted the interest of many thousands in the conservation program of the California Fish and Game Commission. Under the joint auspices of the National Park Service and the Fish and Game Commission field trips are conducted which offer first hand information regarding the living things along the trail side. Thousands who gather at the evening entertainments are acquainted with the wild life of the state through the medium of lectures and motion pictures, and office hours give an opportunity to thousands who seek information. In no other place can so many people be reached in so short a length of time and interest in wild life conservation be so readily secured.

Splendid publicity has been maintained mainly through the quarterly magazine, California Fish and Game, which has now reached an edition of 7000, through magazine articles, and through newspaper items issued to the newspapers of the state. The annual exhibit at the State Fair has also played an important part in the publicity campaign.

INVESTIGATIONS.

Satisfactory bases for legislation can not be obtained without dependable data, secured through scientific research. The Commission has maintained a fisheries laboratory, the staff of which is definitely engaged in the securing of satisfactory data on the fast developing fisheries of the state. Results of the tuna investigation are now ready for publication, and effort is being concentrated upon the sardine investigation. Need for more accurate data on the life history of the salmon has precipitated some valuable experiments on the marking of salmon fry and the consequent study of the returned fish and much valuable information has already been obtained. Need for more information on the food habits of ducks, looking toward the artificial planting of suitable duck foods has led to an examination of hundreds of stomachs of ducks and the analysis of the contents.

LAW ENFORCEMENT.

A goodly proportion of funds received are allotted to law enforcement. Yet seventy deputies have to patrol 156,000 square miles of territory, much of it mountainous. It is obvious that it is impossible for this comparatively small force to apprehend every violator of fish and game laws. Still the average cases per year per deputy was sixteen, showing that deputies were actively engaged in patrol. When one considers that 1500 policemen patrol San Francisco, an area of 40 square miles, and still violations of law occur daily, it is surprising how effective is the work of the game wardens who often patrol one or more counties.

Arrests for violations of the game laws totaled 1221. Of this number 1108 were convicted. The fines collected amounted to $33,998.80 in addition to 1289 days of imprisonment awarded. Arrests for violations of state fish laws totaled 1037 from which there were 983 convictions. Fines collected amounted to $29,028.50 and offenders were awarded a total of 994 days of imprisonment. The total number of arrests amounted to 2258, nearly 400 more than reported in 1920.

During the biennium a large amount of illegally taken fish and game was seized. The totals are of interest: over two tons of deer meat; 4500 ducks; 500 quail; 25 tons of fish, and about 12 tons of lobsters and shellfish. All wholesome fish and game was donated to public and charitable institutions and many grateful letters of acknowledgement have been received. Considerable illegally used fishing apparatus, which was seized, after being condemned in superior court, has been destroyed or sold by the Board in accordance with law.

The wardens of the law enforcement force are all skilled and competent and exercise a high degree of judgment, so necessary in enforcing our laws. Many of them are not college bred or educated; some diamonds in the rough, sons of hardy pioneers who were taught resourcefulness; all capable and self-reliant, with sense and sound judgment of what is right and capable of caring for themselves under all conditions. The high degree of efficiency obtained is the result of love for their work, for the salaries are not alluring, while the dangers are many.

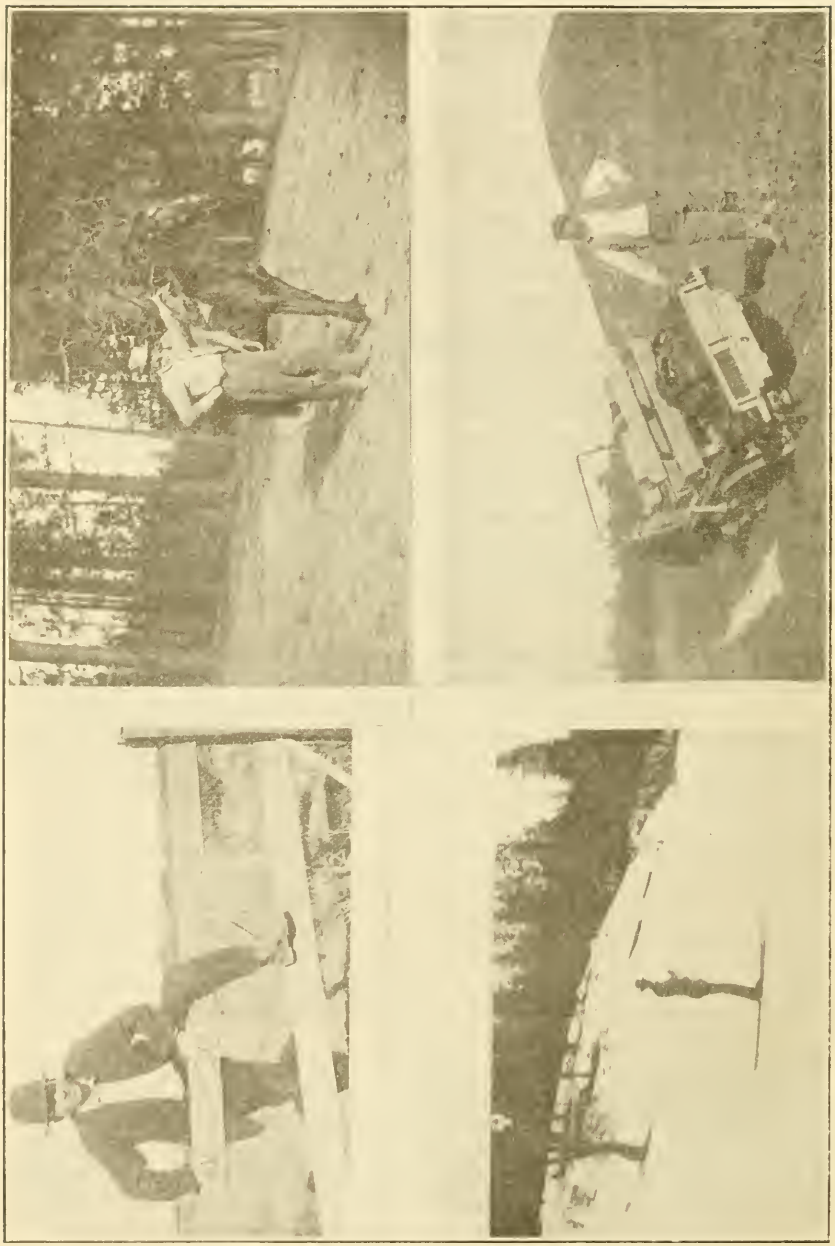

Fig. 2. The game warden at work. Although these days most of the patrol must be made in an automobile, yet in mountain districts patrol must be pursued on horseback, on snow shoes or on foot.

MOUNTAIN LION CONTROL.

Bounties have been paid on 256 mountain lions, a number slightly above the average for past bienniums. A number of counties now offer bounties on lions, in addition to the state bounty, and thus offer an inducement to men who own predatory animal dogs. In one instance the combined state and county bounty attracted a professional lion hunter to this state from Arizona, with a resultant increased toll being taken in Santa Barbara County. State Mountain Lion Hunter Bruce maintained his general average of nearly three lions per month, and was successful in securing several litters of kittens. The present system of lion control seems to be efficacious and if continued should largely eliminate danger to deer and to domestic stock.

FIG. 3. A deputy of the Fish and Game Commission examining game bag of a foreigner at the Sausalito Ferry.

FISH AND GAME PROTECTIVE ASSOCIATIONS.

Increased interest in fish and game is evidenced by the growing number of fish and game protective associations that are being formed. Most eastern states have active associations in every county and an active centralized state organization, but until recently few such organizations have existed in California. Perhaps it is the growing need for careful protection of wild life resources that is causing the banding together of sportsmen in the various communities. Certainly it is too often the case that measures for protection are taken when game has practically disappeared.

Already these associations, now nearly twenty in number, have been helpful in shouldering responsibility for the planting of fish and in influence lent to law enforcement. Provided these associations actively espouse the cause of game protection rather than the cause of mutual protection for members in the securing of game as some have been known to do, there is a wide field of service open to them. First and foremost is the opportunity to develop the proper attitude on fish and game conservation in the various communities.

CURRENT PROBLEMS.

A Commission whose function it is to conserve wild life resources is confronted with a never ending series of difficult problems, as can be seen by the following discussions of the more important ones of the past two years. They usually have a bearing on law enforcement or upon obstacles to the natural increase of a game species.

EXTINCTION OF SALMON THREATENED BY POWER DAMS.

Conservation of the salmon was the first important problem faced by the Fish and Game Commission when it was first formed in 1870, and it still continues an important problem. A reduction of the catch to provide for a sufficient number of breeders to reach the spawning grounds was long the important consideration. Now the increasing number of large power dams threatens the extinction of the salmon run by preventing the fish from reaching their natural spawning grounds. As an example of the present problem the dam of the Anderson-Cottonwood Irrigation District at Redding, Shasta County, may be cited. The lack of a suitable fishway at this dam during the past few years has effectually prevented salmon from reaching their spawning grounds on the McCloud River. Investigation by experts showed that very few salmon succeeded in leaping the dam and the shutting down of the salmon spawning station of the United States Bureau of Fisheries at Baird conclusively proved that salmon were effectively blocked at the Redding Dam. Attempts made by the Commission to force the building of a fishway were unavailing until an injunction suit was instituted. The situation was finally cleared up in the spring of 1922 when the matter was amicably settled. Conditions at the dam are now improved and the spawning station at Baird has again been opened.

The successful outcome here, however, does not mitigate the equally, if not greater problem involved in the proposed dam of the Electro-Metals Company on the lower Klamath River which threatens the extermination of the important run on the Klamath River. At hearings held at Yreka on May 5, 1921, the Fish and Game Commission took the stand that the proposed dam would (1) entirely obstruct the annual migration of the salmon; (2) that a suitable fishway could not be constructed around so high a dam; and, (3) that a hatchery erected at the dam would not solve the problem since the salmon arriving at the dam would not be ready for spawning. For these reasons, and others also, the Commission opposed the granting of a preliminary permit by the Federal Power Commission. It may be that at some distant time in the future power development will be more important than the saving of a valuable run of salmon, but at present there is power development enough to care for all needs of the immediate future and there are plenty of streams, where there is no run of salmon, that can be utilized for power purposes. If the fight to save the salmon run on the Klamath is not successful the end of the vast salmon fisheries with which the state was originally blessed will be at hand.

DEMAND FOR TROUT FRY EXCEEDS HATCHERY RESOURCES.

Easy access to the streams and lakes afforded by the improved highways and the increasing use of automobiles, and the added thousands of people who are availing themselves of the opportunity to fish, are factors that have combined to make an ever-increasing demand on our hatcheries for fish for restocking. Each season sees a marked increase in the number of people who seek recreation in our mountainous districts, and the consequent drain on the trout in lakes and streams has been very great, particularly during the past five years.

The demand from sportsmen throughout the state is for many carloads of fry when only a few cars can properly be allotted. Application blanks for 1922 show demand for 100,000,000 fry when a quarter of that number were available as a result of extra effort.

To meet the need, the department of fishculture has exhausted its resources. Every available dollar has been devoted to fishcultural work, and yet the demand increases.

Only a partial solution is possible as a result of the reduction of the bag limit from fifty to twenty-five. It may be that a shorter fishing season will have to follow in order that depleted streams and lakes may be afforded a chance to recover their former condition.

Every state in the Union where there is game fish to be found is confronted by the same problem. In most cases the condition is being met by an increased angling license to provide more funds for enlarging the output of the hatcheries. This is the remedial measure being suggested by anglers throughout the state.

ENFORCEMENT OF FISHWAY LAW DIFFICULT.

One of the serious problems of the Fish and Game Commission is that connected with the enforcement of the law which provides for the screening of irrigation ditches. In many counties the Commission has made persistent efforts to prosecute violators of the law, but with poor success, owing to the attitude of the district attorney. In order to bring about better cooperation in the enforcement of this important law a new policy has been decided upon. Hereafter, the output from the hatcheries will be allotted to those counties which are enforcing the screen law, and those providing suitable protection for the fish planted in the streams. It seems only reasonable that this course be taken to prevent serious loss of the fish which are reared at considerable expense in the state hatcheries.

GRAZING ENDANGERS FEED CONDITIONS IN GAME REFUGES.

A visit to many of the state game refuges will show that game is not receiving adequate protection, due to the destruction of food supply by cattle and sheep. Food supply is one of the most important factors concerned in the welfare of any species and the grazing of cattle and sheep in the refuge means a lessened food supply for game. Those conversant with conditions maintain that the disappearance of grouse in the higher mountains is due largely to the pasturing of sheep. Sheep are taken to the high mountain meadows at just the time when the grouse are nesting and the nests are trampled out and the grass cropped so clean that even the food supply for these birds is largely destroyed.

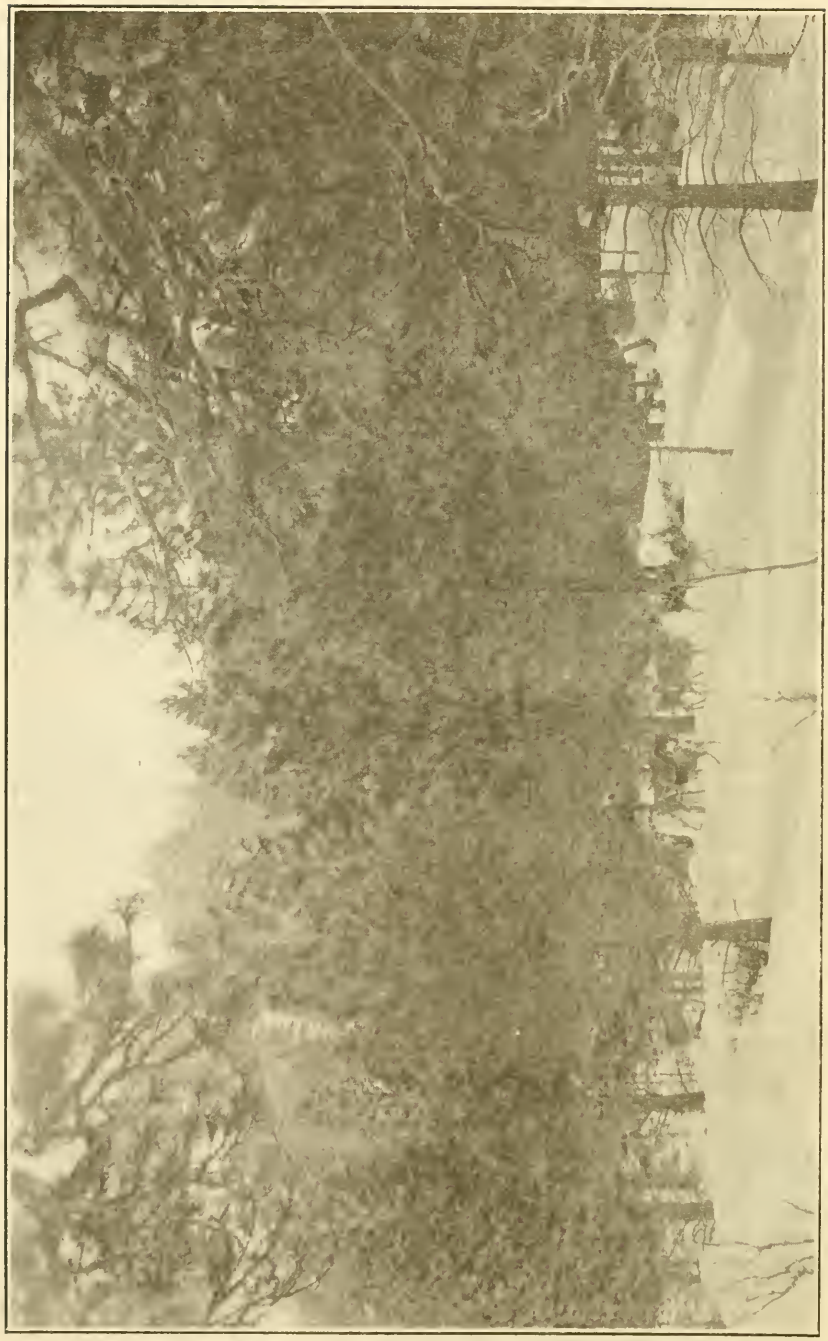

Fig. 4. Winter feeding of deer in Lassen County. This remarkable picture shows typical conditions in the winter of 1922 when extensive feeding operations were found necessary. Photograph by Thompson's Studio, Susanville, California.

Recent reports from Game Refuge 1D in Trinity County indicate that so many cattle are allowed to feed within this refuge that browse has become very scarce for deer. Any area will support only the number of big game animals for which there is an adequate food supply. A diminished food supply means a diminished number of deer.

Unless more attention is paid to the improvement of grazing inside game refuges, these areas will not be performing the service for which they were set aside. Undoubtedly cattlemen and sheepmen will oppose any restriction of grazing but there should be sufficient public sentiment to successfully close to grazing at least portions of each game refuge.

WINTER FEEDING OF GAME.

The winter of 1921-22 like that of 1914-15 was so severe that game had difficulty in securing food. To prevent starvation President Newbert issued the following letter and then ordered wardens to act accordingly.

Sacramento, Cal.,
February 10, 1922.

Dear Sir:

This is the time that tells the tale whether a man is just a meat hunter or a real red-blooded sportsman. It may be that many wild birds and animals are isolated in areas where it is impossible for our wardens to find them, owing to the deep snow. Nature teaches all wild life when in need to seek man and civilization.

Therefore, residents of farms or towns are in a position to render aid by feeding these wild birds and animals. Our Commission is more than willing to purchase feed to tide over these storms and will authorize the expenditure of funds by our wardens.

We ask all lovers of wild life to feed, temporarily, at least, birds and animals until such time as our local deputy or district office may be notified.

FISH AND GAME COMMISSION,
F. M. NEWBERT, President.

The press gave this letter wide publicity and the response was gratifying. A great deal of hay and grain was furnished gratis by residents and several hundred dollars was spent by the Commission. Hay was handled by teams, sleighs, sleds and pack animals. Reports show that over a thousand deer were fed, one hundred and fifty antelope, and several thousand quail. The fact that only a few succumbed to cold and starvation showed that the feeding was instrumental in preventing a great loss.

CARELESS HUNTERS.

Hunting accidents continue too numerous. An incomplete compilation of those for 1921 showed eleven persons dead and fifteen severely injured as a result of carelessness.

Nor is the loss of human life the only result which follows the careless handling of a gun. The Forest Service reported that on eight of the national forests of this state sixty-four cattle and three horses met death from hunters' bullets during the 1921 open season. This loss to cattlemen seems to be increasing year by year. Not only are cattle actually killed and seriously wounded by careless hunters in the mountains, but perhaps even more serious than this is the manner in which cattle are driven from the range by the large number of hunters who camp at

water holes in the fall, often usurping the only watering place for miles around and continually drive the cattle away, to finally die for lack of water. Many permit their dogs to chase cattle so that they are often driven from the high mountain ranges to lower elevations where poorer feed conditions exist, sometimes as much as six weeks before they normally would work to lower elevations. It has been conservatively estimated that this disturbing of cattle by hunters camping at water holes and by the use of dogs, causes a loss of between $2 and $3 per head annually. Some hunters, neglectful of others' interests, break down fences and leave gates open.

These are just complaints of the cattleman and they give rise to a dangerous situation, involving threatened danger in season and exclusion from hunting grounds. Unless hunters take some steps to correct these evils themselves, it is certain that the men financially concerned will be instrumental in further curtailing the hunter, and the careful will be made to suffer with the careless.

THE ALIEN HUNTER.

A glance at the names of those fined for violations of the fish and game laws will show a preponderance of foreigners most of whom are immigrants from southern Europe and many of whom are aliens. Accustomed in their own country to killing everything that swims or flies, they attempt to do the same thing here. The States of Pennsylvania and Utah and more recently the State of New York have seen fit to pass laws curtailing the use of firearms by aliens. These states find that law enforcement is made much easier. A law providing for a special license for aliens with an added provision for the confiscation of firearms found in their possession would help greatly in solving this difficult problem.

INCREASED PROTECTION FOR ANTELOPE.

The continued disappearance of the antelope in North America has emphasized the need for careful protection of the small remaining herds. California is one of the few remaining states that can take pride in a few small herds, the remnant of those vast herds that once made antelope meat cheaper than beef. A recent census shows that there are about 200 individuals left within the state. By far the larger herd ranges south of lower Klamath Lake in the Mount Dome region. The Commission with the cooperation of the U. S. Forest Service and the California Academy of Sciences is making a special effort to give this herd absolute protection. During severe winter weather the animals are fed and a special patrol has been instituted. Fortunately the public sentiment of local residents is being rapidly developed. In this is to be found assurance of better protection in the future.

ADDITIONAL PROTECTION FOR MULE DEER DEMANDED.

With the coming of the automobile and good roads, the large mule deer of northeastern California is being greatly reduced in numbers. During the 1921 open season it was estimated that 900 machines containing hunters visited Modoc and Siskiyou counties. The license plates showed that they came from Oregon and Washington as well as from California.

Many of these hunters obtained the full limit—two bucks—which shows that a very heavy toll was taken. It is the opinion of many hunters of this region that the mule deer will not be able to withstand such concentrated hunting and a sentiment is growing which favors either the closing of the season on this species for at least three years, thus giving them time to recuperate, or the establishment of a limit of one buck.

SERIOUS EPIDEMIC AMONG GRAY SQUIRRELS.

The gray squirrel, a game species, much appreciated by the mountaineers and by boys has almost disappeared in many sections of the state owing to a serious epidemic of disease. The disease first appeared in El Dorado County in 1917 but since that date has spread throughout the state.

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 giving the animal a mangy appearance. Dead squirrels are to be found at the bases of trees and in streams of water.

An examination of specimens by the veterinary and entomological department of the University of California 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.

As epidemics of this sort often occur among rodents it is to be expected that those escaping the disease will soon repopulate the forested area with gray squirrels. However, the scarcity of this game species in many sections has led to a demand for a closed season to allow the squirrels to recuperate.

PUBLIC SHOOTING GROUNDS-GAME REFUGE BILL.

The successful operation of the federal law relating to migratory birds has stimulated conservationists to attempt to provide additional game refuges and public shooting grounds. The Anthony Bill (HR. 5823) designed to bring about these worthwhile conservation measures provides for a federal hunting license of one dollar to be purchased in the form of a stamp and to be affixed to the state license. Provision is also made for the use of such funds as are received in the purchase of public shooting grounds and of game refuges. Although in sympathy with the plan underlying the bill, the Commission is opposed to two minor provisions which would obviously give trouble in law enforcement in California. One provides for complete control of all animal and fish life within a federal refuge which might well take away from the state control over fish planted by the state. An amendment correcting this has been promised by those in charge of the bill; the other, a more serious obstacle, is a provision allowing a man to hunt on his own property without a federal hunting license. So long as this dangerous provision is a part of the bill the Commission can not favor its passage. It will be difficult enough to enforce both state and federal laws without being trammeled by such a stumbling block to law enforcement. It is to be hoped that these obstacles to the passage of the law will be removed and that the main projects may be carried out.

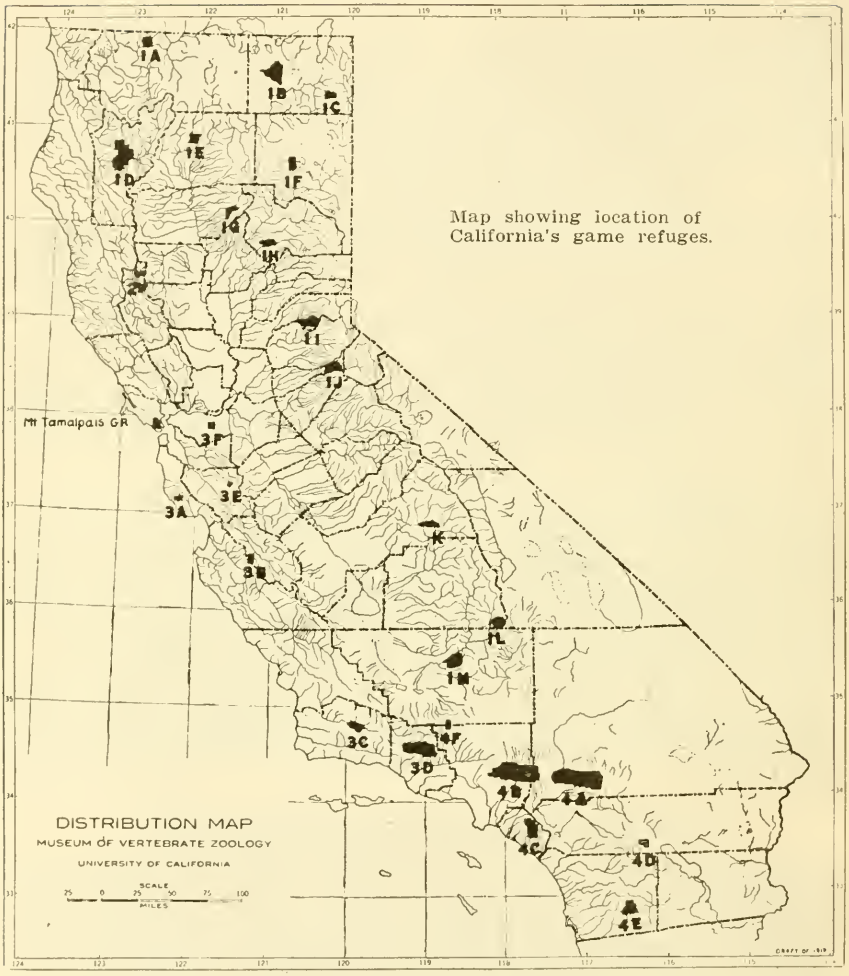

FIG. 5. Map showing location of California's game refuges. There are now 28 state refuges, comprising an area of 1,792,000 acres.

FUR RESOURCES.

The fur trade played an important part in the early history of California, but after the depletion of the two more valuable fur bearers, the sea otter and the beaver, the fur-trading companies deserted the field and the catch was left to mountaineers who wished to use spare time in the winter to increase their income by trapping. Estimates of the value of the pelts taken in the state have been made in the past but the first dependable figures are now at hand as a result of the trapper's license law passed in 1917, which requires each trapper to report his catch. A compilation of the reports for the open season 1919-1920 made by Mr. Joseph Dixon, economic mammalogist, Museum of Vertebrate Zoology, University of California, who is at work on a book dealing with the fur bearers of the state follows:

NUMBER AND VALUE OF ANIMALS REPORTED CAUGHT BY THE LICENSED TRAPPERS OF CALIFORNIA FROM OCTOBER 15, 1919, TO MARCH 1, 1920.

Rank	Species	Number	Average price	Highest price	Total value
1	Skunk	19,052	$3 81	$8 00	$72,588 21
2	Coyote	3,896	7 63	20 00	29,843 36
3	Coon	5,398	5 45	15 00	29,419 10
4	Gray fox	5,222	3 95	7 00	20,679 12
5	Mink	1,704	9 13	20 00	15,557 52
6	Marten	452	26 08	45 00	11,335 16
7	Wildcat	3,783	2 80	12 50	10,592 40
8	Fisher	102	67 33	80 00	6,837 66
9	Ring-tailed cat	1,286	2 62	7 00	3,360 92
10	*Beaver	75	33 23	35 00	2,492 50
11	Spotted skunk	3,586	57	1 00	2,044 02
12	River otter	97	11 88	20 00	1,142 36
13	Muskrat	359	3 14	3 25	1,127 26
14	Bear	116	8 57	20 00	994 12
15	Red fox	28	12 00	20 25	236 00
16	Wolverine	7	30 00	50 00	210 00
17	Badger	197	1 06	2 50	208 82
18	Kit fox	129	1 34	2 50	174 86
19	Mountain lion	20	8 00	20 00	160 00
20	'Possum	90	1 25	1 75	112 50
21	Weasel	178	20	1 75	35 60
22	Mole	27	05	05	1 35
	Total	45,804			$209,292 24

*Taken under permit.

"*Trapping Licenses*—About 4500 issued. Of these, 1300 reported their catch. Persons under 18 are not required, under the present law, to report.

"*Estimated Total Income*—The catch of $209,292.24 reported by the 1300 licensed trappers is found to be about 40 per cent of the entire value of the catch which totals $500,000.

"*Average Income*—About $110 per licensed trapper. The 1300 trappers reporting, including many professional trappers, averaged $160.

"*Note*—The muskrat is not protected by law in California. For this reason the 25,000 muskrats valued at $31,000, which investigation has shown to have been caught in the Imperial Valley in 1919-20, were not reported. The figures for the mountain lion and coyote are also low since 229 lions were killed, and their hides presented for bounty, in 1920. Animals trapped and poisoned by predatory animal trappers working under the direction of the Biological Survey of the U. S. Department of Agriculture are not included in the above report.

JOSEPH DIXON,
October 10, 1922. Economic Mammalogist."

UNITED STATES FOREST SERVICE COOPERATION.

For many years the United States Forest Service has cooperated splendidly in fish and game conservation work. That this cooperation might be improved and might have a common basis an agreement was drawn up and signed by officials of the Forest Service and the Commission early in 1920. The agreement reads as follows:

AGREEMENT.

In order to secure closer cooperation with the Fish and Game Commission, the following informal agreement has been executed:

Whereas, the wild life on the national forests of California is a product of the forest and a great resource, which adds materially to enjoyment of the national

forests by the public, as well as of great economic value, its protection and perpetuation becomes a public necessity; and

Whereas, the Fish and Game Commission of California is the duly authorized agent for the State of California for the protection and perpetuation of this resource, and the District Forester of the Forest Service, United States Department of Agriculture, for the Department; now, therefore

In order to coordinate the work of these departments in the protection of game, fish, birds, and forests of California, Paul G. Redington, District Forester, for and on behalf of the United States Department of Agriculture, and Carl Westerfeld, Executive Officer of the Fish and Game Commission of California, for and on behalf of the State of California, do agree as follows:

1. That under the state laws no differentiation can be made between violators of the law. The law, therefore, should be enforced equally as to all violators.

2. The forest officers, because of their familiarity with the areas on which a large proportion of the wild life in the state exists, can and should assist, by their own personal actions and attitude, in securing the proper respect and enforcement of the state game laws. All forest officers who, in the judgment of the District Forester, can, because of the character of their work be of assistance in the enforcement of the state fish and game laws, will be appointed by the Fish and Game Commission of California as deputy state game wardens. All forest officers so appointed shall assume the following prescribed duties:

(*a*) Pay strict attention to the enforcement of the state fish and game laws, and by persoral actions and attitude assist in creating the right public attitude and sentiment toward the protection of fish and game within the boundaries of national forests;

(*b*) Report all cases of violations of the fish and game laws to the officer's immediate supervisor who will in turn report the violation to the Fish and Game Commission of California, San Francisco, California;

(*c*) Make arrests for violations of the fish and game laws committed within the boundaries of the national forests;

(*d*) Furnish all information available which will assist officers of the state in apprehending or prosecuting violators of the fish and game laws, whether such violation was committed within or outside the national forests;

(*e*) Submit such reports as may be called for by the District Forester;

(*f*) Report misconduct or dereliction of duty on the part of any state official employed in the enforcement of the state fish and game laws;

(*g*) Issue hunting and fishing licenses, receiving therefor the commission allowed by law.

3. The District Forester will cause an annual report to be submitted to the Fish and Game Commission which shall contain complete information as to the present condition of wild life in the national forests and plans for the protection and development of fish and game therein. He will recommend the establishment of such game refuges as seem necessary, the boundaries of which shall not be changed without his approval.

4. The Fish and Game Commission of California will elect a representative of its Commission to act on behalf of the Commission with the District Forester on all matters pertaining to fish and game work on the national forests of California.

5. The duly authorized agent of the Commission shall have power to act upon all reports and requests from the District Forester, furnish upon requisition the number of fish plants necessary to stock streams within the national forests, provide proper facilities for transport to places of destination, and properly supervise shipment from hatchery to nearest railroad point; and shall issue proper instructions to forest officers designated to transport fish from railroad point to streams, giving at least two weeks' advance notice of date of arrival.

6. Upon recommendations from the District Forester, deputy game wardens will be appointed state fire wardens, and the Commission or its duly authorized agent will instruct such wardens to cooperate with the Forest Service in the suppression and prevention of forest fires.

7. All deputy game wardens will pay strict attention to the enforcement of state fire laws, familiarize themselves with the regulations governing the use of the national forests, and by personal actions and attitude assist in creating the right public attitude and sentiment toward these laws and regulations.

8. Deputy state game wardens will report, through the State Fish and Game Commission, any misconduct of forest officers or the dereliction of duties in the enforcement of fish and game laws.

9. The Fish and Game Commission will provide the necessary signs, labor, and material, for the proper posting and supervision of existing state game refuges or those which may hereafter be established within or adjoining the national forests.

10. Necessary expenses of forest officers in the investigation and prosecution of fish and game violations will be paid by the Fish and Game Commission upon properly certified accounts on forms furnished by the Commission.

11. Amendments to this agreement may be proposed by either party upon giving thirty days' notice to the other. Amendments shall become operative immediately after they have been adopted by both parties.

12. It is mutually understood and agreed that this agreement shall terminate at the end of any fiscal year in the event that Congress shall fail to make an appropriation for the ensuing fiscal year.

According to the terms of the agreement forest officers will enforce fish and game laws, make arrests, submit reports and issue hunting and fishing licenses. The force of game wardens will therefore be greatly augmented and better enforcement of the fish and game laws is a certainty. The help of the Forest Service in better posting state game refuges will be another outcome of the cooperation. In return for the services of the forestry men, the game wardens of the state will be deputized as forest fire wardens and will help in protecting the forests and in developing the right public attitude toward the laws and regulations of the national forests. There is to be a continuance of the annual reports on game conditions in the forests furnished by the District Forester.

This cooperation, which has been carefully worked out between the United States Forest Service and the Fish and Game Commission, will make violation of the fish and game laws doubly difficult and will do much to develop a sentiment favoring game conservation.

FIG 6. State lion hunter, Jay Bruce, with large 160-pound male lion, measuring 7 feet 3½ inches, killed near Avery, Calaveras County, March, 1921. Photograph by L. D. Petersen.

STATE FAIR EXHIBIT.

Four years ago the Commission installed a permanent exhibit at the State Fair, consisting of a panorama of the Sierra Neveda from Mount Shasta on the north to Mount Whitney on the south, 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. Each year the scene has been changed and new lighting effects added. The floor space was nearly doubled in 1921, 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 were also the materials manufactured from kelp. Educational films shown twice daily attracted large crowds also. Each year there has been a splendid aquarium display of food and game fishes, including the famous golden trout, brought nearly a thousand miles from its home near Mount Whitney. Other aquaria contained the food and game fishes of the San Joaquin and Sacramento rivers, displayed by the northern district office. Through the medium of this exhibit many thousands of people have become intimately acquainted with the work of the California Fish and Game Commission.

NORTHERN DISTRICT.

The northern district reports great success in law enforcement, owing to a growth of public sentiment. Jail sentences aggregating 1219 days were meted out to violators during the two-year period. Everywhere the judges are cooperating in law enforcement by giving such heavy sentences that the violator does not care to make a second violation.

In the winter of 1921-22, heavy snows in the mountain districts made it important that game be fed in order to prevent their starvation. Deputies of the Commission, aided by many public spirited citizens, were instrumental in saving large numbers of quail and deer. The largest herd of antelope left in the state, located in eastern Siskiyou and western Modoc counties, were cared for during the severe weather and consequently the losses were small. Particular attention has been given the protection of this remnant of the former herds which roamed the state. The popularity of the mule deer and the ease with which the hunter reaches the best hunting grounds is endangering this species. Another cause of decrease is to be seen in the fact that the yearling sometimes has branched antlers, and many young bucks are thus killed. A closed season in Modoc and Lassen counties for a few years would help to improve conditions.

The earlier opening of the duck season in the Sacramento Valley has cleared up the situation in the rice fields. The season is now open during the time the ducks are accused of destroying the rice. Deputies of the Commission were kept busy apprehending the market hunters. Many were brought into court and heavily fined and hundreds of birds were confiscated. Each season the profession of "duck boot-legging" becomes more precarious.

The northern district boasts of increasing interest in fishing for the food fishes introduced into the Sacramento and San Joaquin rivers. A few minutes' ride from the larger cities of the district takes one to places where crappie and blue-gilled sun fish are to be found in numbers. The fact that these fishes take the fly and the spinner has increased interest in them.

The Tahoe free camping ground, established on the old hatchery site, continues to serve large numbers of summer recreationists with small expense to the Commission. All campers appear to appreciate this well-equipped sanitary camp furnished them by the state.

SAN FRANCISCO DISTRICT.

Strict law enforcement in the San Francisco district resulted in 1224 arrests, aggregating $34,442.75 in fines during the biennial period, an average of about $30 per case. In addition, violators served 322 days in jail. San Francisco courts continued to regard violations less seriously than county courts, as evidenced by the number of dismissals and the smaller average of fines imposed.

Cases show an increased number of does killed illegally and hunting accidents have been numerous.

Agitation made by cattlemen and the forest service to shorten the season on deer and thus reduce violations and forest fires may result in the opposite effect because of the concentrated hunting. It also seems probable that an increased penalty for killing game would simply make law enforcement more difficult; the maximum fine is at present $500.

Game and fish conditions in the district are satisfactory. However, overfishing in the streams of the bay section is very evident and something should be done to bring fishing back to a normal condition in these streams.

SOUTHERN DISTRICT.

Reports from southern division headquarters at Los Angeles show that a deputy has been placed in every southern county except one, resulting in more effective enforcement of law and closer touch with fish and game conditions. Most southern counties are cooperating by joint-appointment and division of warden expense. Percentage of convictions to cases made was 94.5; average fine, $28.26. Many forest-rangers have given valuable and appreciated assistance.

Cooperation of county sportsmen's associations toward enforcement and education has been enlisted unanimously; likewise chambers of commerce, the Automobile Club of Southern California and many other organizations less directly interested in conservation. Widest publicity has been given the Commission's work in southern newspapers and, incidental thereto, an information bureau for sportsmen has been organized.

Close relationship and responsibility of the Fish and Game Commission to the sportsmen whose license-dollars support its work, constantly has been respected in the south, resulting in harmonious understanding and mutual assistance. Appreciation manifests itself in sentiment increasingly favoring the license-fees to meet growing demands for a larger hatchery output and extension of specialized work in behalf of game.

Special attention has been paid to conserving the remainder of the native big-game animals, such as antelope and mountain sheep, with favorable results. The deer situation, however, is unsatisfactory and additional protection is felt necessary.

Cooperation with county supervisory boards toward eradication of lions, pests upon stockraiser and sportsman alike, continue bearing apparent results, as one county after another adds enough to make the state bounty attractive to professional lion hunters.

A plan is being worked out to furnish additional sport through the stocking of municipally owned reservoirs with black bass and the opening of these reservoirs to fishermen. This will provide easily accessible and inexpensive fishing.

Regulation of commercial fisheries has had constant attention in cooperation with the Commercial Fisheries Department, whose special responsibility it is, the south now being the center of a steadily growing industry requiring ever-closer patrol.

Special problems of a local nature requiring intensive patrol of the congested centers of duck-shooting interest; the lee waters of Santa Catalina Island, reserved for their attraction-value to sportsmen from the world over; lobsters, clams, all have come in for the necessary special attention, with improvement generally conceded.

REPORT OF THE DEPARTMENT OF FISHCULTURE.

The Honorable Board of Fish and Game Commissioners of the State of of California.

GENTLEMEN: In conformity with the law and regulations of the Fish and Game Commission, I have the honor to transmit a report of the Department of Fishculture for the biennium ending June 30, 1922.

During the last two seasons, covered by this report, we have made a record output at our hatcheries, having hatched and distributed 40,974,000 trout fry and 18,037,000 salmon fry with the probability that the season that we are now entering on will exceed the last one in output of trout fry. We have hatched and distributed 19,000,000 salmon fry from eggs collected from the Klamathon station during the last winter and spring that will not appear in the statistical report until the next biennial report of the Commission.

The limit of hatchery operations has been reached until the people, through the legislature see fit to increase our funds for fishcultural operations. We are now operating thirty hatcheries and egg-collecting stations, several pond systems for the rearing of brood fish, two distributing cars, on which we have been paying regular transportation rates over all the railroads in California, as well as a divison of screens and fishways. The total valuation of the property of the state in use in the fishcultural work, such as hatcheries, lands, fish cars and equipment and all the other equipment necessary to successfully carry on the work, is approximately $350,000. The repairs and improvements on this property amounts to a large sum annually. We are continually carrying on experiments and investigations to improve the work of producing more and better fry and to get better results in our work of distribution.

The same condition exists as I mentioned in my two last biennial reports regarding the ever-increasing demand for trout fry caused by the increasing population of the state and the easy accessibility of the lakes and streams caused by the building of good roads and highways and the use of the automobiles that have placed within easy reach of the lover of the outdoors, places that a few years ago were almost inaccessible. A comparatively short time ago, if a person in ordinary circumstances made one trip to the mountains with a team during the season and enjoyed a few days hunting or fishing, he was well satisfied, but now with the advent of the automobile, there are hundreds of persons who go to some stream or lake to fish over each week end and many times during the whole period that the season is open. The limiting of the catch to twenty-five trout per day by the last session of our

legislature was a move for conservation, but without an increased force of deputies to enforce the law, the limit is often exceeded by persons, who otherwise consider themselves law abiding citizens.

The number of deputies should be greatly augmented to enforce the fish and game laws and there is only one way to do it and that is to increase the revenues of the Commission so that an adequate force of deputies can be in the field all the time.

During 1920, the output of our hatcheries was 17,000,000 trout fry. In 1921, the output was 23,000,000 and the present season, 1922, for which a detailed report will not be in readiness until two years hence, will exceed 25,000,000 trout fry. The statistical report of the distribution of trout fry for the seasons of 1920-1921 will be found in the appendix.

In an effort to keep the waters of the state from being depleted of trout thirty hatcheries and egg collecting stations are operated at full capacity. In many streams examined in the last few years, there are very few, if any, breeding fish left. The constant fishing by anglers during the open season of the easily accessible streams, has so reduced the number of adult fish that natural propagation is limited and insufficient and the streams must be kept stocked from the hatcheries, if the public is to continue to enjoy the privileges of fishing.

TROUT.

The total distribution of trout fry from the different hatcheries for the biennial period ending July 1, 1922, was 40,974,000, the largest number planted in the same period of time since the creation of the Commission. Improved methods of hatching, rearing and distributing the fry are constantly being made, but still it is impossibble to meet the demand made on our trout waters by the anglers. There is a constant demand for more hatcheries and a larger output of fry, and several more hatcheries are needed in the state, but funds must be provided before any further increase of fish from out hatcheries can be had or new hatcheries constructed. Hundreds of persons applying for fish have been instructed to make a wide distribution of the fry. The best results are obtained where the fry are well scattered and planted on the riffles and in the shallow water of the lakes some distance from shore. A close check of the work has shown good results. The cooperation of the sportmen's clubs, county boards of supervisors, chambers of commerce and others, has been of great assistance in getting the fry planted properly and often in almost inaccessible places. The growing interest in the propagation and planting of trout fry is the result of the success in past years.

We must urge again, as in previous reports, that a shorter open season for trout fishing should be instituted for reasons as stated in other reports, viz., to allow the fish a chance to breed in the spring and fall, as well as to give them a chance to grow when the temperature is favorable.

The thousands of fish taken by anglers from Eel River, Klamath and Feather rivers and other places where our egg-collecting stations are located is greatly diminishing the number of breeders each season and the work of collecting eggs from wild trout becomes more difficult each season. The State Fish and Game Commission should, at an early

date, be furnished with funds to establish several pond systems where fish can be reared in numbers great enough to furnish an adequate supply of eggs for all the hatcheries. One of the best pond systems to be found anywhere, is located at the Mount Shasta station, but it is not large enough and owing to the limited water supply, can not be increased. Nearly one-third of the trout eggs collected in California this year were taken from the stock fish in the ponds at Mount Shasta Hatchery. The eggs can be procured from the ponds for less money than they can be taken from wild fish when all the uncertainties connected with collecting eggs from wild fish are considered. The droughts and floods, deep snows, extremely cold weather and other conditions

FIG. 7. Catch of trout from Lake Eleanor, part of the San Francisco Hetch Hetchy project. Many of the new storage reservoirs in the mountain districts are affording splendid fishing.

always make the work at the egg collecting station uncertain. We do not know from one season to another what to expect. Some years the extremely light rain or snowfall causes conditions that are unfavorable for the collection of trout eggs. In other years, floods and extremely high and cold water change the movements of the fish so that our take of eggs is often far less than that expected. The breaking up of the runs of trout in our streams by high dams, built by hydro-electric companies and irrigation projects are all having their effect and to meet these new conditions, it is imperative that the Legislature provide ample funds for the construction of rearing ponds where a sufficient number of breeding fish can be raised to supply the demand for at least two-thirds of the waters to be stocked.

KLAMATH RIVER.

The great Klamath River, the last stand for the collection of both salmon and wild rainbow trout eggs in any large numbers, should be kept free of dams, so that a dependable stock of trout and salmon may be secured from this source for many years to come. The Klamath River runs through a mountainous region from the Oregon line where it enters California to its mouth on the boundary line of Del Norte and Humboldt counties, where it flows into the ocean. There is practically no tillable land, except Shasta Valley, where the water of this stream could be used for irrigation. Applications have been made to construct large dams on this river for the purpose of developing hydro-electric energy. A protest has been filed against these applications to the Federal Power Commission and a protest will be made before the State Water Commission against the construction of these proposed dams. There is enough water appropriated in the other river systems of California to furnish electric power for the development of the state for many years to come, without destroying the salmon run in the Klamath River by the construction of dams impassable to salmon. The construction of high dams on the Klamath River, will surely destroy the salmon run in that river in a short space of time.

FIG. 8. A trap set at Blackwood Creek, Lake Tahoe, before and after uncovering, April 1, 1922. Spawning operations are often difficult because of the heavy snows.

We are satisfied, beyond any question of a doubt, that the chinook salmon (*Oncorhynchus tchawytscha*) and the silver salmon (*O. kisutch*) will not ascend a fishway over a dam where the elevation is over 30 or 35 feet. Our observations in this state and the experience of the experts of the Bureau of Fisheries in Oregon and Washington confirm this statement. The parent stream instinct of salmon is so strong that no matter how perfect the fishway may be built, salmon, particularly the chinook, will only ascend a fishway a short distance, then their instinct impels them to follow the main stream and they leave the fishway and return to the river, and attempt to ascend the main stream, following the bed of the river that their progenitors have followed through centuries past.

While it is true that the species of the Salmonidae will enter tributary streams to propagate, each stream, to a certain extent, has its own race or run of fishes that have been propagated in it. Otherwise, all the salmon that enter a large river would ascend the first tributary that was favorable and suitable for spawning purposes. Competent engineers

who are not fish culturists or scientists, suggest as feasible long fishways on easy gradients with rest pools at convenient places for the passage of salmon over and around the high dams that are being proposed by promoters of hydro-electric power enterprises. The instinct of the salmon to follow the main stream is sure to make any of these plans a failure.

The salmon run in the Klamath River should be maintained for the use of the people as a food supply as well as to furnish eggs to keep up the supply in the Sacramento and Eel Rivers. Hydro-electric projects and irrigation canals have cut off eighty per cent of the spawning grounds on the tributaries of the Sacramento and San Joaquin rivers. The Bureau of Fisheries is assisting in every way possible to maintain the salmon supply by operating their hatcheries and egg collecting stations at Battle Creek, Mill Creek and Baird in Northern California. Their work must be augmented by the surplus eggs from the Klamathon station on the Klamath river, if we are to have the salmon run maintained in numbers sufficient to be of any great benefit to the people.

Referring again to the situation on the Klamath River; if the fishways should be constructed that would allow the salmon to ascend above the dams to their natural breeding grounds and to the egg collecting stations, the fry, the result of natural propagation or from the hatcheries, would be destroyed in passing through the wheels used to operate the generating plants as it is impossible to construct a screen of sufficient fineness to prevent the fry of anadromous or sea running species of fishes from entering the pipes or tubes that furnish the water to the power plants. A great deal has been said and written by the promoters of the projects regarding the installation of electric fish stops, by the use of electrodes to develop an electrical current in the water near the end of the intake pipe. Experiments have satisfied us that the plan is not practical. Freshwater fishes or those that spend their entire lives in fresh water, do not descend the streams in schools or with such a strong instinct to descend with the current as do the anadromous fishes. The anadromous fishes such as the different species of salmon and the steelhead trout are impelled by their instincts to descend the rivers to the ocean, no matter what obstacles may be placed in their way. They must enter the ocean to develop to maturity, and no electrical current passing through the water that causes a tingling or stinging sensation is going to stop them. If the electrical current is made too strong or strong enough to stop their power to swim, they are either killed or stiffened up so that their powers of swimming are paralyzed and they will drift with the current into the pipes leading to the impulse wheels. Screens with meshes small enough to stop the descent of the fry would choke up during the flood season when the fry are making their descent to the sea and at other times, and would be removed by operators of these power plants, so the flow of water to their generators would not be interfered with. Screens in ditches and canals can be easily installed and cleaned, but screens fine enough to prevent the fry of anadromous fishes from entering pipes leading from high dams to power wheels are not practical. Freshwater fishes whose habits are to live their entire lives in the streams and lakes and rivers are easily turned away by ordinary screens as they are not impelled by a strong instinct to descend the streams. They move from different places in the stream in search of food and breeding

grounds and quickly adapt themselves to a changed environment. If the freshwater fishes come in contact with a screen even if the meshes are quite wide apart, they will not make any great effort to pass through unless they are forced to do so by roily water or high temperatures. In ordinary temperatures and normal conditions, they are content to remain in their natural habitat, viz., the pools of the stream where they have been propagated and find conditions suitable for their existence. But the anadromous fishes following their instinct to descend the streams make every effort possible to do so, when the periods of their migrations are on.

CHINOOK SALMON.

The propagation of chinook salmon becomes a matter of greater importance each season, as the natural spawning grounds are being cut off in the rivers and streams of the state by the erection of high dams for the development of hydro-electric power and irrigation. As near as we can estimate; over eighty per cent of the natural spawning grounds on the Sacramento River, San Joaquin River, Feather River and their tributaries are now cut off from the salmon runs. The chinook salmon must of consequence, be greatly reduced in numbers or greater efforts made to propagate them artificially at the hatcheries. The Bureau of Fisheries stations at Battle and Mill Creeks have been operated during the past two seasons, but owing to the flood in the fall of 1920 and the drought of 1921, the take of eggs by the Bureau of Fisheries was very light at Battle Creek and Mill Creek stations.

Owing to the impassable condition of the dam of the Anderson-Cottonwood Irrigation District at Redding, the salmon were prevented from entering the McCloud River and consequently the Bureau of Fisheries did not collect any eggs at Baird. Injunction proceedings against the Irrigation District were begun by the Fish and Game Commission during 1920, through Honorable Jesse W. Carter, district attorney of Shasta County, assisted by our attorney, R. D. Duke, and an application made by him for a temporary injunction restraining the district from operating the dam until an efficient fishway was constructed that would allow the salmon to pass this barrier. The resultant agreement provides that the fishway is to be made efficient by such changes as the fishway inspector and the engineer of the irrigation district should decide was necessary. This fall the necessary changes will be made.

During the fall of 1920, the run of salmon was rather light on the Klamath River but an average take of eggs was expected, but a severe storm caused the Klamath River to rise damaging the racks to such an extent that a large portion of the salmon escaped causing the take of eggs to be materially decreased. Nevertheless, 2,766,000 eggs were collected and shipped to Fall Creek Hatchery, Mount Shasta Hatchery and Fort Seward Hatchery on Eel River.

During the fall of 1921, conditions were very favorable on the Klamath River and the egg collecting crew managed to procure 19,000,000 chinook salmon eggs, the largest number ever collected from the river. The eggs were shipped to Fall Creek Hatchery at Copco, Mount Shasta Hatchery at Sisson and Fort Seward Hatchery on Eel River. The resulting fry were hatched and reared in good condition. The fry hatched from the eggs at Fall Creek Hatchery, were held in

ponds and will be released this fall when conditions of the river and temperature are favorable.

We desire again to call particular attention to the salmon run in the Sacramento and San Joaquin rivers. Already greatly depleted, it is threatened with extermination, if measures are not taken at once to increase the output of salmon fry from the hatcheries. The construction of impassable dams and the diversion of water for irrigation is fast cutting off the last remaining spawning beds in the tributary streams of these rivers and this excellent fish is doomed to extermination if prompt action is not taken. This department has called attention to this condition for the last four years, but the legislature and the commercial fishermen as well as the general public pay no heed to the recommendations offered and no action to save this fine fish is taken. The Fish and Game Commission is waging an uphill fight when it comes to conservation as the people do not realize the destruction of wild life until it is too late.

MOUNT SHASTA HATCHERY.

During the season of 1920 and 1921, the Mount Shasta Hatchery has been operated to its fullest capacity, 10,966,000 salmon fry and 21,676,800 trout fry being hatched and distributed from this station. The Mount Shasta Hatchery is one of the best equipped stations in the country. The pond system alone furnished 18,000,000 trout eggs during the last biennial period. These with the additional eggs shipped from outside stations, gave this splendid total of trout fry that were distributed throughout the state, from this hatchery.

The Mount Shasta Hatchery has had the necessary repairs to keep this important station in a condition to operate without unnecessary loss and damage. During 1921, the following repairs and improvements were made: Lumber shed 18 feet by 20 feet, with corrugated steel roof; garage 30 feet by 24 feet, 10 foot walls; new foundation under water tank that furnishes water to the superintendent's residence and cottages for the help; new culverts and gates in five of the large ponds; new foundations under Hatchery B and old shingle roof replaced with corrugated steel roofing; all troughs from Hatchery D removed and new sills put in under the building and new columns supporting the roof; also forty-six new troughs were installed in the place of those too badly decayed for further use; new sills were put under Hatchery C and a new floor in the aisle; a new settling tank for Hatchery E was built, 8 feet by 48 feet by 4 feet in depth; an addition to the carpenter and repair shop 12x16 feet was made, ceiling placed in the laundry at the superintendent's residence; fourteen new electric light poles were placed on the grounds and wires restrung; new stringers placed under main bridge across the head of inlet ponds; new furnace constructed in food preparation room.

Repairs in 1922: Waste gates repaired to date on ponds 28, 29, 30 and also walls repaired on ponds 5, 39 and 40; hatcheries B, C, D, meat house, woodshed, barn, lumber shed, repainted; other buildings will be painted during the year; 800 feet of new railing placed around ponds to replace those that were rotted and falling down; 2½-inch well driven for domestic supply and connected with pump to supply three of the dwellings on the hatchery grounds, as well as to furnish

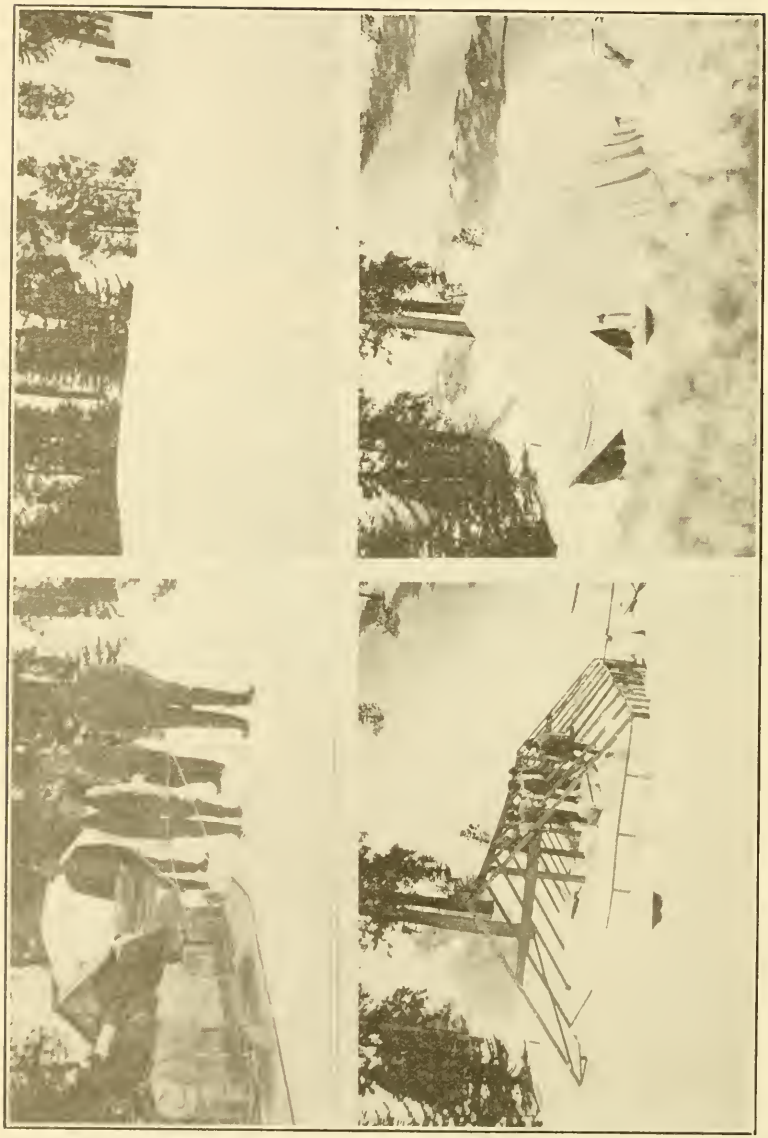

FIG. 9. Scenes at the Feather River Hatchery on arrival of the spawntakers, April 5, 1922. A. The spawntakers arrive with provisions. B. The hatchery site. C Uncovering the frame work. D. Ready for operations.

water for irrigating lawns and flower beds; foundation under hatchery A renewed; repairs made on pond walls that had rotted and were unsafe; new floor placed in the living room of the superintendent's residence. A great many other improvements were made to maintain the ponds, hatcheries, power plant, truck, wagons and other things too numerous to mention in a brief report.

A number of permanent improvements are needed at the Mount Shasta Hatchery to improve conditions and reduce the cost of operations. One of the most important is the installation of a refrigerating plant, where ice could be made to supply the distribution cars as well as to keep the fish food from getting tainted during the warm weather.

The large ponds that the state has been leasing from their owners for the rearing of salmon fry have passed into other hands and if the leases can not be renewed for a term of years, a new location should be found on some tributary of the Sacramento River, where suitable ponds for the rearing of salmon can be constructed and the salmon fry given the benefit of several months of pond culture before being released into the river.

Money is needed to make these improvements. This state is progressing and if the people desire to enjoy the angling in the many streams of the state and save the salmon, the fish par excellence of all our food fishes, the necessary funds must be furnished to the Fish and Game Commission to improve and enlarge the hatcheries and pond systems for rearing of fish. It is up to the people to make their decision, for in their hands rests the future development of fish cultural work.

BOGUS CREEK STATION.

This fine egg-collecting station has kept up its record during the last two years. There were 5,000,000 eggs collected during this period and shipped to the different hatcheries. A number of improvements were made during the two seasons last past: a tank for holding the spawning fish was built 30 feet long, 8 feet wide and 8 feet high; a board roof covered with malthoid roofing was placed over the tank; the old cabin was torn down and a new four-room cottage was built for the use of the station; concrete foundations were placed under the holding tank and a concrete toe wall was constructed under the racks and a concrete bed under the trap, besides other improvements to better conditions at the station.

HORNBROOK STATION.

This station did not come up to expectation in 1921, owning to a drought during the springs months, but the conditions were normal in the spring of 1922 and a good collection of eggs was had. During the biennial period of 1920–1922, there was collected from this station 2,172,000 rainbow trout eggs.

The following improvements were made at this station during the last two years:

Sixteen feet added to the holding tank, besides placing a concrete toe wall under the racks across the bed of the creek, eight feet in width; two extra concrete piers were placed under the rack frame to support the structure against the flood waters and a rock wall was built on the east

side of the creek to prevent the creek bed from washing out and widening the channel. This was necessary to prevent the high water from allowing the fish to pass around the trap in ascending the creek. During the seasons of normal rainfall, this is one of the best egg-collecting stations in the Klamath River basin.

KLAMATHON STATION.

The total take of chinook salmon eggs at this station during the last two seasons was 28,076,000. During November, 1920, a severe rainstorm damaged the racks at this station to such an extent that a large portion of the salmon in the pool between the racks escaped and passed up the river. This materially affected the take of eggs. The take during the fall of 1920, was 8,898,000 eggs, which were hatched at Fall Creek and Mount Shasta hatcheries.

During the summer of 1921, the piers were repaired and other improvements made on the racks and during the fall and early winter of 1921, 19,178,000 chinook salmon eggs were collected and shipped to Fall Creek Hatchery, Mount Shasta Hatchery and Fort Seward Hatchery in Humboldt County. These eggs hatched out in excellent condition and the resulting fry were distributed in the Sacramento, Klamath and Eel rivers.

The Klamathon Station is now one of the most important salmon egg-collecting stations in California, as the Klamath River salmon run can be increased by successfully planting several millions of salmon fry in the river each season. It is of vital importance that the salmon run be maintained in the Klamath River, to furnish eggs for the Sacramento, Eel and San Joaquin rivers and this can only be done by keeping high dams out of the river below the Klamathon Station.

FALL CREEK HATCHERY.

This station has been a success since it was built. All the salmon and trout fry reared at this station have been planted in excellent condition, except one small lot of salmon fry that became affected with a bacterial disease early this season. Fortunately this lot soon yielded to treatment when the pond was disinfected with the chemicals used for such purposes.

During 1920 and 1921, the following improvements were made at this station: three ponds completed: pond No. 1, 70 feet by 20 feet; pond No. 2, 115 feet long, 30 feet wide and 4½ feet deep; pond No. 3, 116 feet by 65 feet, average depth of 4 feet. These ponds are used for rearing salmon fry. A large settling tank was constructed to remove the sediment from the water supplying the hatchery.

The pond system has been a success. The temperature of the water and other conditions make the Fall Creek Hatchery an ideal place for the rearing of salmon fry. Several more ponds are needed at this station for this work as soon as the funds are available.

CAMP CREEK STATION.

This station has kept up its record as one of the best of our egg-collecting stations. There were 4,100,000 rainbow trout eggs collected during the last two seasons. The following repairs and improvements were made since our last biennial report: a large holding tank for

spawners was built 30 feet long, 6 feet wide, and 8 feet high, with concrete foundation; a toe wall or concrete bed was laid across the bed of Camp Creek, 8 feet wide on which the rack for the traps are placed; a concrete foundation was placed under the trap and a small concrete pier was built on the south bank of the creek to prevent the washing away of the banks; an addition was built on the cabin used by the men for living quarters; an extension of 16 feet was made on the large holding tank and a small tank used during the time the fish are being handled for spawning purposes; 365 feet of new flume was built from the creek to the holding tank, and a suspension bridge was constructed across the Klamath River, 257 feet long to be used to carry the eggs from Camp Creek Station across the river to the railroad so that they can be shipped to the different hatcheries. This was necessary as the river is so rapid that the men were constantly in danger of losing their lives by the overturning of the boat used to convey the eggs across the river.

MOUNT WHITNEY HATCHERY.

Mount Whitney Hatchery has been operated to its full capacity during the last two seasons. The remarkable growth of the fry in this hatchery still attracts the attention of the applicants and fish culturists.

During the fall of 1921, an epidemic appeared among the fry at this hatchery that caused considerable concern for a time but a protracted treatment brought the fry out in good condition with a very small loss. We were assisted in our investigation of this disease by the members of the State Board of Health and the state bacteriologist at Berkeley, who kindly made laboratory examinations for our department, as our laboratory equipment has not been unpacked owing to the fact that we have not been able to procure a room in which to work.

FIG. 10. Fresno County Sportsman's Club planting fish. The Commission depends largely upon the work of such organizations for the successful transfer of the fish from the fish distribution car to the stream. Photograph by Bart Harvey.

The grounds at Mount Whitney Hatchery have been improved by the planting of trees and flowers. The lawn and flowers are being kept in good shape, and the hatchery is one of the most attractive places in Inyo County. Hundreds of tourists and vacationists going into the upper part of Inyo County, Mono and Alpine counties, stop at the hatchery every week during the summer and fall.

This hatchery has proven to be one of the most important and valuable hatcheries in the country. It supplies a large district with trout fry in excellent condition. The distribution area that is covered from this hatchery includes the country adjacent to the eastern side of the lower San Joaquin Valley, Inyo and Mono counties to the north and the counties below the Tehachapi Range to San Diego, except San Bernardino County, which receives the bulk of its trout fry from Bear Lake Hatchery. The demand for fry from this hatchery is greater than the capacity of the hatchery to produce. Additional hatchery equipment should be added to this station when funds for this purpose are available.

FIG. 11. Type of pack can utilized by Fresno County Sportsman's Club. Several of the clubs own their own cans. Photograph by Bart Harvey.

Pack trains should be provided to carry trout fry to the barren lakes in the high Sierra to the west of the hatchery, and to other sections, as well as to restock the depleted streams and lakes where the fish are greatly depleted in numbers by the excessive fishing of the last few years. This important hatchery should be enlarged by the addition of smaller auxiliary hatcheries erected on the same grounds, all under one management and where the same water supply can be used that is now being used in the main building.

COTTONWOOD LAKES STATION.

The collecting of golden trout eggs during the season of 1920 was carried on from the middle of June to the latter part of July. There were 782,000 eggs collected and conveyed to the Mount Whitney Hatchery. These eggs were very delicate and produced a great many structually

weak embryos. These succumbed early in the season, but the remainder, 319,000 were distributed in the lakes of the high Sierra and in lakes in the Yosemite National Park. Reports received from a number of lakes where these fish have been introduced are, that they are thriving and making a rapid growth. The golden trout is a very delicate fish and is not resistant to bacterial infection of a pathogenic nature. This, no doubt, is due to the fact that these fish have inhabited the pure water of the high Sierra range, that is free from bacteria and fungoid growths for many ages and have not the resistance of the species that have their range in lower altitudes or the exotic species that have been introduced into this state from the eastern states and Europe.

The golden trout by their bright colors, fall prey to the other species. They will not thrive where other species of trout are living and should only be planted in waters where no other species of predaceous fish exist. No collection of golden trout eggs was made during 1921 or 1922, as we were desirous of determining the results of the plants already made. We would recommend that the golden trout distribution be confined only to the barren lakes of the high Sierra range, until at such time as a resistant stock of these fish can be propagated.

RAE LAKES STATION.

The Rae Lakes Egg Collecting Station was operated during the seasons of 1920, 1921 and 1922. During these three seasons, 1,488,000 eggs were collected. The fish do not yield over 250 eggs each on an average caused by the lack of proper food in the lake owing to the high altitude, 10,500 feet. The eggs are delicate and considerable extra care must be given them in the early stages to produce strong fry. As soon

FIG. 12. On the summit, 13,000 feet, with rainbow trout eggs from Rae Lakes, July 20, 1920. Photograph by L. J. Stinnett.

as the fish cultural department can make further investigations, efforts will be made to introduce the proper aquatic plants and insects to furnish a greater abundance of food for the fish in these lakes.

During 1920, species of gammarus were introduced into Rae Lakes, but we have not been in a position to have an examination made as to whether they have thrived or not. This work should be taken up as soon as funds are available and a survey made of the Rae Lakes and other regions to introduce insects for fish food where such life is scarce.

TAHOE HATCHERY.

The new Tahoe Hatchery building was completed during the fall of 1920. It was operated during 1921 and is being operated during the present season of 1922. During these two seasons 1,500,000 trout fry were hatched in excellent condition. The new site is a great improvement over the old hatchery site near Tahoe City. There is an abundance of pure water. The only condition that must be overcome, one which was planned for when the new site was selected, is the construction of shallow ponds surrounding the springs that furnish the supply of water for this hatchery so that the cold water may be increased in temperature, in order not to retard the development of the fry. While the fry raised in the cold water are very strong and healthy, they do not grow as rapidly as they should and the ponds for warming the water should be built at an early date.

The plan of fencing and improving the grounds around the new Tahoe Hatchery, of building roads and cottages for the help and a building to be used for a storeroom and for preparing the feed for the fish, have not been carried out, as there was not sufficient funds to complete this work and to carry on the increased amount of work at the other stations of collecting eggs, hatching and distributing the fry.

The new Tahoe Hatchery, when all the work on the grounds and water system, is completed will be one of the most attractive and up-to-date hatcheries in the country and one in keeping with the general progress of improvements around Lake Tahoe.

BLACKWOOD CREEK TRAP.

A trap was installed in Blackwood Creek during 1921-1922 as has been done in former years, when conditions were such that we desired to collect an extra number of eggs. A good take of eggs was secured considering the seasons. During the season of 1921, the water was rather low. During the season of 1922, there was a deep snowfall on the watershed of Blackwood Creek and the snow melted rapidly during June, causing extremely high water which wrecked the trap. During the two seasons 1,000,000 eggs were collected that well repaid the Commission for the efforts made.

WARD CREEK TRAP.

A trap was placed in Ward Creek during the spring of 1922 in an attempt to collect a larger number of eggs for the Tahoe Hatchery. The melting of the deep snow caused very high water in the creek and caused the crew considerable trouble to keep the racks in place. A number of fish escaped over the racks, but 200,000 eggs were collected.

All of these traps should be constructed with concrete toe walls across the bed of the creeks and permanent racks built. The traps made of light material and built on temporary cribs or make-shift affairs are damaged whenever there is a flood on the creeks and consequently we do not get as many eggs as we should. All of this kind of work should be made permanent whenever funds for permanent work can be obtained.

TAYLOR CREEK TRAP.

During the fall of 1921, a trap was constructed in Taylor Creek near Tallac Hatchery as it was estimated that it would be cheaper to operate a trap than a seining crew at the mouth of the creek, until the scattered run of fish would be attracted to the creek by the overflow of Fallen Leaf Lake which had held the water of Taylor Creek back for several years during the period of drought. The management of the

FIG. 13. Fish pond No. 3 at the Fall Creek Hatchery, one of the ponds utilized as a nursery for young salmon.

Tallac Hotel had been storing the water in this lake for hydro-electric purposes and caused the flow of water to be so low in the creek during the spawning season that the fish were not attracted to the stream as in former years and consequently the take of eggs fell off. This past spring, the melting snow and the early rains last fall caused the lake to fill and there was an abundance of water in the creek. The water was so high that the trap was damaged, but the crew managed to collect approximately 250,000 eggs. With the return of the average seasonal rainfall and snow storms, the creek will have its normal flow and in a year or two the same good run of trout will be found in the creek as during the past twenty-five years, with the exception of the years when the water was being stored in the lake; then seining operations will be the proper means of collecting eggs at the mouth of Taylor Creek.

MOUNT TALLAC HATCHERY.

This hatchery has been operated during the past two seasons, with the usual results. The seining operations at the mouth of Taylor Creek were discontinued owing to the run of fish being broken up and scattered by the low water in the creek during the last four years of drought, lasting up to the winter of 1921-1922, when a normal snow and rainfall prevailed throughout the Tahoe basin. We operated traps in the surrounding creeks to collect our supply of eggs for this station as well as shipping eggs from other stations. With the return of normal weather conditions, the run of trout in Taylor Creek will soon be as good as in former years. We have made our usual plants of trout fry in Taylor Creek and no doubt when the seasonal storms are normal and the creek discharges its usual amount of water into Lake Tahoe, the trout will enter the stream as in former years and in as great a number.

There were hatched and distributed from Tallac Hatchery during the

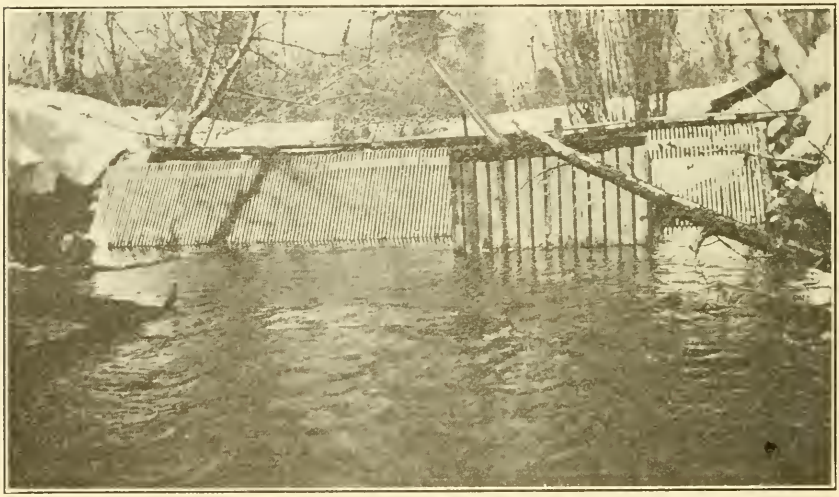

FIG. 14. Racks and trap on Taylor Creek, Lake Tahoe, April 1, 1922. Such temporary racks are utilized in securing black-spotted trout for spawning purposes.

last two seasons 1,318,000 trout fry. During 1922 we are hatching 800,000 eggs. The troughs at this station need renewing and the station needs a general overhauling and many needed repairs.

UPPER TRUCKEE RIVER EGG-COLLECTING STATION.

In the fall of 1920, a trap and egg-collecting station was established on the Upper Truckee River, between the mouth of the Upper Truckee River and Myers Station. The station was built to collect black-spotted trout eggs of the variety known as the large lake trout which ascend this stream to spawn; also to prevent the fish from ascending the stream to its upper reaches, ultimately to be destroyed on descending the stream by the farmers and stock raisers damming the river to flood their meadow lands during the summer and fall. There does not appear to be any law to prevent landowners from placing temporary dams in streams to raise the water level so that it will run over the land on

either side of the stream and thus flood their cultivated lands. A law should be passed to prevent this method of irrigating as it is impossible to screen the water where it is allowed to pour over the banks of a stream for a distance of several hundred feet, to flood a piece of land.

The trap has been successfully operated during the spring of 1921 and 1922. One million eggs were collected and shipped to the different hatcheries.

UKIAH HATCHERY.

Ukiah Hatchery, the property of the town of Ukiah, has been operated under a lease for the last two seasons as in former years. This small station is a very valuable one for our purpose. It furnishes fry for the local district as well as providing for the eyeing of eggs collected at the Snow Mountain Egg-Collecting Station at Cape Horn dam on the South Eel River. The water at Snow Mountain Station is not fit for hatching or the eyeing of eggs as soon as the warm weather of the spring sets in. We are now negotiating with the trustees of the town of Ukiah for a lease for a term of years so that needed improvements can be made at this station. The state should own all its hatchery sites and not be compelled to operate on leased lands. The majority of the egg-collecting stations and small hatcheries are on leased land owing to the fact that the commission has not had the funds to purchase lands and water rights. The funds of the Commission have never been adequate to carry on the work of propagating fish and distributing the same and at the same time furnish money enough to purchase land and erect as many suitable hatcheries as the work demands. If the lease on Ukiah Hatchery can not be renewed, another site in that section will have to be selected as it is necessary that the Commission have a permanent hatchery in that section in which to hatch eggs collected in the South Eel River section. Of the eggs retained and hatched at this hatchery during the last season, there were 512,000 fry shipped to the applicants of this region.

SNOW MOUNTAIN STATION.

The total take of eggs at Snow Mountain Station during the two seasons covered by this report were 2,873,000 steelhead trout eggs.

The drought of 1920 and the excessive fishing in the lower reaches of the river caused a falling off of the number of spawning fish that reached the Snow Mountain dam. We are planning to have an increased take of steelhead eggs from this section as the stopping of commercial fishing in the lower reaches of Eel River will allow a greater number of spawn fish to reach the station and the holding of a portion of the water in Lake Pillsbury will give us an opportunity to raise rainbow trout for stock fish.

LAKE PILLSBURY.

This body of water was made by the Snow Mountain Light and Power Company constructing a dam across the South Eel River about twelve miles above Cape Horn dam. The dam is situated below the junction of the Rice Fork of the Eel River, Salmon Creek and the main South Eel River. The dam is over one hundred feet high and the

reservoir covers an area of approximately 2000 acres. This reservoir holds back the flood water of the river and will be used for developing electric power and irrigation. The water will be drawn down each season, except a portion that will be left in the bed of the reservoir next to the dam. There will be a basin left of from 50 to 80 acres, from 12 to 15 feet deep. In this basin the trout will enter as the water recedes from other portions of the lake.

This area will be ample to keep the fish in good condition until the lake begins to fill from the winter rains raising the streams flowing into the lake. During the spring months the eggs can be collected by catching the spawners as they ascend the three tributary streams. Traps and a small hatchery will have to be built to collect and handle the eggs. The tributary streams will have to be stocked with a number of rainbow fry each year to maintain the brood stock in the lake. Fishing should be prohibited in the lake as well as in the South Fork of the Eel River above the dam, Rice Fork of the river, Salmon Creek, as well as in one or two other small streams that empty into the lake for a distance of several miles from the lake, so that the streams can be used as a rearing ground for the trout fry that must be planted in these streams each season to maintain the breeding stock in the lake.

FORT SEWARD HATCHERY.

Fort Seward Hatchery was established in 1916 for the purpose of raising trout and salmon fry for the region covering northern Mendocino County, Humboldt County and western Trinity County. The hatchery has proven a success from the time it was established. The ever-increasing demand for trout fry in this district demonstrated that this hatchery was too small for the district to be stocked. During the fall of 1921 plans were made to enlarge the hatchery and make general improvements at this station. An addition was built on the hatchery building and forty troughs added. The hatchery now has a capacity of 100 troughs which if operated to the best advantage will furnish all the fry necessary for this district for a great many years.

A number of improvements were made since our last biennial report. A tram and cable line with a skip have been installed to convey fish egg cases and supplies to the hatchery as well as to transport fish cans from the hatchery to the railroad stations. This tram system is operated with a gas engine located in the hatchery. It has operated successfully and saved the expense of keeping and hiring teams to transport articles to and from the hatchery. The bridges leading to the hatchery on the roads from Fort Seward on one side and Alderpoint on the other, have been washed away and the only way the foreman and the hatchery employees have to get their supplies is by railroad and from the railroad station to the hatchery over the aerial tram system. Whenever funds are available, these roads should be placed in repair and the bridges rebuilt and an auto truck or team furnished this station. The Fort Seward Hatchery is one of the most important in the state as it has a large territory to supply with trout and salmon fry and has the only water supply on the line of the Northernwestern Pacific Railroad that can be depended on to furnish suitable water for hatchery purposes all through the year.

During the two seasons covered by this report, there has been distributed from this hatchery 1,850,000 trout fry and 1,000,000 salmon fry, besides 1,375,000 trout fry and 2,000,000 salmon fry that are now being planted that will be reported in the next biennial report.

There was an epidemic among the fry at this station this season, caused by bacterial infection. The exact cause was not determined. The fish were given the best care possible and everything done to keep them in good condition. Laboratory examinations were made of the water from the creek and smears and water from the troughs, but too much time had elapsed between the time the trouble ended and the laboratory examination, to determine the cause. The opinion of those at the hatchery was that the trouble was caused by the carcasses of a couple of deer decaying in the creek above the hatchery supply. The decomposition of animal matter in the water will often cause trouble among the fry at the hatchery. After the loss, caused by the affection among the fish, the remainder of the fry were shipped out in good condition.

BROOKDALE HATCHERY.

All the steelhead trout eggs collected at Scott Creek Egg-Collecting Station were transferred to this station as in former years. The usual number of eggs to supply sufficient fry to stock the streams of Santa Cruz County were hatched at this hatchery, and the remainder of the eggs were shipped to other hatcheries. The Brookdale Hatchery is the property of the county of Santa Cruz and is operated by the state under an agreement providing that half a million steelhead trout fry be hatched and planted in the waters of Santa Cruz County each season under the direction of the board of supervisors of the county. The building is getting old and the foundation is rotted. A new hatchery should be built on some other site in Santa Cruz County, where there is a larger supply of water. The water supply is not sufficient to hold the trout at Brookdale Hatchery as late in the season as they should be held, and a larger hatchery is desirable. An increase in the number of fish to be planted in this section is very important to supply the demand of the anglers. If funds are not provided for the construction of a new hatchery in this section, a large sum will have to be spent in another year to repair and improve the old building, which the water supply does not justify.

SCOTT CREEK STATION.

This station which has been leased from Santa Cruz County was purchased by the Fish and Game Commission during the fall of 1920. The site was purchased from Mr. Gianoni and the county of Santa Cruz relinquished their rights to the cottage, tanks, traps, dam, etc. This gives the state full control of a very good egg-collecting station, where an average of 2,000,000 steelhead trout eggs are taken annually. This was a good investment for the state as Scott Creek has been set aside as a fish preserve by the legislature, thus insuring a permanent supply of eggs for that district. There was collected during the two seasons covered by this report, 4,200,000 eggs.

ALMANOR HATCHERY.

This hatchery, located near the outlet of Lake Almanor was abandoned during the fall of 1920. During the latter part of each season there was not sufficient water to operate the station successfully, as the Great Western Power Company uses so much of it for the domestic supply at their cottages, thus depriving the hatchery of its supply. The building was torn down and the troughs moved to Domingo Springs Station. The lumber was also used in making improvements at Domingo Springs.

DOMINGO SPRINGS STATION.

This egg-collecting station and hatchery has been successfully operated during the last two seasons. The rack across Rice Creek where the trap is situated was damaged by high water during the spring of 1920. New cribs were built and timbers for the main chord replaced and the rack and traps generally overhauled. This station furnished us with 3,500,000 rainbow trout eggs during 1920-1921.

WARNER CREEK TRAP.

During the fall of 1920, a rack and trap were placed in the mouth of Warner Creek. Warner Creek rises in Warm Spring Valley on the basal slopes of Mount Lassen and flows southerly to its junction with Rice Creek, the two streams forming the North Fork of Feather River, tributary to Lake Almanor. During the spring, the water in Warner Creek rises to a great height in the narrow canyon at its mouth. A large number of rainbow trout ascend this stream each spring. A permit was obtained from the Forest Service to erect a cabin and place a rack and trap in this stream. The high water made it difficult to operate at this place, but our crews managed to procure 896,000 eggs during the springs of 1921–1922. This station is located about five miles below Domingo Springs Station. There should be one large rack constructed across the North Fork of Feather River below the junction of Warner Creek and Rice Creek and all the work concentrated at one place. This will insure a large take of eggs each season and at the same time be more economical.

A lease for a hatchery site and egg-collecting station below the junction of Warner Creek and Rice Creek was procured from Curtis, Collins, and Holbrook Company three years ago, but as we have not had sufficient funds to construct the station, the work has been deferred until the financial condition of our Commission would permit the work being done.

CLEAR CREEK HATCHERY.

Clear Creek Hatchery and Egg-Collecting Station has been operated as in former seasons. The run of fish from Lake Almanor entering Clear Creek, a tributary of the Hamilton branch of the Feather River which has its mouth in Lake Almanor, still maintains a good run of rainbow trout despite the heavy fishing in the lake. Two million eggs were collected at this station and 600,000 fry hatched at Clear Creek Hatchery. The remainder were shipped to other stations. The traps and tanks were enlarged and plans are being made to enlarge the holding tanks and to

place more troughs in the hatchery. A cabin will be built for the accommodation of the help. This station can be improved so that several hundred thousand more eggs can be collected annually.

JOHNSVILLE EXPERIMENTAL HATCHERY.

This station was established during the spring of 1921. It is situated on Jamison Creek, a tributary of the Middle Fork of the Feather River, seven miles from Blairsden on the line of the Western Pacific Railroad and two miles from the mining town of Johnsville. The site was selected on the property of the Plumas-Eureka Mining Company in a narrow valley lying between Eureka Peak and Mount Washington. The object was to establish a hatchery in this region to furnish fish for the South Fork of the Feather River, the Middle Fork of the Feather and their tributaries, South Fork of Yuba River and tributaries and the lakes in the Gold Lake region, as well as other streams along the line of

FIG. 15. Rack at Camp Creek, a tributary of the Klamath River, April 12, 1922. The Camp Creek Egg Collecting Station furnishes many thousands of rainbow trout eggs annually.

the Western Pacific Railroad. The hatching troughs, forty in number were placed in a tent and a temporary tank and flume for the water supply installed. This work was done under great difficulties owing to the depth of the snow. There were 689,000 rainbow trout fry and 111,000 steelhead trout fry distributed from this station. The rainbow fry did not thrive during the early part of the season. They were affected with a fungoid disease probably brought to the hatchery with some shipment of eggs. There was considerable loss among the fry for a time; but as the season advanced the fry improved and were planted in good order.

During the spring of 1922, when our men arrived on the ground to begin operations, the snow was from 12 to 15 feet deep on the level with great masses on the slopes of the adjacent mountains, threatening to come down in the shape of an avalanche at any time. The work of

shoveling out the snow and opening the station was an arduous one and one fraught with danger from the threatening snowslides. Mr. Doney and the foreman, Justin Shebley, after studying the conditions carefully recommended that after this season's operations, the temporary equipment be moved to a site at a lower altitude on a site easier of access to the railroad.

During the spring of 1922, 750,000 rainbow and steelhead trout eggs were shipped to the hatchery, but the work of getting the eggs from Johnsville and Blairsden over the deep snow on hand sleds was a very hard task. The eggs hatched in excellent condition and all the fry were planted in good condition. A suitable new site was found on the property of William A. Adams, on Sulphur Creek, where the snow does not fall so deep and where there is no danger of snowslides wrecking the building. A lease for this site was procured from the owners of the property and during the fall the cabin, troughs, tent frame, flumes and foundation will be moved to the new site and set up for next season's operations on a temporary basis. If the new site proves suitable, as it appears to from our study of conditions there, a permanent hatchery will have to be constructed with a capacity sufficient to furnish trout fry for the district mentioned above.

BEAR LAKE HATCHERY.

The new hatchery at Green Spot Springs, is known as the Bear Lake Hatchery. We have distributed from this station in Bear Lake and in the streams of San Bernardino County during the last two years, 2,228,000 trout fry. The eggs, in 1920-1921 were collected at the egg-collecting stations on the small tributary streams flowing into Bear Lake; viz., Metcalf Creek, North Creek, and Grout Creek. During the spring of 1922, owing to conditions prevailing at these stations, caused by extremely cold weather and low water, the spawning fish did not enter the creeks when they were ripe and ready to spawn, but congregated in schools off the mouths of the creeks where they remained until maturation had taken place in the ovaries, and when they did enter the creeks only a small percentage of the eggs could be fertilized, owing to the over-retention of the eggs. The average number was collected but owing to the small percentage fertilized, we were compelled to ship eggs from our northern California stations to furnish the Bear Lake Hatchery with its capacity number of eggs. Fishing has continued good in Bear Lake all season and if conditions are favorable, the usual number of eggs will be collected.

Reports have reached us several times during the last two seasons that someone had introduced black bass into Bear Lake without a permit from the Fish and Game Commission which is a violation of the law. No proof of this was had until a large mouth black bass was taken from the lake this summer. This is to be deplored, as the bass and trout will not thrive together in the same waters. In a few years, if the bass increase, they will gradually destroy the trout, and trout fishing in Bear Lake will be greatly diminished. The fishing for black bass will not take the place of trout fishing as bass will not bite in high altitudes except when the weather is favorable. The law against the introduction of fish into the waters of this state by private parties, without a permit,

should be made a felony. Incalculable damage may be done at any time by the owners of private fish farms and others who do not know anything about the habits of the fish they are handling, and care less, if they can but make a few dollars profit. We hope that the black bass will not thrive in Bear Lake, as there is every prospect that there will be good trout fishing in the lake if the limits and other laws are observed and the lake kept well stocked with trout fry each season.

NORTH CREEK EGG-COLLECTING STATION.

This station has been operated during the last two seasons as formerly. The run of trout during 1920-1921 in North Creek averaged about the same as during the two former seasons. There were 4,600,000 trout eggs collected during the two seasons covered by this report. 1,150,000 eggs were hatched and the resulting fry distributed as soon as they were swimming up well, which is the better way to plant fry in a lake such as Bear Lake where the water is shallow along the shores and where the large trout do not feed. There is an abundance of insects in Bear Lake so that the trout do not want for natural food. The fact that Bear Lake still affords good fishing for the anglers who visit it each season, is proof that this system of planting in Bear Lake is producing good results, as there are no natural spawning streams flowing into the lake in which the trout can spawn. The traps and tanks at North Creek Station were damaged by the flood water that came down the creek during December, 1921, as were all the traps at our egg-collecting stations on Bear Lake. These were temporarily repaired for the operations during the spring of 1922. Permanent traps with concrete foundations should be built as soon as the funds are available for this work. It will be more economical in the end than to be repairing damages caused by high water on traps that are not built on firm foundations.

METCALF CREEK TRAP.

This small station is an auxiliary of the North Creek Egg-Collecting Station. The same conditions prevailed at this place as are described for the North Creek Station. The trap was washed out during December, 1921, and temporary repairs made. This trap should have a concrete foundation and a different type of trap installed.

GROUT CREEK TRAP.

Likewise, the trap located on Grout Creek, one of the streams flowing into Bear Lake was washed out by the flood of December, 1921, and carried a quarter of a mile down the stream and deposited on the sand covered flat and there it was left when the flood waters receded. This trap was not used this season as the expense was too great to repair it or to build a new one.

WAWONA HATCHERY.

This hatchery has been operated during the last two seasons, with good results. During the fall of 1920, the troughs, foundations and tanks were renewed and repaired where it was found necessary. A bridge was constructed over the Merced River opposite the hatchery so that supplies could be delivered to the hatchery and the fish cans taken across

the river to the road without going over the almost impassable trail on the south side of the river. This bridge is a great improvement and facilitates the handling of fish and supplies at the hatchery. There was distributed from this station during the last two seasons, 690,000 fry. A cabin or small cottage should be built at this hatchery as the foreman has to live in a tent or board at the Wawona hotel, three-quarters of a mile from his work, which makes it inconvenient for him. Someone should live near the hatchery during the time the fish are being hatched and distributed.

KAWEAH HATCHERY.

The Kaweah Hatchery has been operated in a tent for the last three seasons as there has not been money enough in our funds to construct a permanent hatchery according to the plans submitted by the state architect. The fry that have been hatched at this hatchery were a strong, healthy lot, proving that the water is suitable for hatchery purposes. Plans should be made to construct a permanent building at this site as the demand for trout in the Sequoia and General Grant National parks and other sections of Tulare County and streams in the high Sierras east of this section, is very great. This station should be improved as soon as possible.

BRANSCOMB EXPERIMENTAL EGG-COLLECTING STATION.

During the summer of 1921, leases were procured for the sites of three traps and a temporary egg-collecting station on the South Fork of Eel River, Kinney Creek and Charlie Creek, tributaries of the South Fork of Eel River. Traps were installed and cabins of rough boards built for the accommodation of the men. A tent frame was erected on Kinney Creek and twenty hatching troughs set up. The work at this station was undertaken to determine whether a sufficient number of salmon and steelhead trout eggs could be collected in this branch of Eel River to supply Fort Seward Hatchery with salmon eggs to keep up the greatly depleted run of salmon in Eel River as well as to collect steelhead trout eggs to supply Eel River and other streams where the demand for steelhead trout fry is very great. The traps were installed during the summer and fall of 1921, and everything put in readiness to collect eggs if the salmon should run in such numbers as they did in former years.

Owing to the excessive fishing in the lower reaches of the river and the extremely low water in Eel River at the time that the salmon should have ascended the stream, no eggs were collected. During the spring there was such high water in these creeks that attempts to collect steelhead trout eggs were practically out of the question.

FISHWAYS AND SCREENS.

During the period from January, 1920, to June 30, 1922, the inspections of screens and fishways has been carried on efficiently. We find that there is less opposition in installing fishways and screens than when the work was first begun. The only ones to resist the law until threatened by injunction proceedings are some of the large hydro-electric companies, who do not want to comply with the law as they fear that if they construct fishways they will have to give up some of the

water to operate the fishways properly and maintain the fish below their dams. The amount of water that is necessary to comply with the fishway law, during the minimum flow of water in the late summer and fall is not great enough to work any damage to the power companies.

During the spring and late fall when the fish are ascending the streams to spawn there is ample water for all purposes. All that is required during the minimum flow is that enough water be allowed to pass through the fishway, culvert, over or around the dams to maintain fish life below them.

Following is a list of fishways surveyed and inspected for repairs or alteration by inspectors since our last report.

SURVEYS AND INSPECTIONS OF FISHWAYS.

January 14, 1920. The new dam at Mendota, known as the Mendota Weir, property of Miller & Lux, Incorporated, inspected.

January 15, 1920. Campbell Weir, property of San Joaquin Valley Farm Land Company, San Joaquin, surveyed. Stimson Weir owned by Zalta Irrigation Company, Fresno, surveyed.

January 27, 1920. Folson fishway inspected with G. N. Bergren, engineer, and A. Lindstrom, carpenter foreman. Repairing of seven pools that required it, and the flashboards required to put fishway in working order arranged for.

January 29, 1920. The P. M. Doyle dam, Truckee River, surveyed for a run-around fishway at south side of stream.

February 3, 1920. Fishway of Western States Gas and Electric Company on South Fork of American River at Chute Camp, ten miles above Placerville, El Dorado County, inspected.

February 10, 1920. Fishway of Crocker Hoffman Company, Merced River at Snelling, Merced County, inspected.

May 12, 1920. Dam of Red River Lumber Company, Hamilton branch of Feather River, Plumas County, surveyed for fishway.

June 18, 1920. Dam in San Lorenzo River, tributary of Salinas River and owned by San Lorenzo Ranch, inspected.

June 30, 1920. Dam of Anderson Cottonwood Irrigation District on the Sacramento River, at Redding, Shasta County, inspected. Affidavit filed with District Attorney Carter.

July 6, 1920. Dam of California Fruit Exchange in Grey Eagle Creek, Plumas County, and dam in Long Valley Creek owned by Murphy Lumber Company at Sloat, surveyed.

July 14, 1920. Fishway at Boca Dam, Little Truckee River, owned by the Union Ice Company, inspected.

Fishway of Truckee Lumber Company dam in Truckee River at Truckee, Nevada County, California, inspected, and the Union Ice Company dam at Prosser Creek in Nevada County, surveyed for fishway.

July 24, 1920. Philadelphia Dam in South Stanislaus Creek, Tuolumne County, which is owned by the Pacific Gas and Electric Company, surveyed for fishway.

July 25, 1920. Relief Dam, Relief Canyon, tributary of Stanislaus River, Tuolumne County, and owned by the Pacific Gas and Electric Company, inspected.

July 25, 1920. Pine Crest Dam on South Fork Stanislaus River which is used as storage and owned by the Pacific Gas and Electric Company, Tuolumne County, inspected.

July 26, 1920. Sand Bar Dam on Middle Fork Stanislaus River, Tuolumne County, which is owned by the Pacific Gas and Electric Company of San Francisco, surveyed.

August 4, 1920. Fishway at Mendota Weir, San Joaquin River of Fresno and Madera Counties, inspected.

August 5, 1920. The dam of East Side Canal Company on San Joaquin River, San Joaquin County, surveyed.

August 16, 1920. Kerckhoff Dam, which is owned by the San Joaquin Light and Power Company, Fresno, and San Joaquin River below dam, inspected.

August 17, 1920. Adit 1 San Joaquin River, owned by the San Joaquin Light and Power Company, Fresno County, inspected.

September 15, 1920. Dam in upper Truckee River owned by Wm. Barton, El Dorado County, surveyed. Dam in upper Truckee River owned by J. D. Kyburz, El Dorado County, surveyed.

December 28, 1920. Dam of Anderson-Cottonwood Irrigation District at Redding, inspected.

January 1, 1921. San Clemente Dam in Carmel River, Monterey County, owned by Del Monte Properties Company, inspected.

FIG. 16. A steelhead trout on its way up the fishway on the Folsom Dam in El Dorado County, proof of the satisfactory working of the fishway designed by the Fish and Game Commission.

February 11, 1921. Dam in Novato Creek, Marin County, owned by Marin Meadows Ranch, inspected.

May 24, 1921. Verdi Power Dam, in Truckee River, Washoe County, Nevada, owned by Verdi Power Company, inspected.

May 24, 1921. Mogul Dam in Truckee River, Washoe County, Nevada, owned by Truckee River General Electric Company, surveyed. Fishway for Hyland Dam in Truckee River owned by the Reno Light and Power Company, Washoe County, Nevada, surveyed. Electric Light Dam, Truckee, owned by Reno Power and Light and Water Company, Reno, Washoe County, Nevada, inspected.

May 25, 1921. Fishway at Derby Dam, Washoe County, Nevada, owned by U. S. Government, inspected. Indian Dam, Numana, Washoe County, Nevada, owned by U. S. Government, inspected.

May 27, 1921. Taylor Creek Dam, Taylor Creek, El Dorado County, owned by Anita Baldwin, surveyed. Ditch to Wm. Tevis place. Dam at Blackwood Creek where trap was washed out, inspected.

May 29, 1921. Fishway at Truckee Lumber Company dam in Truckee River, Nevada County, which is owned by the Truckee Lumber Company, inspected. Dam of Polaris Ice Company, Truckee River, Nevada County, fishway of Truckee River Electric Light and Power Company, owned by P. M. Doyle, Nevada County, and dam of Pacific Fruit Express Company, Donner Creek, Nevada County, inspected.

June 13, 1921. Dam in Little River, Humboldt County, which is owned by Little River Redwood Company, at Bullwinkel, surveyed.

June 27, 1921. Dam in Hat Creek, Shasta County, which is owned by Pacific Gas and Electric Company, surveyed. Dam No. 2 in Hat Creek, Shasta County, owned by Pacific Gas and Electric Company, surveyed, for fishway at rapids.

July 26, 1921. Page Dam in Los Gatos Creek, Santa Clara County, inspected.

October 13, 1921. Dam in Sugar Pine Creek, Tuolumne County, owned by E. O. Sylvester and F. D. Nowell, surveyed.

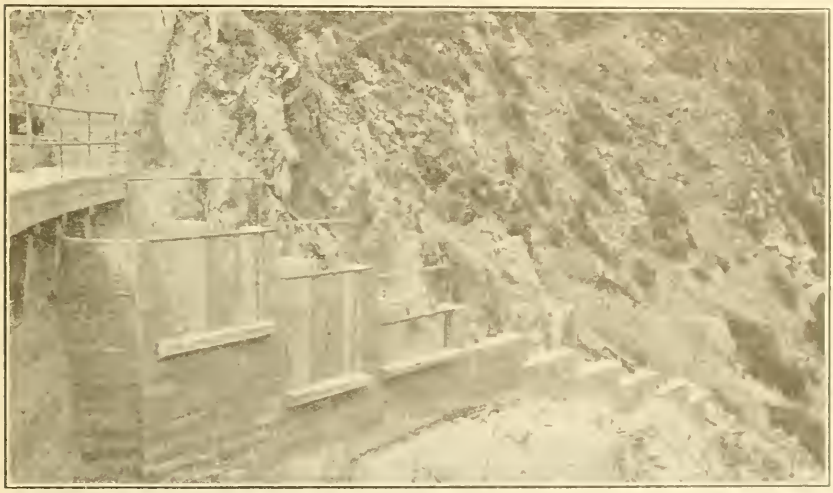

FIG. 17. Fishway at San Clemente Dam on the Carmel River in Monterey County, a fishway recently completed. Photograph by A. E. Doney.

November 4, 1921. Dam on South Fork of American River which is owned by Western States General Electric Company of Stockton, inspected.

November 17, 1921. Fishway over Capay Dam, Yolo County, which is owned by Yolo Light and Power Company of Woodland, surveyed.

December 2, 1921. Salmon Falls Dam in American River, which is owned by Natomas Company, inspected.

January 4, 1922. Indian Dam and outlet of Truckee River which is owned by the U. S. Government, Washoe County, Nevada, inspected.

April 31, 1922. San Clemente Dam in Carmel River, Monterey County, owned by the Del Monte Properties Company, inspected.

May 15, 1922. Ponds and streams at State Industrial Home, Sonoma County, inspected.

June 3, 1922. Dam in Little Chico Creek, Butte County, owned by H. M. Baker, surveyed.

June 15, 1922. Dam at Redding in the Sacramento River, owned by the Anderson-Cottonwood Irrigation District, inspected.

June 19, 1922. Dam on Browns Creek, Trinity County, owned by Robert Gibson, inspected. Dam in Hay Fork River, Trinity County, owned by John Enos, and dam in Hay Fork River, called the "Frow dam" owned by John Enos, Trinity County, surveyed.

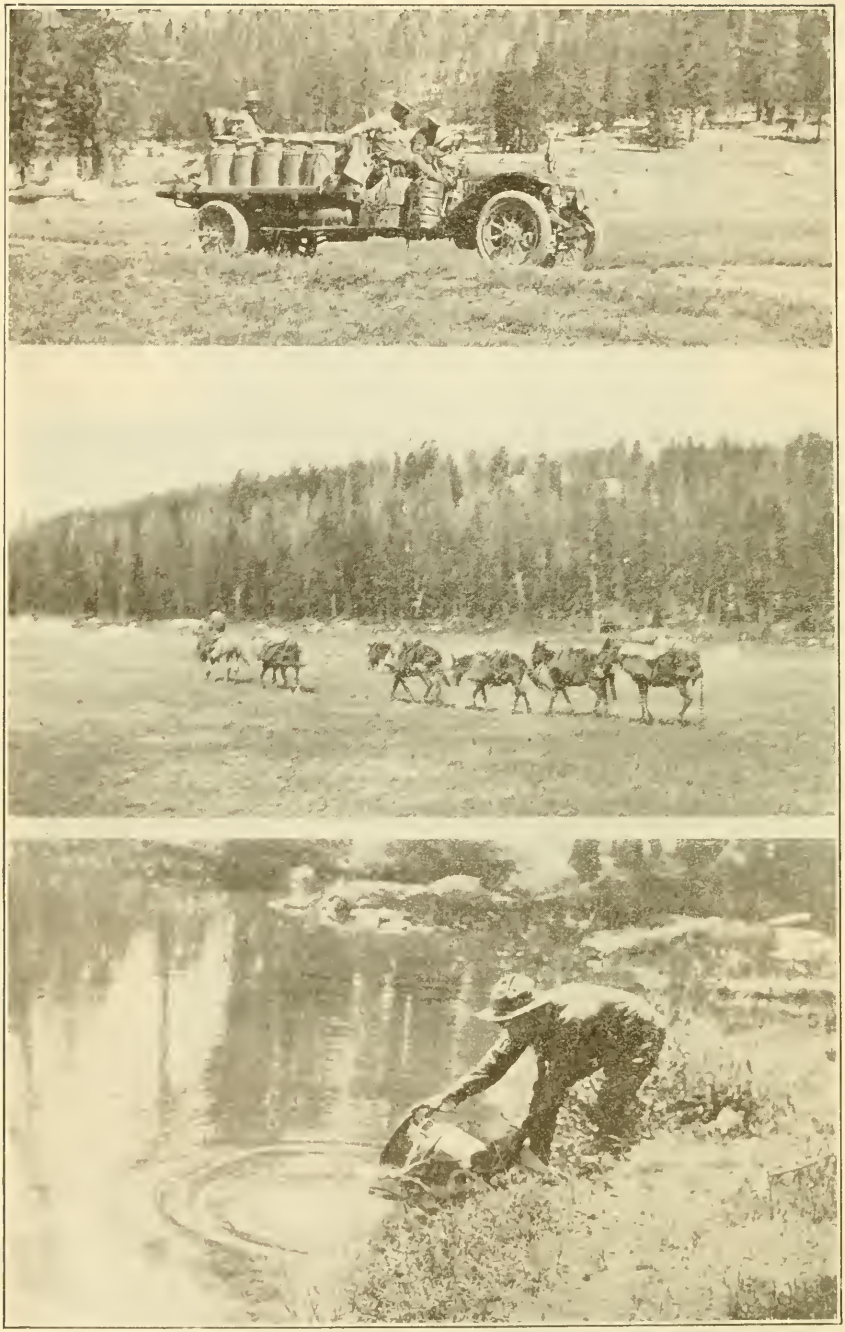

FIG. 18. Planting trout in Yosemite National Park. Many fish before reaching the streams must journey by rail, by motor truck and by pack train. Photographs by H. C. Bryant.

June 29, 1922. Dam in East Fork Carson River, Nevada, owned by Douglas Milling and Power Company, Douglas County, Nevada, and the Curtz Dam in East Fork of Carson River, Alpine County, owned by Peter Curtz, inspected.

June 19, 1922. The Hercules dam in East Fork of Carson River, owned by the Hercules Mining Company of Reno, Nevada, surveyed.

July 2, 1922. The fishway and dam of the Crown Willamette Paper Mill Company, Floriston, Nevada County, inspected.

July 2, 1922. Dam and fishway of the Truckee River General Electric Company, Reno, Nevada, in Nevada County; dam and fishway at Wicks Spur, Truckee River, Nevada County, owned by the Union and National Ice Company, and dam on Prosser Creek, Nevada County, owned by the Union Ice Company, inspected.

July 18, 1922. Dam and fishway of Anderson-Cottonwood Irrigation District at Redding, Shasta County, inspected.

July 22, 1922. Dam in Lost Creek, Butte County, owned by the South Feather River Land and Water Company of Butte County, and the dam on South Fork of Feather River, owned by the Palermo Land and Water Company, Butte County, surveyed.

July 25, 1922. Fishway over dam of the Sutter-Butte Canal Company, Feather River, Butte County, inspected and surveyed.

Total inspected, 41.

Total surveyed, 28.

SCREEN SURVEYS AND INSPECTIONS.

The surveys for installation of screens in ditches, canals, pipes and flumes has been carried on systematically during the period since our last report. From July 1, 1920, to July 1, 1922, 187 surveys for screens were made and 254 notices served on owners or occupants of ditches to install screens. It often happens that a ditch or canal is owned by several persons cooperating in the use of the water and in maintaining the ditch or canal, but not a legal or incorporated body and it is necessary to serve each individual with a notice to compel them to build the screens and to pay their proportion of the installation.

Eleven hundred and eight inspections of screens were made during the period since our last report. A number of ditches and canals had to be inspected several times to get the data and to see that the screens were installed and after they were installed to see that they were kept in repair or in efficient condition. Twenty injunction suits have been filed by our attorney against ditch owners who have not complied with the screen law. Several of these have been settled by the owners carrying out the plans and instructions given them. The other cases are in the hands of the district attorneys of Trinity, Butte, Tehama, Alpine, Mono and Inyo counties. A number of large canals have been screened during the last two years. The most important of these, is the canal of the Glenn-Colusa Irrigation District, where a screen of the pivotal type 238 feet long by 11 feet in depth, built in sections, each unit so arranged that it can be reversed and the debris allowed to escape with the current, has been installed. Reclamation District 2047 in Colusa County has installed two screens of the De St. Maurice type over their two nine foot pipes leading from their pumps. During the past six months, the Pacific Gas and Electric Company has built and installed a number of rotary screens in Stanislaus, Butte and Tehama counties.

COOPERATION WITH THE DIVISION OF WATER RIGHTS.

We again respectfully recommend that legislation be passed that will arrange for the cooperation and coordination of the Division of Water Rights with the Fish and Game Commission in regard to the appropria-

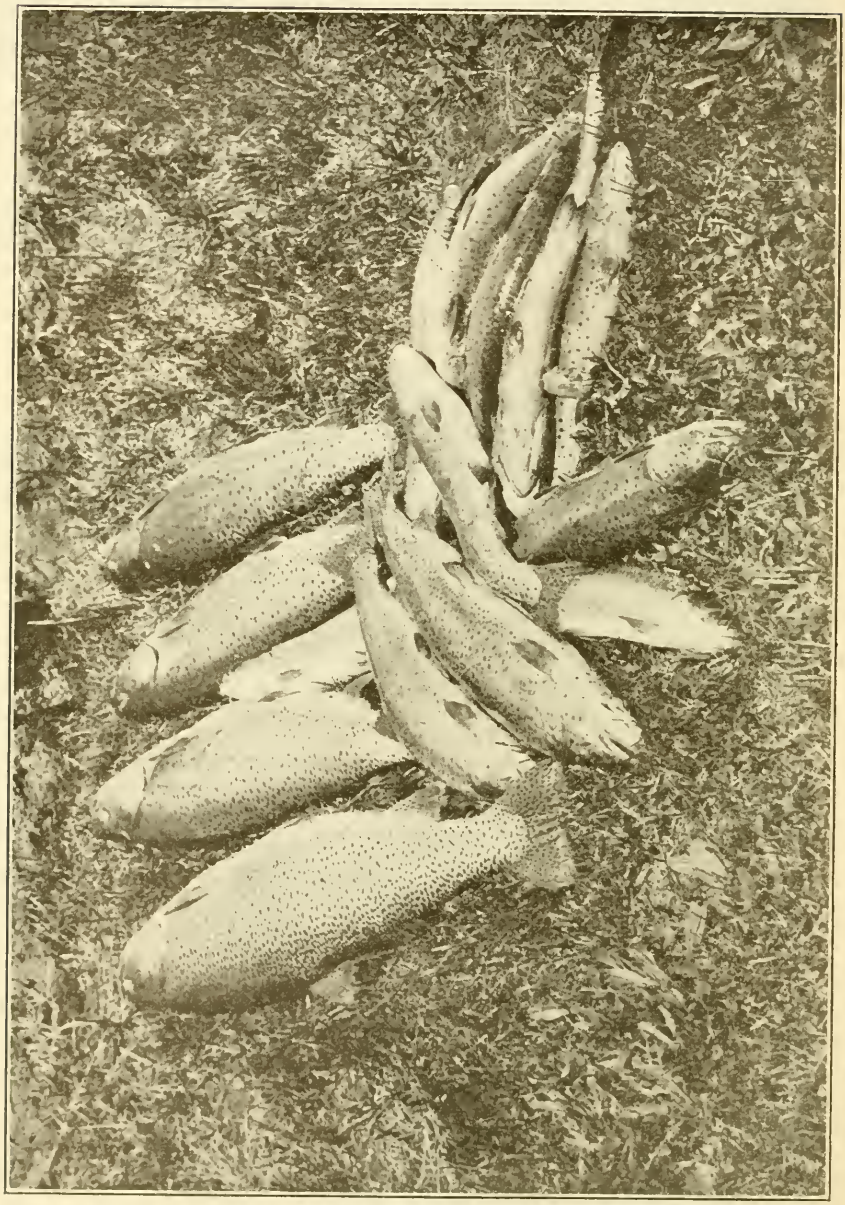

FIG. 19. Catch of Tahoe black-spotted trout. Photograph by Leon Greenbaum.

tion of waters. We made this recommendation in our last biennial report, but it was unheeded by the legislature and Water Commission.

The Division of Water Rights should be compelled to allow enough water to remain in our streams during the period of minimum flow to maintain the fish life below all diversion points on the rivers and streams. In the mad scramble for the appropriation of water for irrigation and the development of hydro-electric energy, no attention is paid to the fish life, which can be conserved without injury to other interests, if a little good judgment is used in granting appropriations. The rights of the people to enjoy fishing both for food and pleasure should be safeguarded before it is too late. No stream should be entirely diverted.

The Water Commission or the Division of Water Rights has allowed the appropriation of the entire flow of streams without any consideration being given to the fishing interests. Those interested in conservation are indifferent to these vital problems. After the water is all appropriated and the streams are dried up below the diversion points, then they complain that the Fish and Game Commission has not done their duty. We have repeatedly made recommendations that are for the best interests of all the people, but they are unheeded.

RECOMMENDATIONS.

We respectfully recommend the following to be acted on as soon as possible if the work of this department is to keep up with the progress of the rest of the state. An increase of the anglers' license sufficient to enable us to maintain the hatcheries now in existence in the state and to improve and construct others in different sections where the demand for hatchery work is greatest, and the construction of two or three more pond systems for the rearing of trout for breeders to insure at least 25,000,000 eggs annually from pond-reared fish is necessary if we are to meet the demands for trout fry. This is necessary to supply the streams and lakes until a greater demand is made by the increasing population of the state.

That the Klamath River be set aside as a fish preserve from Klamathon to its mouth and that no dams be allowed to be constructed in the river below the egg-collecting station at Klamathon. This measure would enable the Fish and Game Commission to collect salmon eggs for the maintenance of the salmon supply in the Sacramento River, San Joaquin River and Monterey Bay. The Klamath is the one remaining stream in which the chinook salmon can spawn as well as where salmon eggs can be collected for the purpose of propagation in numbers sufficient to justify extensive operations. There are enough power plants constructed and plans made for others on the tributaries of the Sacramento and San Joaquin rivers to furnish power for many years to come without interfering with the salmon run in the Klamath River. We would also recommend that wherever dams for the development of hydro-electric energy or irrigation are constructed which interfere with the movements of spawning trout or salmon and where in the judgment of the Fish and Game Commission, it is necessary to construct hatcheries in lieu of fishways, that the owners or occupants of such dams, be compelled to furnish the Fish and Game Commission with the money necessary to operate such hatcheries, the amount neces-

sary to be determined by an estimate submitted to the State Board of Control. It is only right and just to the people that those who are benefited by the appropriation of water and by the construction of dams that are impassable to fish and over which efficient fishways can not be built owing to the great height of the dams, furnish the money to operate the hatcheries that must be established to save the run of fish. These hatcheries should only be built where conditions are favorable for the propagation of fish.

The law relating to the Division of Water Rights should be amended so that an appropriation of all the water in a river or stream would be impossible. A sufficient flow of water should be allowed to flow in the bed of our rivers and streams during the period of minimum flow to maintain fish life below all dams.

The fishing season should be shorter in certain districts.

The spearing of trout should not be permitted in any district.

The distribution of trout fry should be improved by the employment of experienced fish planters. Under our present system we have not money enough in our funds to keep men skilled in this work employed the year around. Consequently the crews, excepting the car superintendents are generally inexperienced men that are employed to assist in this work each season when the distribution begins. Then in the fall, when the season's work is over they are laid off and generally find other employment before the next season. The fish planting operations could be greatly improved if experienced men were kept for this purpose who would make a special study of this work. This can only be done when adequate funds are provided to employ these men at the hatcheries and on the distributing cars, the year around. Some of the sportmen's clubs are employing men who are making a study of fish planting and the results are gratifying. If all the instructions given in our instruction sheets were carried out by the applicants, this would not be necessary, but a number of the applicants disregard the instructions given to them and the fry are not always planted to the best advantage.

The present law preventing the planting of fish in any of the waters of the state should be amended so as to make the act an indictable misdemeanor triable in the superior court and the penalty made very severe. The introduction of undesirable or predatory species of fish into waters where game and food fish are liable to be destroyed, should be safeguarded against as much as possible.

A systematic survey of the lakes and streams of the high Sierras should be made by a competent entomologist under the supervision of the Department of Fisheulture to determine the proper aquatic insects and plants to be introduced to furnish a more abondant supply of food for the trout. We have successfully introduced the large salmon fly (Corydalis) in the Tahoe region and have made attempts to introduce scuds or gammarus in some of the other lakes, but to make this work a success, a careful study of the insects and aquatic plants in each region should be made to find out where new species can be introduced to improve the natural food of the trout.

Respectfully submitted.

W. H. Shebley,
In charge Department of Fisheulture.

REPORT OF DEPARTMENT OF COMMERICAL FISHERIES

The Honorable Board of Fish and Game Commissioners of the State of California.

GENTLEMEN: In our last biennial report the rapid and spectacular growth of California's fisheries was reviewed: of how California had reached first place amongst the states in the size and value of its fisheries, with an annual catch of over 250,000,000 pounds and with a wholesale value as fresh fish and manufactured products, of over $25,000,000. The tuna and sardine industries which were responsible for most of this increase were experiencing a healthy growth prior to and during the early period of the great war. Upon our entry into the war our fish packers responded to the government's call for an increased production of food by putting up an enormous pack of sardines in pound oval cans. Many new canneries were built and nearly all of those already in existence were enlarged. The pack of sardines in 1918 was about a million and a half cases, requiring a catch of 150,000,000 pounds of fish. Our fishermen made increased catches of sardines without increasing their price and the canners in turn were able, through increased production, to sell to the people for even less than before the war. As far as we know the only food product which did not increase in price during the war was California sardines. Our canners and fishermen are deserving of credit for that.

Much of this great output of sardines, instead of going into consumption in this country and especially in Europe as was intended, was held by jobbers and others in this country for speculative purposes. With the fall of prices in 1920 and the collapse of foreign exchange our canned fish, instead of reaching foreign markets as was intended, was left in this country. Our sardine packers were especially hard hit for the reason that this country is as yet a rather poor market for sardines. Our packers of tuna suffered in the same way and all lost heavily as they were compelled to sell the large stocks they had on hand for less than the cost of packing.

The past biennial period has been one of readjustment with our fishing industries. It was dangerous to put up large packs during a period of falling prices. It was necessary to dispose of the goods on hand and to wait until the stocks hoarded by speculators had been largely consumed.

Some of our canners have failed financially while most of them have had a desperate struggle to weather the storm. The output of the fisheries has naturally been much reduced. This was expected. The present year of 1922 has been one of rather rapid recovery and it now seems quite certain that much of the ground gained during the period of expansion is going to be held, and that the industry will continue on a much higher level of production than existed at the beginning of the war. Until rates of exchange will permit them to again sell in foreign countries our canners have turned their attention, with considerable success, to enlarging the market of tuna and sardines in this country. The demand for California canned tuna was the first to revive and canners are endeavoring to pack all of these fish they can

get during this season of 1922. So far they have failed to get as many fish as they would like. This has been most disappointing for they were depending on profits from a good tuna pack to help offset the losses of last year.

The long-finned tuna or albacore, which is known by the trade name "White meat tuna," is found within a very narrow range on the west coast of North America and it is not likely that this fishery can be expanded much beyond its present dimensions. In fact certain phenomena have developed which may indicate depletion and these are causing us to watch this important fishery most carefully. We feel confident, however, that the other varieties of tuna will support a larger industry than they have been called upon to supply in the past. Our larger fisheries, with the exception of salmon, are of quite recent origin and it is believed that none of them with the exception of salmon and possibly albacore, have been fully developed. It is to be expected our sea fisheries will grow and that our sardine industry will surpass the importance it reached during the war.

As has been pointed out in former reports, the primary and almost the sole duty of this department is to look out for the conservation of our fisheries, so as to safeguard this valuable resource of the state against overfishing and, as far as possible, to keep our fisheries up to their highest stage of usefulness. The law is very definite in stating that it is the duty of the Fish and Game Commission to carry on such investigations as are necessary to determine the real abundance of our principal commercial fishes; to collect accurate data which will show natural fluctuations in abundance as distinguished from those due to overfishing; to make recommendations to the legislature for the conservation of the fisheries and to enforce the conservation laws which the legislature passes. These duties, delegated mainly to this department, we have carried out to the best of our ability with the funds which are available for the purpose.

SALMON FISHERIES.

We first take up the subject of salmon for, while the salmon fisheries of the state are not of first importance economically, they are of first importance from the standpoint of conservation. The salmon in this state are most urgently in need of greater protection if we are to prevent their commercial extinction. The need of better protective measures has been urged at each session of the legislature, but the measures passed have been inadequate and far short of our recommendations. In our report of four years ago it was pointed out that the development of salmon trolling in the sea, together with the more intensive fishing in the rivers, and the shutting off of salmon from their spawning beds in the rivers by power and irrigation dams, made it absolutely necessary that radical fishing restrictive measures be adopted. Very little was accomplished at that session. In fact, salmon conservation on the Sacramento River went backward instead of forward, for Sacramento River fishermen had a bill introduced in the legislature which proposed to open up the main fishing grounds (District 12b) for salmon fishing during the general closed season of June and July. A compromise was finally arrived at under which June and

July were to be kept closed but the continued use of trammel nets was to be permitted in the district during open seasons, a concession which had been granted as a war measure by the United States Food Administration. That part of the law which provided a closed season of June and July in District 12b was later attacked by counsel for the fishermen who claimed that the section of the Penal Code which describes the kinds of nets which may be used, permitted the use of gill nets of certain mesh in the district during June and July. The case was finally decided in favor of the fishermen, Judge McKenzie of the superior court of Contra Costa County deciding that laws restricting the right to fish must be clear and without ambiguity. The final result was that salmon were getting less protection than ever.

FIG. 20. State Fisheries Laboratory, East San Pedro, California. It is here that important research work on the commercial fisheries is being carried on by a staff of scientists. Photograph by W. F. Thompson.

At our request a bill was introduced at the 1921 session of the legislature which proposed to give the Sacramento salmon a fair measure of protection. It provided that salmon netting be eliminated in the river above the city of Sacramento; that the months of June and July be closed to conform to the season already provided for striped bass and shad; and that the fall season be closed on September 15th instead of the 25th. Closed seasons were also provided to curtail the catch of salmon in sea trolling. The measures finally adopted were inadequate. Fishing in the upper Sacramento continues; the months of June and July are still open and the closed seasons adopted for the outside trolling districts were cut down so as to give but little protection. The only salmon measure of importance adopted was closing the fall season on September 17th, eight days earlier than before.

Since that time the salmon catch in Monterey Bay and in the San Francisco and Sacramento River regions has decreased most alarmingly, so that most of our fishermen and fish dealers are now agreed that something must be done if we are to save the salmon. The

number of salmon has been so greatly reduced that it is not very profitable for the fishermen to fish either in the open sea or on the Sacramento River so that now many are arguing that fishing be stopped entirely either in the sea or in the river. The policy of the Fish and Game Commision, which has been to keep both forms of fishing and to preserve the salmon by restricting the fishing in both of these regions, is no longer tenable for the reason that the startling decrease of the past two years in the abundance of salmon has now made it necessary to so restrict the catch that it would not be profitable for either the sea fishermen or the river fishermen to operate if the catch must be divided between the two places. It would seem necessary under these circumstances to follow the lead of Washington and Oregon and eliminate the catching of salmon in the sea. The chief argument against outside trolling is that many immature salmon are caught by that method and that the fish being full of feed are difficult to market in the best of condition.

It will also be necessary, in our opinion, to adopt radical protective measures on the Sacramento River even if outside trolling is stopped. Any protection given the salmon outside will result in more intensive fishing inside and a sufficient number of salmon would not escape the nets and reach the spawning grounds unless inside fishing is also restricted. The closed seasons inside are not sufficient even now and the distance fishing as permitted up the river is entirely too great. For the protection of salmon as well as of striped bass and shad, we recommend that net fishing be prohibited above Rio Vista; that there be adopted a closed season from May 15th to July 15th, and that the use of trammel nets and "diver" nets be prohibited in the river.

Power and Irrigation Dams a Menace to Salmon. Salmon at maturity leave the sea and ascend streams nearly to their source where the two sexes pair off and the female deposits her eggs in a crude nest where they lay buried in the gravel until they are hatched. In the Sacramento River tributaries it takes the eggs about two months before the embryo breaks from the egg. It is about a month more before the yolk of the egg is used up by the embryo and it is necessary for it to seek other food. It then emerges from the gravel and feeds upon insects and whatever other food it can find in the water. Within a year it drifts down the stream and passes out to sea where is remains until it has reached maturity three or four years later. It then ascends its native stream, as its parents did before it, for the purpose of reproduction.

It can plainly be seen that if salmon are to be saved from extinction they must not only be saved from the fishermen's nets, but they must be able to ascend their parent streams in sufficient numbers to perpetuate the race and the young after hatching must be able to pass down the stream into the sea. Any dam or artificial obstruction in the river will, if high enough to prevent the salmon from leaping over, prevent the salmon from reaching the spawning grounds in the headwaters. If the young salmon, in their migration to the sea are permitted to pass into irrigation ditches and thence on to the land where they would die; or if they are permitted to pass through the turbines or power plants where they would be killed, the future supply of salmon in that par-

ticular river would be destroyed. It is possible under ordinary conditions to keep the young salmon out of diversion ditches by means of screens, and it is possible under ordinary conditions to construct fishways on dams so that salmon and trout in their up stream migration may pass. But within the past few years we have been facing conditions in this state which are not ordinary. Dams are being constructed for the purpose of developing power which are far too high for a salmon to pass over by means of any fishway which has so far been devised. Fortunately the first of these high dams have been built in tributaries where, although their effect on the salmon has been serious, they have blocked the salmon from reaching only part of the spawning beds in the watershed. The streams which the salmon choose are those which have a good summer flow, just the ones which are the most valuable for the development of hydro-electric energy. Electric power companies are now seeking to get concessions from the state and federal government to construct high dams on a greater scale than heretofore attempted and these dams they propose to build in the main rivers where they will obstruct most of the salmon and prevent them from reaching their spawning grounds. The attitude of these companies appears to be: If the spawning migration of salmon can not be gotten above these dams and the young after hatching can not be gotten safely down past the dams, the salmon will have to go, for the electric power is worth more in dollars than the salmon. At first thought this seems a reasonable view to a good many people, but a good deal can be said on the other side. The fish happen to be one of the things which still belong to the people of the state and it is very doubtful if the people's right in the fisheries can be taken from them even by an act of the state legislature and it certainly can not be taken from them by the federal government.

The state should not permit the extermination of these fish just because more money can be made out of the stream if the water is used for other purposes. We are not altogether sure that the salmon can not be gotten over these high dams and the young gotten down again but it is not up to the people to go all the way in demonstrating how this can be done. Those wishing to use the water are the ones to demonstrate how the water can be used for power or irrigation without destroying the salmon. This should be an actual demonstration on dams now existing and should not be tried out as an experiment on dams to be constructed in the future. The expense of these experiments should be borne by the power companies, and they should also bear the expense of the future operation of the fishways and screens. If hatcheries are operated to offset the damage caused by one of these dams the company should not only build and equip the hatchery but should bear the expense of its future maintenance.

SALMON INVESTIGATIONS.

It requires no research by trained men to determine if the salmon in our state are likely to become depleted by overfishing. The greatly reduced commercial catch of what may be called our Sacramento salmon, coupled with a corresponding falling off of the number of salmon which escape the hooks and nets and reach the spawning grounds in the river,

show us clearly that our salmon of the Sacramento are well on the road to commercial extinction. Salmon investigations have been carried on for the purpose of determining what protective measures should be adopted in cutting down the commercial catch. Another, secondary object of the investigations is to gain information which will throw light on the methods employed in artificial propagation; more especially on the question of when and where the young salmon should be liberated.

The salmon investigations are in charge of Prof. J. O. Snyder of Stanford University. He has one full-time assistant, Mr. E. A. McGregor, and has employed one other assistant during the summers.

FIG. 21. 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.

Much work has been done in gathering data and material at the several salmon fishing centers. Much of the material has yet to be studied and analyzed. This material has at all times been gathered so that as far as possible it was representative of the commercial catch. An age analysis has been made of each season's catch through a study of the scale samples which have been systematically taken. This knowledge will be of invaluable assistance in devising closed seasons for the different sea trolling districts for the purpose of minimizing the catch of immature salmon.

It was hoped that through a study of the samples of scales collected it would eventually be possible to identify the salmon of any stream when.

they are caught at sea. If this could be done it would then be a simple matter to determine what streams are furnishing the salmon which are being caught in any sea trolling district—a very necessary piece of information if we expect to regulate the sea or river fishing properly. It has been concluded that it will take a vast amount of work and a good deal of time before we can hope to identify the chinook salmon of any of our streams by the character of that part of their scales which was formed while they were fry in their native stream. It may never be possible to do this.

It has been decided that this knowledge can best be gained by marking given numbers of salmon fry of the different streams as they are liberated from the hatcheries. Several of these marking experiments have been carried out and the results have been so encouraging that a series of these experiments on a more extensive scale has been planned. It has been found from these experiments that salmon from the Sacramento River are caught in the sea by trollers from Monterey Bay, to Shelter Cove in Mendocino County. Just what proportion are caught in each of these widely separated trolling districts will not be known until more extensive marking experiments are carried out.

In the light of this slight knowledge gained it seems highly probable that the development of the Mendocino County salmon trolling, was largely at the expense of the Sacramento River salmon. It is quite certain that the large catch by trolling off the Mendocino coast came from sources other than our northern California streams, and we now can not help suspecting that the fishery was drawing heavily on the Sacramento River salmon supply. This suspicion is strengthened by the fact that the salmon catch off Mendocino and in the Sacramento have experienced the same slump during the last three or four years. It is very necessary that we know how much of the Mendocino catch is from the Sacramento if we are to properly regulate the sea trolling on the Mendocino coast. The question is of the utmost practical importance and serves well as an illustration of the practical value of investigation work.

A second lot of Sacramento River salmon fry were marked and liberated in the Sacramento two years ago. These fish will be in their fourth year next season and it is expected that captures of these marked fish will throw much light on the movements of the Sacramento salmon in the sea.

Klamath River salmon fry were marked and liberated in the Klamath three years ago. Some of these fish were recovered last year, when they were in their third year, after they entered Klamath River. These salmon were all mature males or "grilse." These marking experiments have been reported upon by Professor J. O. Snyder in past numbers of California Fish and Game. This year the salmon which were marked on the Klamath River are in their fourth year, and individuals were captured by trollers in Monterey Bay, off Point Reyes, Eureka and in the Klamath River. The results of this season's work also will be reported in California Fish and Game.

The first of a new series of marking experiments on the Klamath River, was started this year by marking and liberating 25,000 fry. Next year this number will probably be doubled, half of them to be liberated in the Mad River, the other half in the Shasta River, a tributary, in order to get additional light on the parent stream theory.

Funds Insufficient for Salmon Conservation Work. With the growing scarcity of salmon the Fish and Game Commission's salmon conservation work has had to be increased. This has necessarily been accompanied by an increased expenditure of money along this line. There is a necessity for increasing the salmon hatchery work as well as a necessity for increasing the salmon investigation and patrol work. The state spends annually more than $25,000 in hatching salmon and the United States is spending a like amount in this state for the same purpose. The Commission desires to increase this work. Added to the hatchery work there is the expense of the salmon patrol and investigation work which amounts to more than twenty thousand dollars each year. The Fish and Game Commission receives no appropriation for this work but must finance it out of the revenue from commercial fishing licenses and the very small amount received from the tax on salmon which are canned or salted. The entire amount received from all commercial licenses sold in northern California together with the tax on salmon for canning and salting is not nearly sufficient to pay even the state's portion of the expense of salmon hatching, to say nothing of the patrol and investigation work which are equally necessary. The bulk of the salmon which are caught are used in the fresh markets and the fish which are used in the fresh markets are not taxed for conservation work. It will be necessary in the fight to save the salmon to increase the revenue for conservation work in the districts where the salmon work is being done. Fish used in the fresh markets should be taxed to furnish a revenue sufficient to carry on this very necessary work.

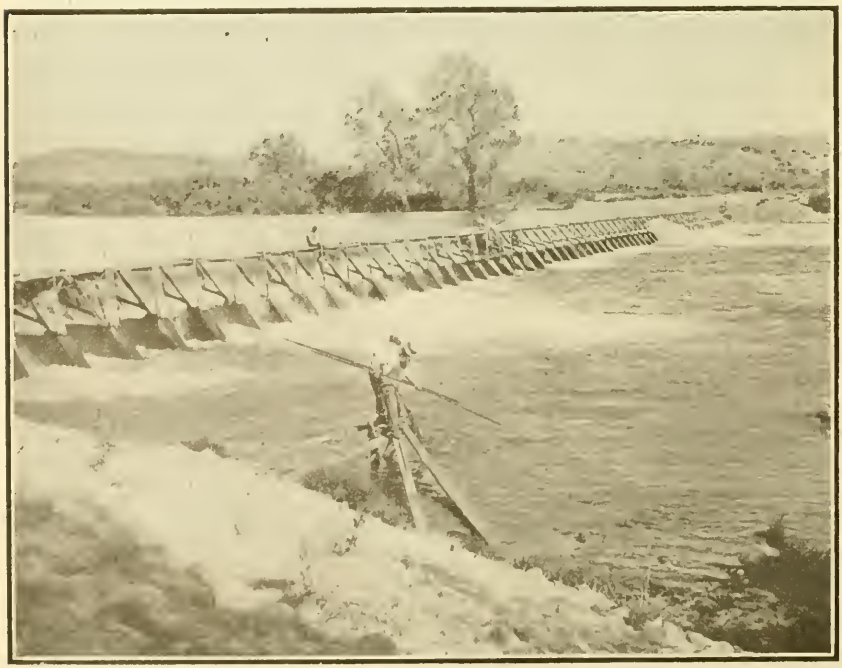

FIG. 22. The Redding Dam, which for several years acted as a barrier to migrating salmon. Better conditions now exist at the dam and some salmon succeed in passing. Photograph by E. A. McGregor.

STRIPED BASS DECREASING.

The annual commercial catch of striped bass in California shows a decrease of about fifty per cent since 1915 and along with this decrease in the commercial catch is a decided scarcity of bass in many of the haunts where both anglers and commercial fishermen formerly found them abundant. The present scarcity is most noticeable in most parts of San Pablo Bay and in the mouths of sloughs tributary to it. On the other hand striped bass are apparently more plentiful in some other places and good angling has been enjoyed in places where they had been caught only in very limited numbers before. There are some ardent striped bass anglers who believe that these fish are just as plentiful as they ever were. They believe that some of the sloughs have been fished out by anglers but that in most cases the bass have moved from their old haunts and have to be sought in other places. Commercial fishermen say that the bass are about as numerous as ever but that they have moved and that the best net fishing is to be found in places where the bass were formerly not so abundant.

Most bass anglers, however, are firmly of the opinion that the bass are not only less plentiful but that they are on the road to extermination. It is our belief after reviewing all the evidence that striped bass are not so plentiful and that they are being over-fished at the present time.

It should not be argued that the falling off of the commercial catch shows that the bass are being fished out by the nets and that there are less than half as many bass as in 1915. It is very much more likely that the fifty per cent decrease in the commercial catch is almost entirely due to the very good restrictive legislation which has been obtained through the efforts of the Fish and Game Commission and the commission's efficient enforcement of the protective laws.

The usual method of protecting fish against over-fishing is to restrict the catch and when efficient protective measures are adopted and enforced the resulting decrease in the catch should not be used as evidence that the fish are being exterminated. The scarcity of bass in some of their old haunts about San Pablo Bay we believe is largely due to the bass moving to other regions. This movement is largely due to the pollution of San Pablo Bay waters by the government's dredging operations about Mare Island and in deepening the channel from Mare Island to Pinole Point. Much dredging has also been done about the mouths of the more important sloughs. The continued stirring of the mud by dredging operations has caused the tides to carry great quantities of silt over the bay and into the mouths of the sloughs where it has settled to the bottom like a blanket and has pretty effectually killed the diatoms and other plant life which form the basis of the food supply of fishes. This condition was called to our attention by Dr. Albert Mann of the Carnegie Institute after he had made a diatom survey of San Francisco and San Pablo Bay waters. Dr. Mann was alarmed by the conditions he found in San Pablo Bay and stated that if we are to preserve our fisheries we will have to guard against the blotting out of diatom life by silt from dredging operations such as is taking place in our bays and rivers. There can be no doubt that the pollution of the waters by sediment from the dredgers has caused the bass to largely

abandon their old haunts about San Pablo Bay. Oil pollution may also be a contributing factor.

The best evidence that striped bass are being depleted by fishing operations is the growing scarcity of large individuals. This is one of the surest signs of depletion and very nearly every one agrees that there are fewer large bass. Striped bass need more protection but protection is more urgently needed in the case of the salmon. As these two fish in the San Francisco Bay region are caught by the same fishing methods and are to a large extent caught at the same time in the nets, it is necessary to protect both if we are to protect either, so striped bass and salmon protectionists are proposing to get together and aid the Fish and Game Commission in the better protection of the two fish.

CLAM INVESTIGATION.

Since our last report Fish Bulletin No. 4, entitled "The Edible Clams, Mussels and Scallops of California" by Professor F. W. Weymouth has been issued as a contribution from the State Fisheries Laboratory. This bulletin gives descriptions and illustrations of over forty species of California clams and scallops, which are likely to have a commercial importance, together with the localities where they are found, their abundance and the condition of the beds. There is a key which will enable any one to identify the species with but little difficulty. The methods of our shellfish industries are given, together with something of the habits of the more important species. Future possibilities of forming and extending the beds of the introduced soft-shell clam are discussed. The need of state control of the tide lands suitable for clam farming is also discussed. This is one of the best bulletins the Commission has issued and it has attracted considerable notice and favorable comment.

Since the publication of this bulletin Mr. Weymouth has been giving part of his time to the study of the Pismo clam, one of our most important mollusks. This work was first begun in 1919 while completing the survey for the bulletin above mentioned. A report on this work has been submitted and soon will be issued as a bulletin. Although the matter treated in the report is of high scientific value the layman will find it very interesting. It will give the life history of the clam; its habits, age, rate of growth and fluctuations in abundance. A census of the clams on the Pismo Beach, San Luis Obispo County, has been made each year, which shows a remarkable fluctuation in the success of each year's crop of clams. In that respect the bulletin will illustrate in a remarkably clear manner what is termed the natural fluctuations in the abundance of year classes, which in the conservation of one of our fisheries must be distinguished from fluctuations due to overfishing. It was found that, with the exception of the year 1919, the spawning seasons of the past six or seven years have been comparative failures. The census of the clams on the beaches show that the clams of the 1919 year class, now in their third year, constitute 90 per cent of all the clams to be found.

For the purposes of conservation, the most important information gained is that the clams during their first three years before they have reached the best size limit, pass their life in the sand of the beaches

FIG. 23. Sardine boats waiting to unload at San Pedro. The sardine industry is now the most important fish industry in the state. Photograph by E. M. Nielsen.

above the low tide line. As the Pismo clam inhabits only such beaches as are the most frequented by people for surf bathing, they are, during these years, exposed to the illicit digging not only of the visitors but of local people as well, for one of the attractions of the beaches is the serving of clams in the restaurants and chop houses. It is clear that even if the commercial digging of the larger legal-sized clams is entirely stopped, the continued taking of these small clams will result in the practical extermination of the beds in San Luis Obispo County as they have been exterminated in the past in the southern part of the state.

ALBACORE INVESTIGATIONS.

Publication of the results of the albacore investigations has been delayed partly because of the necessity of economy, the personnel of the State Fisheries Laboratory has been cut down and much of Mr. Thompson's time has been taken up with directing the sardine and other investigations; and partly because of the fact that with the continued analysis of each season's albacore catch, new problems have presented themselves which have necessitated the reworking of much of the earlier data.

On account of evidence that the albacore may now be undergoing depletion it is probably best to delay publication of the results of the investigation until the data collected during the present season can be worked over. In the case of the albacore it has been extremely difficult to determine whether evidences of decreasing abundance of albacore were caused by actual depletion of the fish from over-fishing or only a fluctuation due to natural causes. To determine this point it will probably be necessary to wait until the comparative abundance of the older year classes can be determined in future seasons, although it is possible this can be determined from the data of the present season.

If we are to conserve these fish in an intelligent manner we must learn, from the comercial catch, what is their actual abundance from year to year. To determine this and to be able to distinguish depletion caused by over-fishing from natural fluctuation in abundance, it is necessary to determine the relative abundance of the year classes from year to year. This can only be done by determining the age and rate of growth of the species. This has been a difficult task as the age can be determined from the structure of the scales only with the greatest difficulty. To decipher the age from the scales it was necessary to develop a special technique for the purpose which would not be subject to the criticism that the age determination was largely the individual opinion or guess of the observer. It was necessary to supplement this by determining the age from the length frequency. That is by measuring great numbers of individuals and finding the size groups into which they fall. Theoretically there is a different size group into which they fall.

After the first three years the albacore grows so slowly and irregularly that the size groups overlap so that it is not possible to determine age beyond the second or third group by this method. Nothing which has been done by the countries most advanced in fisheries conservation work gave any knowledge of how to proceed under these circumstances. It was necessary to work out an entirely new principle and after a great deal of work it was discovered that the age groups are indicated by a sex ratio analysis in comparison with the size of the fish. The results

from this procedure confirmed the determination of age and rate of growth as determined from the scales. A great amount of work had to be done in developing new principles, for the science of fisheries conservation is a young one as yet and this work, as well as much of the work done in the sardine investigation, will be distinct contributions to the methods employed in this science. After developing methods of finding the age of the fish it is an easy step to working out the comparative abundance of the year classes, which will enable one to say quite positively which is a natural variation in abundance as distinguished from actual depletion from over-fishing.

This question of depletion is the all-important one but it is necessary to observe the relation of the several year classes through several seasons before depletion is positively proven.

The average yearly catch of a boat fishing for albacore has decreased rather steadily over a period of years. This does not necessarily mean depletion but it is enough to cause anxiety. Last season there was a falling off in the proportion of older fish which, if it continues in subsequent seasons, is the best of evidence that depletion is occurring. The problem is more difficult than it appears at first sight for the methods of the fisheries are undergoing change. During the past two seasons one-man or "jig" boats, which catch the albacore by trolling, have increased rapidly in number and the hook and line boats, which catch the albacore by short lines on poles or by hand after they are attracted around the boat by live sardine bait, complain that these "jig" boats scatter the schools and are the cause of the reduced catches of the boats fishing with the old Japanese method. These are questions which we are now confident are subject of solution with the methods being pursued in the investigation.

SARDINE INVESTIGATIONS.

The sardine investigation has continued along the line of the program laid down in 1920 and published in this Commission's quarterly magazine, (Vol. 6, No. 1, pp. 10-12.)

The objects of the investigation are stated by Mr. Thompson in an article on the progress of the work, in California Fish and Game, Vol. 6, No. 4, page 180, as follows:

"The program under which the work has been done contemplates (1) the discovery of depletion if it should occur; (2) the discovery of any great natural fluctuations in abundance or quality other than those due to over-fishing; (3) the foretelling of these fluctuations, which in other fisheries have at times caused great damage; (4) the deciphering of those habits of the species which are of importance to the canner and fisherman, such as migration, and (5) a knowledge of such facts as will aid the legislator. The absolute completion of this program is without doubt well removed, but contributions to it of great value will be made in the very near future, enabling us to make at least provisional answers, a thing impossible now. Among these we may list the age and rate of growth, the breeding season, and the degree of independence of the sardines in different regions. That the foretelling of fluctuations is not visionary may be seen from the work of the Norwegian fishery authorities on the herring. The other elements of

the outline given are dependent entirely upon the records we obtain—and we are acquiring the very best possible."

Some of the details of the work in carrying out this program at San Pedro and Monterey are given by Elmer Higgins and O. E. Sette in CALIFORNIA FISH AND GAME, Vol. 6, No. 4, pp. 180-182 and in subsequent articles in the same publication by Mr. W. F. Thompson.

For a period of two years daily samples of the fish have been taken as they were unloaded from the boats at the cannery, careful measurements made, weights taken, and the sex and state of maturity observed. This mass of data has been systematized and analyzed so that now important results are being obtained.

In determining the age and rate of growth of the sardine it was found that the scales as an index of the age were very unsatisfactory. It was necessary therefore to get this knowledge by reverting to the old method of tabulating the length frequency of the fish. (See CALIFORNIA FISH AND GAME, Vol. 5, No. 2, p. 53.)

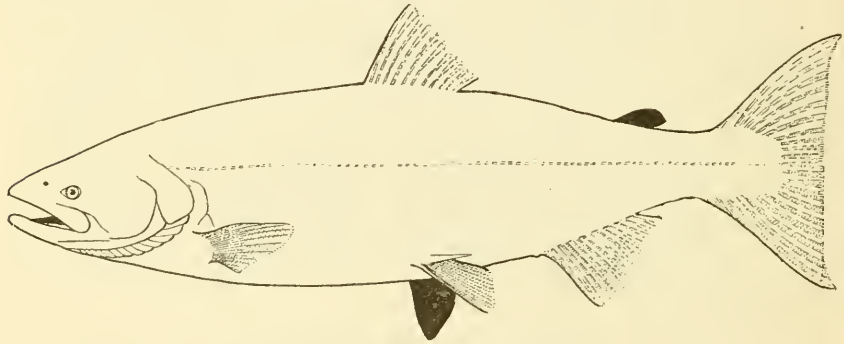

FIG. 24. Drawing showing the way in which young salmon have been marked by removing the adipose and right ventral fins. Returned marked salmon are furnishing much valuable evidence as to the life history and habits of this, the finest of food fishes.

By this method the rate of growth of the fish during their first four or five years has been worked out, and a paper on this phase of the subject by Mr. Higgins is ready for publication. This ability to determine the rate of growth and the abundance of the year classes which go to make up the various sizes of commercial importance, is not only of great importance from the conservation standpoint, but it will also be of great importance to the industry in that it will enable us to forecast the relative abundance of year classes which will be drawn upon for canning. This applies more especially to the quarter oil pack, as the small fish used for the quarter oil cans, come mostly from one year class.

It has been determined from the data gathered that our sardines, as we had suspected, do show the phenomenon of dominance of year classes, and for that reason the sardine industry may be subject to great natural fluctuations in abundance. It is extremely important, for the good of the fishery, that we be in a position to know just what the fluctuations mean. To foretell that certain sizes will be plentiful

or scarce, as we now will be able to do, will be of benefit to the canners. It will also be of benefit to them to know that a scarcity is due to natural causes and not to overfishing.

The sardine, it has been found, grows rather rapidly in length at first. At the end of the first year's growth they average not quite four inches in length; at the end of two years about six and three quarter inches; at the end of three years about eight and one-quarter inches; while at the end of four years they reach a length of about nine inches. From the growth curve established from these known figures the age of the larger sizes can be estimated approximately. The largest sizes may be ten or twelve years old. The growth curve of our sardine is similar to that of the European sardine. Our sardine is also similar in its spawning habits, in that the spawning season extends over several months of the spring and summer and in that the spawning sardines leave the coast and probably spawn well off shore.

The sardine work had not progressed very far before it became evident that there were several factors which influence the size of the sardines taken by the fishermen. A great deal of work has been done in determining the effect of these factors and this work will be treated fully in the report of the work now about completed.

The influence of these other factors on the size of the fish in the catch would probably not have been detected had samples of the catch been taken only a few times a month as has been done in Europe in similar work. In fact entirely erroneous conclusions could have been arrived at. This led to an investigation by Mr. Sette to determine the error involved in different methods of sampling. This work is a contribution of considerable value to the methods employed in fisheries investigations and besides casting doubt on some of the conclusions arrived at through insufficient sampling in Europe, it shows how large the samples should be and how frequently they should be taken.

Daily samples of the catch have been taken over a period of two years in order to work out and determine the seasonal fluctuations in size and also the fluctuations in size within the lunar periods and also to explain the causes of these fluctuations. That these factors are important is shown by the fact that the rate of growth in this instance, and the dominance of year classes could not have been determined without knowledge of the fluctuations in the size of the fish taken by fishermen during different phases of the moon. After this season samples need be taken only at intervals of twice a week at Monterey as was done the present season at San Pedro, and on that account the work will be simplified and reduced to a large extent and it will be necessary only to follow the abundance of the year classes as is now being done in the case of the albacore. We will then be able with our present force to take up the investigation of other important fisheries which are in danger of depletion, such as the barracuda and white sea bass.

PURSE SEINE INVESTIGATION.

We mentioned in our last report how purse seine fishing had been introduced into Southern California mainly for the purpose of catching blue-fin tuna. It was complained by other fishermen that these boats in using their nets for other kinds of fish caused great waste,

especially of small barracuda and sea bass and that they frequently made such large catches of mackerel and more especially of barracuda that they could take only part of the fish on their boat while the balance were all dead before they could be released from the net. Fishermen's organizations which are opposed to purse seines are seeking legislation which will either abolish these nets entirely or else greatly restrict their use. In order that we might be fully informed on this matter Dr. Skogsberg of the State Fisheries Laboratory staff was detailed to make a thorough study of the operations of these nets during the 1922 season. He has not only observed the operation of purse seines, but has studied the other methods of fishing as well in order that comparisons may be drawn. The report of this investigation will be submitted after the close of the season and will be available for use at the next session of the legislature.

Although Dr. Skogsberg has not given his final conclusions, several things are quite evident. First: The purse seine boats are not making any money and any radical regulation, such as the proposed regulation of size of mesh, will put them out of business. Second: The canners are dependent upon them for the blue-fin tuna for canning. Third: The fresh fish markets in San Pedro are almost entirely dependent on purse seiners during the winter months. Fourth: The loss of barracuda on account of flooding the markets occurs in May and June due to great catches being made while the fish are schooling preliminary to their spawning period. At those times the prices obtained hardly pay running expenses. He probably will propose a closed season for barracuda during these months.

FISH REDUCTION.

At the 1921 session of the legislature the law regulating the use of fish in reduction plants was amended so as to permit the use of food fish under the following conditions: food fish to be used only if, after application, evidence is addueed at a hearing held before the Fish and Game Commission that there is no market for the fish for human food, and secondly that in no case was it permissable for more than 25 per cent of the capacity of the cannery to be used for reduction purposes. The Fish and Game Commission's attorney gave it as his opinion that although the wording of the percentage provision was ambiguous, the law intended that a cannery could not use fish in its reduction plant unless it was canning fish, and that they could not use more than 25 per cent of the catch in their reduction plant.

After hearings before the Fish and Game Commission held at Monterey and at San Pedro, the percentage limit of sardines which could be used for reduction purposes was fixed at ten per cent for Monterey, while later twenty-five per cent was fixed for the southern district, for it was shown that it would be difficult for them to get along on less on account of different fishing conditions in that region. There was a very strong incentive to use more than the limit for reduction for there was a very poor market at the time for the canned sardines while there was a fairly good market for fish meal and oil. As a result two or three of the Monterey canners exceeded the limit.

No prosecutions were made partly due to the lack of definite evidence and partly due to some misunderstanding on the part of the canners as to whether over-supplies of fish due to accident on the boats or to the machinery of the cannery were to be counted in determining the percentage.

It is also evident that some were receiving more fish from the fishermen than appeared on the records but this could not be proven. As there was considerable dissatisfaction among some canners and fishermen in regard to methods of arriving at the weight of the fish delivered at the canneries we presented the case to the State Superintendent of Weights and Measures. He called a meeting of the canners at Monterey during the present summer at which it was determined that the box or measure used in hoisting the sardines from the boat should

FIG. 25. Purse seine boats at San Pedro Harbor. An investigation of this type of fishing has been in progress to determine whether or not it be dangerous to the fisheries.

be either of wood or metal and that the capacity of each be accurately determined by the state sealer. Also that each canner under the law is a public weigher and must take out a license and give a bond and issue certificates of weight under a state seal. As the Superintendent of Weights and Measures has the authority to revoke this license, as well as forfeit the $1,000 bond for falsification of the weights, it is believed that by this cooperation of the two state departments the evils which have existed will be eliminated and it will be possible for us to enforce strictly the limit of sardines which may be discarded for reduction purposes. This program is also to be carried out in Southern California.

By February, 1922, ten companies in the San Pedro district were actively engaged in packing sardines and the investigation which followed at the end of the month indicated that seven plants had exceeded the 25 per cent limit. In acordance with the provisions of the

Fish Reduction Act complaints were filed in due time and hearings held in East San Pedro, to take testimony in each case. The evidence offered showed that seven companies had violated the fish reduction regulations and orders were subsequently issued, on May 15, 1922, suspending the fish packing license of each company found guilty of exceeding the 25 per cent limit.

Three companies later obtained writs of review with an order attached restraining further action suspending operations at their respective plants, and, at the same time, a new organization of leading packers was formed which made the suspending order ineffective in the case of three other companies. No further action was taken until

FIG. 26. Hauling a purse seine.

the last of June, when the orders suspending the packing licenses of seven companies found guilty of violating the fish reduction regulations were rescinded by the Commission.

During the present summer of 1922 the Monterey sardine canners again made application to be permitted to use a percentage of the sardines for reduction purposes. A hearing was held by representatives of the Fish and Game Commision at Monterey and from the evidence submitted it was determined that to place a lower percentage limit on the amount of sardines which could be diverted for reduction at Monterey than is granted in the Southern California districts placed Monterey canners at an unfair disadvantage, and as it was deemed necessary, from the evidence submitted by canners in Southern Cali-

fornia the season before, to allow a 25 per cent limit for the San Pedro district, the Fish and Game Commission issued an order to each canning company instead of one order for all as in the previous season, in which it granted the 25 per cent limit but reserved the right to revoke the reduction privileges of any company if it used more than the limit or if it did not keep sufficiently accurate records from which we could determine the actual percentage used for canning and for reduction.

The fish reduction law is working fairly well but several amendments should be made so as to make it more easy of enforcement.

FISHERIES PATROL.

In the San Francisco District no changes have been made in the fisheries patrol. During the past crab season crabs were smuggled out of Humboldt County (District 7) and taken into the San Francisco markets. The law prohibiting the shipment of crabs out of the northern districts, on account of the wording of the law, is very difficult to enforce. To put a stop to these violations the patrol launch *Steelhead* was shipped to Eureka by steamer and remained on that part of the coast during the season.

The closed season on salmon established in the outside trolling districts is difficult to enforce without a more seaworthy boat than our launch *Steelhead*. It will be necessary very soon to get a boat which can cover the coast from Monterey to Eureka.

In southern California the fisheries patrol is conducted in the same manner as described in our last report, except that one extra patrolman has been employed to help prevent the landing and sale of undersized halibut, barracuda and lobsters and also to prevent fishermen from operating nets within 750 feet of pleasure piers and thus bother the sportmen who fish with rod and line therefrom.

The commercial fisheries patrol in southern California is a difficult one to handle for the reason that there is no love lost between sport fishermen and commercial fishermen. This feeling has been heightened by reserving for sportsmen certain waters about Catalina Island and around all piers, jetties and breakwaters along the mainland. Certain compromises were made by the sportmen who fish at Catalina and very little trouble is now experienced in keeping net fishermen out of the closed island district.

Most of the time of the patrol boat *Albacore* is taken up with trying to prevent the operation of "drag nets" within the three mile limit. There is no doubt that these nets are very destructive if operated in shallow water along shore, for it has been shown that when so operated three tons of small unmarketable halibut will be destroyed for each ton which can be marketed. Used in deep water, however, this net becomes unobjectionable for it does not destroy an excessive amount of young fish and operates in a territory where other styles of nets would not be used. To encourage this offshore fishing the legislature, at our request, while prohibiting the use of these nets within the three mile limit, permitted their possession in order that they might pass back and forth through the closed zone. This was recommended

by us for the recognized spokesman for the fishermen assured us they would cooperate with us and would see to it that these nets would not be used within the three mile limit. This promise has not been kept. On the other hand the number of these nets has been on the increase and most of the fishermen using them have become experts in avoiding being caught with sufficient evidence against them to cause their conviction. We therefore expect to ask the legislature to prohibit the possession of these nets in any of the southern California districts.

EXPERIMENTAL LABORATORY OF THE U. S. BUREAU OF FISHERIES AT SAN PEDRO.

In May, 1919, the United States Bureau of Fisheries established a laboratory at San Pedro for the purpose of aiding the fishing industries of the coast by an experimental study of the methods of canning and preserving fish. The bureau proposed to carry on experiments for the development of new methods for canning heretofore unutilized fishes, to improve on the methods already in use, and to experiment on new methods for species already being used in the California canneries.

The first line of experiments constituted the major part of the work of the laboratory during its first year. To quote from the Commissioner's report for the fiscal year, 1920: "It (the bureau) has devoted its attention particularly to little used fishery products for which satisfactory canning methods have been lacking and to the establishment of standard methods which will yield standard packs. The mackerel (*Scomber japonicus*), an abundant fish but little esteemed on the California coast, has received more consideration than other species. Over 80 different packs of this fish have been put up and subjected to careful examination, with the result that a number of promising methods have been developed, several of which have been released for the use of the trade. Other species experimented with are bonito, barracuda, pilchard, sea bass, smelt, tunas, and yellowtail, several hundred packs of the various species having been put up and held in storage for examination periodically. A number of special problems have been encountered in the course of this work which may require rather extended study before a solution is found, as, for example, the unpleasant odor and taste in canned bonito and the detinning of cans in packs of such fish as barracuda. A vital desideratum of the bureau, if it is to fulfill its functions and render the largest measure of service to the fisheries, is adequate provision in the matter of personnel and funds to enable it to render the canning industry of all sections aid in the preservation of crabs, shrimps, turtles, and certain fishes, and determining more definitely the possibility of applying newer methods in the case of staple canned fishery products. The need for accurate data in these fields is well shown by the large number of requests that the bureau receives."

The bureau expended on the laboratory during the fiscal year about $20,000. This included equipment, materials, remodeling and rent of quarters in one of the municipal dock buildings and the salaries of the director, Mr. L. F. Lingle, a chemist, a technologist and a stenographer-assistant. By the beginning of the fiscal year 1920–1921 the spirt of economy had taken hold of Congress with the result that

the Bureau of Fisheries failed to get the appropriations necessary to carry on the work of its technological laboratories. Its fishery products laboratory at Washington City of necessity remained practically idle during the year and the laboratory at San Pedro would have been abandoned had not the State Fish and Game Commission agreed to carry the expense of the laboratory for the year. The Bureau of Fisheries and this Commission have cooperated for many years in fisheries conservation work. This cooperation began when the bureau established a salmon hatchery in this state on the McCloud River about the year 1875. A few years later when the bureau, then the United States Fish Commission, was short of funds, the Fish and Game Commission, then the State Fish Commission, financed and ran the bureau's hatchery through several seasons. Later, in 1897, the State Commission in turn being short of funds, the bureau took over, by purchase, the state's salmon spawn-taking station on Battle Creek and an agreement was entered into which has been continued to this day, under which the two cooperate in the propagation of salmon. The bureau maintains all of the salmon spawn-taking stations in the state, with the exception of the one near Hornbrook on the Klamath River, which was recently turned over by the bureau to the State Commission, and the state has carried on the bulk of the salmon-hatching operations at its Mount Shasta Hatchery.

In other words the bureau is assisting the state by spending annually more than $25,000 in salmon propagation. State and federal employees have also assisted each other in the salmon investigations and this mutual help has been most beneficial. Under the circumstances it was natural that the United States Bureau of Fisheries, when it failed to get the appropriation necessary to carry on the work of its San Pedro laboratory should call upon the Fish and Game Commission for aid. Not only would the laboratory have been lost to the state but a large part of the work of the first year, if left uncompleted, would be lost. The Fish and Game Commission, therefore, agreed to carry on the work of the laboratory for the year, or until the bureau could get an appropriation for the purpose.

The work of the laboratory during the fiscal year 1920-1921, was partly devoted to completing the experiments on methods of canning little used varieties of fish as well as the varieties already being canned. Satisfactory methods were developed for practically every species of fish studied. The information thus gained should be of future value to the industry and obviate the necessity of individual canners wasting their energy and time on experiments for which few of them are equipped.

A large part of the laboratory's work was devoted to a study of sardine packing methods and a study by the chemist of the sardine fry baths with the object of cleansing and rectifying the oil or devise means whereby the fry bath might be entirely done away with. Much valuable information was gained which is resulting at the present time in improvements being made in the processing of the larger, "pound oval" sardine. The chemical changes which take place in the fry bath were published by this Commission in 1922 as Circular No. 1

entitled "Changes in Oil Used for Frying Sardines," by Harry R. Beard, assistant to the laboratory.

For the past fiscal year the bureau received an appropriation for its technological investigations which, while entirely inadequate, has enabled it to carry on the work of its San Pedro laboratory by reducing its personnel and to a large extent its efficiency. This Commission aided it to the extent of furnishing the stenographer assistant, and agreeing to stand good for the rent of the building if the Los Angeles Harbor Board could not be induced to donate it temporarily. During this last fiscal year the work of the bureau's laboratory has been devoted largely to experiments on methods of packing sardines in which the oil fry bath has been eliminated.

Respectfully submitted.

N. B. SCOFIELD,
In Charge.

REPORT OF THE LEGAL DEPARTMENT.

The Honorable Board of Fish and Game Commisioners of the State of California.

SIRS: I herewith submit to you a report of the work performed by the legal department for the two years ending June 30, 1922.

Much of the work of this department is in conjunction with the other departments with the exception of the prosecution of violators and trials of civil cases and hearings under the law governing screens and fishways and the commercial fishing laws; therefore much detail is eliminated for the reason that it would be a repetition of the statements found in the reports of the various departments.

During the biennial period 2258 arrests were made of which number 2091 were convicted or plead guilty, 162 dismissed or acquitted and 5 cases still pending.

The amount of fines imposed was $66,421.50 and of this amount $63,027.30 was collected.

The number of days of imprisonment imposed was 2283.

The number of arrests made, the number of convictions had, the amount of fines imposed and collected and the number of days of imprisonment show a marked increase over the previous biennial period.

The district attorneys throughout the state have cooperated with the Commission and have rendered excellent service in the prosecution of fish and game cases and likewise the justices of the peace, by inflicting more jail sentences and imposing heavier fines, are joining with the Commission in an endeavor to stop game law violations.

The appropriation of our waters for irrigation and power purposes is making serious inroads on our inland fisheries due to the fact that the operating companies consider the fish of little or no value.

The laxity on the part of the farmer to maintain screens in their irrigating ditches causes a tremendous loss of fish each year and it requires the utmost vigilance on the part of the Commission to see to it that the law compelling the installation and maintenance of screens is complied with.

Criminal prosecutions under the law have seemed ineffective for in scarcely any instance has any court imposed a penalty on any person, firm or corporation charged with failing to comply with the screen or fishway law. As a consequence it was deemed advisable to proceed against such persons, firms and corporations by way of injunction.

The Anderson-Cottonwood Irrigation District constructed and has maintained and operated a dam across the Sacramento River above Redding, Shasta County, California, that has prevented the passage of salmon and other fish and threatened the extermination of the salmon run on the Sacramento River. An order was served on said district to construct and maintain a fishway over said dam as provided by law, but said irrigation district refused to comply with said order, contending that an opening in the center of the dam was a sufficient fishway. The force of the water through this opening was so great that no salmon or other fish could pass.

Injunction proceedings were begun against the district in December, 1920, and the case came on for hearing before the superior court of Shasta County on January 30, 1922. After the people had presented their case an agreement of compromise was reached between the district attorney of Shasta County and the representatives of the Commission on behalf of the people and the representatives of the Anderson-Cottonwood Irrigation District whereby a good and sufficient fishway would be constructed over said dam that would permit the free passage of salmon at all times during the year.

Injunction proceedings were instituted against a number of persons, firms and corporations in Butte, Tehama, Inyo and Trinity counties seeking to restrain said persons, firms and corporations from permitting fish to enter the ditches or canals of the defendants and thereto destroyed by reason of their failure to install and maintain proper screens at the intake of their respective ditches.

Most of these cases are at issue and will be tried shortly.

The last large run of salmon is in the Klamath River. An application was made by the Electro-Metals Company, a trust, to the Federal Power Commission for a permit to construct two dams on the Klamath River near the forks of the Salmon River. One dam 75 feet high and the other 200 feet high. The construction of these dams, or either of them, would completely destroy not only the salmon run but also the steelhead run.

The Fish and Game Commission filed a protest against the granting of this permit with the Federal Power Commission. The matter of the protest came on for hearing before Mr. F. H. Fowler, district engineer of the United States Forest Service at Yreka, Siskiyou County, May 5, 1921, and at Requa, Del Norte County, May 26, 1921, and many witnesses were heard on behalf of protestant and applicants.

The best authorities in the country on the habits of fish maintained and proved that fish have not and will not pass over a dam more than forty feet high at the most and therefore the granting of this permit and the construction of either of these dams would absolutely destroy the run of salmon and sea run trout on the Klamath River.

There is a dam on the Klamath River at Copco about twenty-five miles above the mouth of the Shasta capable of developing over fifty-five thousand horsepower with only one-third developed and several more dams of like capacity can be installed between the present dam and the mouth of the Shasta River besides the hydro-electric development on the Pit River and the Feather River. The present power program of the various companies already operating on our streams and rivers will produce enough power to supply the demands of our state for years to come and the salmon and sea run trout on the Klamath River should not be sacrificed until the time comes when every other river and stream now devoted to the production of electric energy is developed to its highest potential capacity.

The Commission has and should do its utmost to save the last large run of salmon in California. A hearing on the protest will be had in Washington before the Federal Power Commission shortly.

The legislature of 1921 passed a law prohibiting the use of sardines fit for human consumption or canning for human consumption to be used in a reduction plant, but authorized the Commission after a hearing to allow an amount of sardines not to exceed twenty-five per cent of the canning capacity of the person, firm or corporation canning or packing sardines to be used in a reduction plant. Several hearings were had and orders made granting permission to use sardines as provided in the act. Almost every person, firm or corporation granted such privilege violated the order of the Commission. Charges were filed against those violating the privilege as provided by the act and hearings were held and the licenses of several of the canners were suspended as provided by law.

There has been a marked decrease in the number of cases and complaints for the pollution of public waters.

The large number of letters of inquiry received continually show a desire on the part of the public to be informed of the laws respecting the seasons for taking fish and game and a desire to comply with the law.

Our fish and game is one of our great natural resources attracting many thousands of people to the outdoor life and the automobile and our highway system bring the remote sections of the state within easy reach of the hunter and fisherman. As a consequence the utmost vigilance must be kept in order that our fish and game may not become exterminated and to prevent this, laws must be made with due regard for the breeding season, a reasonable bag limit to be taken during the open season and a strict enforcement of the law governing the same.

Respectfully submitted.

R. D. Duke,
Attorney.

REPORT OF THE BUREAU OF EDUCATION, PUBLICITY AND RESEARCH.

The Honorable Board of Fish and Game Commissioners of the State of California.

SIRS: We have the honor to submit herewith a report on the work and accomplishments of the Department of Education, Publicity and Research, covering the period from July 1, 1920, to June 30, 1922, this being the fourth report of this kind since the inauguration of the department.

The following brief outline of aims which has been followed by the department since its inception gives an idea of the character of the work:

I. Education of the youth especially but also of all to an understanding of the nature and extent of the state's natural resources and the need and value of conserving them.
   A. To be attained by means of:
      1. School and public lectures.
      2. Bulletins and leaflets.
      3. Magazine articles and the press.

II. Wide publicity concerning the work and accomplishments of the California Fish and Game Commission.

III. Backing of the educational and publicity campaign by exact and dependable data secured by painstaking and scientific research.

There is seldom anything spectacular to report in the obvious results of an educational campaign, nor can current results be depended upon to furnish evidence of the effectiveness of the plan. Fruition of the project to instruct the youth of our state regarding the conservation of natural resources is to be looked for far in the future and then only can a fair measure be made of the actual success attained. Pending the time when the actual results are more apparent, your attention is called to the outstanding accomplishments of the biennium.

LECTURES.

Increasing demand has been made on our services for conservation lectures and displays of motion pictures. Many more people have been reached in this way than in any similar period since the beginning of the work. As heretofore, the attempt has been made to distribute the lecture work as nearly as possible over the entire state. When a request comes in for a lecture, it is filed and as soon as convenient lectures at nearby places are arranged for certain dates, thus making the trip of the lecturer most worth while.

In many instances all of the school children in a town have been dismissed in order to attend the lecture given. In one instance every high school in the county having proper facilities was given an illustrated lecture at the request of the county superintendent of schools. An endeavor to reach fish and game protective associations of the state has resulted in five splendid meetings with such organizations. Illustrated lectures are always one feature of the Commission's exhibit at the State Fair during September.

During the spring of 1922 a series of nine lectures on fish and game was given to a large class in general forestry in the University of California. This work appears very valuable because of the fact that many prospective teachers are thus reached, as well as many who will some day be connected with forestry administration in this state. As the lectures were open to the public, many townspeople attended.

The following is a summary of the lectures given. This does not include the numerous lectures given during the summer in connection with the summer resort work, a tabulation of which will be found on another page.

Organization.	*Number lectures.*	*Attendance.*
High schools	36	9,199
Grammar schools	28	9,778
Normal schools	3	138
Universities and colleges	14	1,520
Civic groups and public	32	9,763
Boy scouts	6	313
Game Protective Associations	5	930
State Fair	19	2,610
Miscellaneous	4	850
Totals	147	35,101

Fig. 27. Field study class in Yosemite, 1921. Nature walks form part of the summer resort educational program of the Fish and Game Commission. Photograph by H. C. Bryant.

SUMMER RESORT WORK.

The educational work in the summer resorts started by this department in 1919, at Lake Tahoe, has been continued the past three seasons in Yosemite National Park. A cooperative scheme worked out by the National Park Service and the Fish and Game Commission has resulted in the forming of a nature guide service, designed to awaken visitors to their natural history opportunities and to convince them of the need and value of wild life conservation. By means of lectures and camp fire talks, trips afield, office hours and exhibits visitors to this national park have been made acquainted with and interested in the living things of the park. The work has fully demonstrated that persons on their summer vacations in the mountains are more susceptible to information regarding fish and game and its conservation than they are at any other time. Furthermore, reference to attendance figures shows that nowhere could so many persons be reached with a conservation message, in so short a length of time. These two points alone should gain increased support for this work, although the success of the work can best rest upon the enthusiasm and spirit of those who have come in contact with it.

Lectures and camp fire talks are given at the principal resorts in the park each evening. The more formal lectures are illustrated with motion pictures or lantern slides. Shorter talks usually deal with some bird or animal or answer some oft-repeated question on natural history.

The daily field trips offered form an important feature, for here individual instruction is given and a direct personal contact made. How better can conservation be taught than to use a living individual of a species as a basis of discussion! The sight of a family of Sierra grouse makes a more lasting impression than word pictures or even photographic studies. Many teachers make use of this opportunity to obtain first-hand information regarding living things. As these teachers go back to their classes, conservation ideas are spread through the schools.

SUMMER RESORT WORK.

Yosemite Free Nature Guide Service.

	Field Trips.		*Lectures.*	
	Number.	Attendance.	Number.	Attendance.
1920				
July-August	58	899	34	14,937
1921				
June-August	104	2,214	52	31,545
1922				
June—	48	1,069	19	12,425
Totals	210	4,182	105	58,907

During the office hours questioners appear by the hundred— "What kind of a trout did I catch yesterday?" "What bird has a red head, yellow breast and black wings?" "What kind of deer is found in the park?" Such are the questions asked. Exhibits of mounted birds and mammals and colored pictures aid in this educational work. Small nature study libraries, furnished by the California Nature Study League, have filled the need for reference works.

Splendid publicity has been obtained through weekly news items issued to over a hundred newspapers. The attitude taken by the newspapers and by the public has been very gratifying.

That the nature guide movement has been a success is evidenced by the fact that the number of people touched has almost doubled in each succeeding year, and interest has been so keen that a similar service is now offered in Yellowstone National Park, Glacier National Park and, in a small way, in Sequoia National Park.

Due to the interest of Mr. Stephen T. Mather, Director of National Parks, an opportunity was afforded of advertising the Yosemite Nature Guide Service in eastern states. A trip arranged by Mr. Mather, enabled Dr. H. C. Bryant and his associate, Dr. L. H. Miller, to spend two weeks in lecturing in the larger cities of the east during January, 1921. This also made possible attendance upon the National Game Conference held in New York, and an opportunity to explain the work of the California Fish and Game Commission to this gathering of sportsmen.

FIG. 28. Conservation taught first hand. A group of children listening to conservation stories in Yosemite, summer, 1921. Photograph by H. C. Bryant.

MOTION PICTURES AND LANTERN SLIDES.

Over sixty thousand persons have seen the Commission's educational films during the past biennial period. There is great need for some new films. Exhibits and motion pictures are the chief means by which the people of the state can visualize the work and accomplishments of the Commission. It is important, therefore, to augment this part of the work. Only two new reels have been added, both of these dealing with the nesting birds of the Farallone Islands. The Salisbury Wild Life films are still in use, but they are badly worn. A film showing the life history of deer is particularly desirable. The salmon fisheries would also make a good subject for a film.

Three worn duplicate films have been given wide distribution by the University Extension Division, the reported attendance being 16,400.

Sets of lantern slides dealing with wild life conservation have been loaned to schools on several occasions. Where motion picture apparatus is not available they form the illustrations for lectures. Slides now belonging to the Department number 240. A print of the Tuna Fishery film was furnished the United States Bureau of Fisheries for use at the International Exposition at Rio de Janeiro.

The following is a list of our educational films:

Salisbury_____6 reels, badly worn set
Salisbury_____2 reels, loaned University Extension, badly worn
Hatchery_____2 reel (1 colored) in fair shape
Tuna_____1 reel, in fair shape
Birds of Farallone Islands_____2 reels, in fair shape

PUBLICATIONS.

Demand for the quarterly magazine, California Fish and Game, continues so great that the edition has now reached 7000. It is now the oldest publication of its kind in the United States, most others having been discontinued during the war. An attempt to clean up the mailing list during the spring of 1922 did not materially reduce the size of the mailing list.

Every number issued in 1921 was a special number, attention being given to salmon, history of the Commission, hawks and to the sardine.

The first two numbers in 1922 were also special numbers, that of January being a Game Refuge number, and that of April being a Hatchery number. A complete list and index of the publications of the Fish and Game Commission since its establishment in 1870 appeared in the April, 1921, number. The Hawk number, (July, 1921,) contained two colored plates and many other illustrations designed to correct the usual misunderstanding as to the value of California hawks. The 96-page Sardine number, the material for which was furnished by the State Fisheries Laboratory, has been in great demand and the supply is now nearly exhausted. The valuable historical and statistical data contained in the Hatchery number (April, 1922) will become more and more valuable in years to come. Attention should also be called to a series of reports by Professor J. O. Snyder of Stanford University, on results of the Commission's salmon marking experiments. Volume 7, (1921) contains 286 pages and 93 illustrations, together with complete reports and index. Analysis shows 26 general articles and more than 150 notes, all relating to fish and game and its conservation in California. Separates of the more important articles have been secured for distribution.

Two additions have been made to the series of Fish Bulletins, as follows: Fish Bulletin No. 4, "The Edible Clams, Mussels and Mollusks of the Pacific Coast," by Frank W. Weymouth; and Fish Bulletin No. 5, "A Key to the Families of Marine Fishes of the West Coast," by E. C. Starks. A new series of publications to be known as Circulars has been started with the appearance of Circular No. 1, entitled "Changes in Oil Used for Frying Sardines," by Harry R. Beard. The plan is to place in this series small technical papers of interest only to certain groups.

No additions to our series of teachers' bulletins has been made the past few years, nor has a revised edition of the useful pamphlet on "Bird Study in the Public Schools" been issued. These are projects which should be cared for in the near future.

An article dealing with work of the Fish and Game Commission, prepared by this bureau, appeared in the March, 1922, number of *Western Out-Of-Doors*. At the request of the National Research Council, a paper on the research work of the California Fish and Game Commission was prepared. This is to be published in one of the bulletins of the Council.

FIG. 29. Children receiving instruction from a nature guide. Yosemite, summer, 1921. A fair share of the educational work is devoted to educating children regarding the need and value of wild life conservation. Photograph by H. C. Bryant.

In 1920 the biennial report contained 149 pages and 28 illustrations, together with an appendix containing the statistical reports.

The summer resort work of the Commission has been given wide publicity in eastern magazines and newspapers, as well as the local ones.

A free newspaper service has been maintained and the numerous items issued have been widely used by editors throughout the state. Matters of import to hunters and anglers and results of work done by the Commission have most frequently been used as subjects for the press items. Items taken directly from CALIFORNIA FISH AND GAME frequently appear in newspapers and sporting magazines, thus giving wider publicity to the work of the Fish and Game Commission. This newspaper publicity work really needs the sole attention of one man and our recommendation is that a trained newspaper man be added to the staff of the department. By so doing, this end of the work could be greatly augmented and full advantage taken of the wide opportunity presented along this line.

In our opinion nothing has helped to gain the confidence of the people of our state as has our quarterly, CALIFORNIA FISH AND GAME, which has periodically taken to those most interested, the activities and accomplishments of the California Fish and Game Commission.

Exhibits of the publications of the Commission have been installed at the State Fair each year to supplement the splendid panorama and display of fish made by the Hatchery Department.

RESEARCH.

Unfortunately, the time of your director has been so fully occupied that it has been possible to undertake less and less actual research work. This is unfortunate and it is to be hoped that certain research work, already planned, can be undertaken in the near future. Fisheries research work is well supported and game research should have its share of attention in addition.

Work has continued on the investigation of the food of ducks in California. The results of stomach examination of hundreds of ducks has been tabulated and summarized and additional analyses made.

Further studies of methods of identifying and the food habits of hawks culminated in the publication of an article on California hawks in the July, 1921, number of California Fish and Game. Considerable material relative to game has been added to the regular files kept for holding this material. A study of game conditions within a protected area has been afforded in the past two summers' stay in Yosemite National Park. The effects of total protection can nowhere be studied to better advantage than in this national park.

The department continues to compile data on the annual deer kill, on hunting accidents and on the work of the scientific collector.

Respectfully submitted.

(Signed) Harold C. Bryant,
In Charge,
Education, Publicity and Research.

WATER POLLUTION.

Honorable Board of Fish and Game Commissioners.

Gentlemen: Complaints of water pollution have been fewer during the past biennial period than ever before during a like period. This is, no doubt, due largely to the fact that manufacturers have at last realized that prevention is better, (and more profitable), than cure.

Complaints were filed and convictions obtained against the Northwestern Pacific Railroad, the Shipping Board Steamer *Eastern Sailor* and the tanker *Buccinum*, (under charter to the Shell Oil Company).

A complaint was also filed against the Sacramento Gas Company for lampblack pollution of the Sacramento River. This company at once began construction of a filter of sufficient size to handle all their waste waters and thus preclude the possibility of further cause for complaint and this filter is, at the present time, in successful operation.

A number of accidental losses of oil occurred during the period resulting, fortunately, in a minimum of damage to fish life.

The largest amount of oil thus lost was caused by the earthquake of March tenth which ruptured the pipe lines of the Union Oil Company where they crossed headwaters of the Salinas River. Flood waters carried all, (so far as can be ascertained), of the oil to Monterey Bay without depositing it either upon the river banks or the shore of the bay. The amount of crude oil lost was 2,500 barrels.

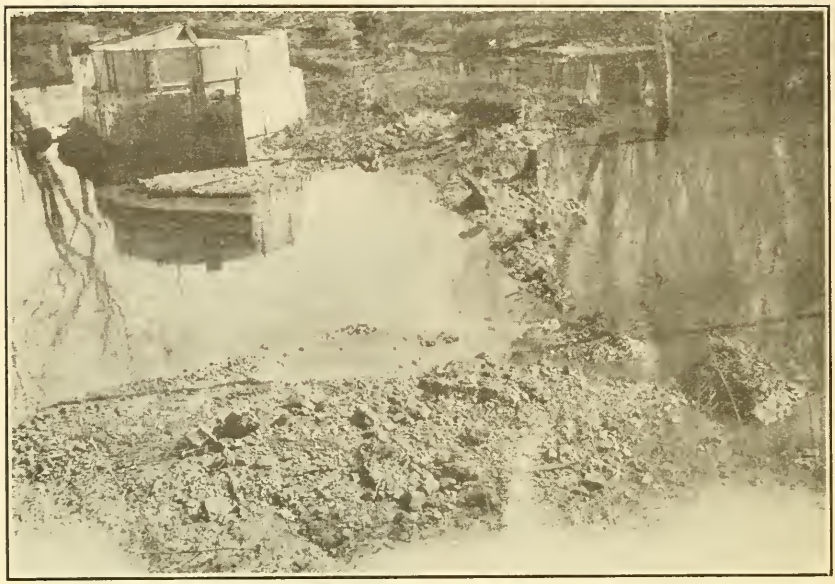

FIG. 30. Sump of Sacramento Gas Company on March 1, 1922. Flood waters have opened sump and lampblack is passing into Sacramento River. Photograph by A. M. Fairfield.

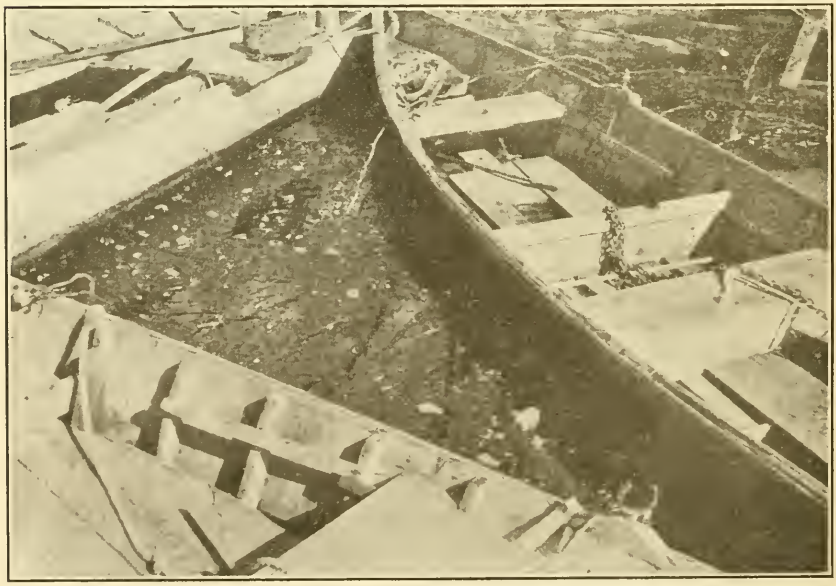

FIG. 31. River bank a short distance below plant of Sacramento Gas Company on March 1, 1922. Gray matter between skiffs is lampblack carried from a sump by flood waters. A law prohibits this sort of pollution and enforcement is in the hands of the Fish and Game Commission. Photograph by A. M. Fairfield.

The next largest amount was lost from the Union Oil tanker *La Placentia* at Port San Luis on July 30, 1921, and was due to the ignorance of one of the crew who failed to understand orders. Some 500 barrels of fuel oil went overboard. The beaches at Pismo and Oceano were "smeared," with consequent damage to clams and decided inconvenience to bathers.

Pollution by small amounts due to breaking of loading hoses are of fairly frequent occurrence but the damage is probably slight.

This department receives frequent requests from other states for information regarding our laws and their enforcement. These letters indicate clearly that California has the reputation of having the cleanest waters in the Union in spite of her area, length of coast line, enormous production and use of petroleum and the magnitude of her manufacturing industries. We are fortunate in that the greatest percentage of our firms and indutrsies are in favor of the enforcement of our pollution laws and endeavor to comply with them no matter at what cost. Two millions of dollars have been expended during the last ten years by corporations to prevent pollution *without recourse to law!*

Very truly,

A. M. Fairfield,
Pollution Expert.

NORTHERN DISTRICT REPORT.

The Honorable Board of Fish and Game Commissioners of the State of California.

Gentlemen: It would require a volume larger than the biennial to do justice to the fish and game conditions of the northern or Sacramento District. It contains a larger mileage of streams and lakes populated with many species of fishes, and a greater area of hunting grounds than any other district. A summary of the outstanding features of fish and game conditions is all space will permit.

CONSERVATION.

Perhaps the most important outstanding feature of the Sacramento Division during the biennial period is the marvelous growth of sentiment regarding the enforcement of fish and game laws. A few years ago a person who gave information concerning game law violations was classed as an informer or spy. Today not only sportsmen but those who do not hunt or fish, but who realize the value of California's wonderful wild life asset report violations that come under their observation as fearlessly as though it were a more serious crime. This is particularly true of the female sex—made possible perhaps by the family auto, which brings them in direct contact with all things beautiful outdoors.

So strong is the sentiment of game protection growing that many justices of the peace have a standard schedule of penalties to fit the crime. Game law violations are at a minimum in El Dorado County since a well-known and popular justice of the peace has said to several offenders: "My price for violating the deer laws is $300; for killing a doe it is 150 days in jail in addition." This has a very deterrent effect. Jail

sentences are now given to second offenders and aggravated cases. Records for this district show jail sentences for the year 1919-20, a total of 102 days; for 1921-22, 1219 days. There are a few justices of the peace who are loath to inflict a fine, but the moral support of a live sportsmen's organization is rapidly eliminating this.

WINTER FEEDING.

The winter of 1921 was the most severe on game animals and birds since the winter of 1916.

By the publicity given to the press by circular letters and by cooperation with the Forest Service and game protective organizations in the snow belt previous to the heavy fall, especially in Plumas, Lassen, Siskiyou and El Dorado counties, the counties in which deer and quail suffered most, we were enabled to succor many of them, although lions and coyotes took a heavy toll in the soft snow. Generally speaking, the deer and quail wintered fairly well. Thanks are due to many sportsmen and others in donating feed and in assisting our deputies in this laudable work.

Between 300 and 400 deer and between 2000 and 2500 quail were fed in Yuba County. At Indian Valley, Ranger C. E. Whittier fed 1200 pounds of hay and 237 pounds of wheat. Tony Laveszolla fed hay to the value of $16.75; salt, $1.25. Mr. Otto Riffel of Blairsden rendered valuable assistance in giving information and feed and Mr. Lyons, looked after a bunch of deer. Deer were reported dying for lack of salt in the Trinity National Forest. Four hundred pounds of salt were purchased for them. Mr. James Harris of Clio voluntarily fed a large bunch of deer. Forest Supervisor Albert E. Gould of Quincy rendered valuable assistance in the work. Deputy Lippincott of Yreka fed 250 quail at Orofino.

A summary shows expenses of winter feeding in Yuba, Sierra, El Dorado, Trinity, Plumas, and Siskiyou to the amount of $140.25, exclusive of feed voluntarily donated by residents of the above counties, which was greatly in excess of that purchased by deputies.

ANTELOPE.

Deputies in Modoc, Lassen and Siskiyou counties took a census of the remaining antelope in 1912. This showed but 19 of these animals remaining. Countless herds of them roamed the above named counties at one time, especially in the Madeline Plains district. By a strict patrol of their winter and summer range we were able to increase the herds until the last census taken last December showed over 200 of them. Particular credit is due to Fish and Game Deputies Geo. W. Courtright of Straw and J. O. Miller of Bray, whose letters are appended:

Straw, Cal., Feb. 16, 1922.

DEAR SIR: I will hereby give you a brief report of my knowledge of the remaining antelope of Modoc and Siskiyou counties.

Early settlers of Modoc tell of the large herds of antelope which they used to see on the big sage plateau, seven to fifteen miles from the town of Alturas, approximately twenty-five years ago. There were several small herds left, which each year dwindled down to three or five animals at most. This big sage herd of antelope in Modoc County numbered approximately fifteen in 1909.

During the 90's several small herd were known to visit the many little valleys of the above sections, but not to remain longer than a few days. During the summer of 1894 I, with my father, saw three antelope on the bed of Egge Lake, which is

located well to the southwest corner of Modoc County. These three have never been seen since by any person in the vicinity of Egge Lake. During the winter of 1898 I saw just one antelope in township 43 north, range 7 east, M. D. M. near Timber Mountain. I was told this antelope was killed the following day by Ed. Comins of Straw, California.

During the winter of 1894 I made a trip to Pecord, Siskiyou County, which was then located a few miles west of the town of Dorris. In conversation over antelope the cowboys would tell of racing the large herds of antelope a few years back. On this trip I personally observed a small herd of antelope near Mount Dome, Siskiyou County, having approached within a few rods of the antelope before they detected my presence. I became very much impressed. I counted twenty-three head. I made many inquiries relative to the number then existing in that vicinity. The cowboys informed me that this small herd was at that time the total of the remaining antelope in that section.

During the spring and summer of 1901, I, in company with my grandfather, R. P. Courtright, spent considerable time in the vicinity of Medicine Lake, which is located in township 43 north, range 3 east, M. D. M. Here I had the pleasure of seeing a small herd of antelope at the Bray Wells, a few miles north and west of Plumas Lake, which is located approximately 7 miles west of Medicine Lake, Siskiyou County. I also saw small herds near the lower sheep camp wells, approximately 8 miles south of Mount Dome, and at the headwaters of Willow Creek, near Mount Dome.

It appeared that the animals were on a slight increase between 1894 up to 1910 or 1911 and 1912. Since 1913 I have taken great interest and have made numerous countings during winter months, which gave me a fine oppportunity to see all the remaining animals. While the residents of the near vicinity of Mount Dome estimate there were from 150 to 300 antelope, I was only able to locate approximately 76 during the years 1913 to 1920. During these winters I often saw the young animals in a poor, weak and sickly condition following the herd with their ears dropped down, without apparent vitality or strength to follow.

G. W. Courtright, Deputy.

Fig. 32. Walter H. Bray of Hornbrook, with his predatory animal dogs.

BRAY, CALIFORNIA.

DEAR SIR: The accompanying picture was taken of a band of 87 antelope. I watched them for some time and got the direction they were traveling, then I got ahead of them and waited for them. I was hid in a juniper, but the leaders spotted me and lined up to take a look. The picture was taken at a distance of fifty-five yards. These animals are not wild at this time of the year. It is no trouble to get within 150 or 200 yards of them in the open, but it is some job to get close enough to take a good picture. I am going out there again in a short time and will try to get some more pictures of the herd. The same day I took the picture I found three more antelope in Mitchell's field, making 90 altogether. It is possible that there was another small band somewhere that I did not find.

J. O. MILLER, Deputy.

This is an example of what a strict application of game patrol will do for game conservation. A refuge should and no doubt will be created for their winter and summer range by the 1923 legislature.

DEER.

Irrespective of any action taken toward surrounding the black-tail deer with more protection, either by limit or season, it is absolutely

FIG. 33. Winter feeding of deer at Blairsden, California, March, 1922. Photograph by Otto A. Riffles.

necessary to afford greater protection to the mule deer of Lassen and Modoc counties, especially in the Lava Bed sections, before they are finally exterminated. This grand animal, the largest of the deer family, with the exception of the elk, many of which weigh nearly 300 pounds, is laboring under a protective handicap placed by nature. It is unlawful to kill a spike buck, which among the black-tail is usually a yearling deer. About 98 percent of yearling mule deer have forked or branched antlers. Very few have spikes. They consequently are legal deer to kill even before they are yearlings. As the youngest buck deer are more valuable for service, it does not take much calculation to figure out the great disadvantage under which this species of deer labor. A closed season in the counties of Lassen and Modoc for two or more years would result in bringing back this splendid animal.

QUAIL.

The excessive snowfall at such low altitudes was more or less destructive to both mountain and valley quail. One compensative feature was the fact that the snowstorms were intermittent and the birds were able

Fig. 34. Part of the Mount Dome herd of antelope, the last large herd left in California. Careful protection is being given these antelope. The picture shows 87 animals and was taken by Deputy J. O. Miller in December, 1921, during winter feeding operations.

to recuperate between these periods. Intelligent feeding enabled many flocks to weather the storm. An outstanding feature of this was that hundreds of quail made the small towns their temporary home and were fed in the main street by residents.

SAGE HEN—GROUSE.

These birds are not abundant, and like certain other game birds, are victims of the efficiency of the trinity of the auto, good roads and the ever-increasing efficient marksman.

DOVES.

The later open season of September 1st, established by both the federal and state law, has made a remarkable improvement in the number of these birds. It has demonstrated that these birds remain late enough in the season if not molested.

DUCKS—GEESE.

The inauguration of an earlier open season by sixteen days by the United States Biological Survey, Department of Agriculture, which now controls migratory waterfowl, and by the state, has solved the problem of alleged damage to rice crops by ducks. The rice farmer is now enabled to "take it out on the duck" while he is with him, thus removing the incentive to violate both the state and federal laws. While this season is not entirely satisfactory to the average hunter, owing to weather conditions, still it is more satisfactory to all as a remedy to the condition which previously existed.

INTRODUCED FISH.

The phenomenal growth and increase in our introduced fishes, the bass, sunfish, and crappie, is most remarkable, and is eagerly taken advantage of by the rapidly increased interest taken in this outdoor, gentle sport. These fishes may now be found in all waters of the lower altitudes, and in many waters up to 2500 feet in which it would be unwise to plant trout. The crappie appears to be taking the place of the Sacramento perch near Sacramento. This species seems to become more abundant from year to year, and every week-end and holiday sees hundreds of men and boys angling for this splendid game fish.

The crappie takes the fly readily and is easily caught on a spinner. Anglers maintain that the crappie compares favorably with the black bass as a pan fish. A splendid exhibit of these fishes has been made annually at the State Fair.

LAUNCH PATROL.

The patrol launch Rainbow, with a speed of nearly 30 miles an hour, has maintained its reputation for the speedy breaking up of and preventing of violations of the netting and other laws.

FREE CAMPING GROUND.

The Fish and Game Commission has maintained a free camping ground on the old hatching property at Tahoe City for the past three seasons. A much larger number of people patronize it each succeeding year and pronounce it the most ideal spot, the best equipped and most sanitary they have visited.

Respectfully submitted.

(Signed) GEORGE NEALE,
In Charge.

SAN FRANCISCO DISTRICT REPORT.

The Honorable Board of Fish and Game Commissioners.

Sirs: During the two years closing June 30, 1922, 1224 arrests were made by the deputies of the San Francisco District for violations of the various laws relating to fish and game. Fines totaling $34,442.75 were paid into the state treasury and in addition jail sentences aggregating 332 days were served by defendants.

Outside of the city of San Francisco the support received from the various justices of the peace of the district was most satisfactory. Only 3 per cent of the actions filed were dismissed and only 4 per cent placed on probation. These for the most part were minors and technical offenders. The average fine imposed was slightly under $30.

In San Francisco while the percentage of dismissals was even smaller than in the district in general, 2 per cent, the percentage of defendants placed on probation was much greater, 23 per cent. The average fine imposed was smaller, $23. The San Francisco courts evidently do not regard violations of the fish and game laws as seriously as do the country courts. While there has been a gradual increasing sentiment during the past several years, there still is a reluctance on the part of hunters to report violations until after so great a time has elapsed that there is no possible chance of catching the culprits.

California has much more to contend with in protecting her game than do most of the eastern states. During the summer time thousands of our people live out of doors in their automobiles. They can go to every part of the state, camping where night overtakes them. Guns and fishing outfits are in almost every car. The temptation to kill game out of season is so strong that many can not resist—with a result that game is killed during the breeding season when the loss of one bird means the destruction of an entire flock.

In the east, on account of the summer rains, there is not one camper where there are hundreds in California and it is not so difficult to enforce the laws during the breeding season.

It is impossible in California without funds available to employ wardens to control all of the violators. If every sportsman would take it upon himself to see that the laws were respected and report violations there would be a much greater respect for the law and there would be much more game.

There seems to be an increased number of careless or wilfully criminal deer hunters. The law prohibits the killing of does and spike bucks. The legal deer must be forked horn or better. This law makes it necessary for the hunter to be certain that he is shooting at a legal deer. Unfortunately there are many hunters who shoot first and look afterwards. If it happens to be a legal deer they bring it into camp, but otherwise it is left to decay in the hills.

Many hunters are so careless in shooting at moving brush that in many instances their target is a human being. Year after year many hunters are killed or wounded by their own companions. Any individual killing a person in this way should be prosecuted for man-

slaughter, if not murder. He is guilty of violating the law and also grossly careless, and if that carelessness results in the death or injury of a human being he certainly should be held responsible and made to pay the penalty.

In September, 1921, a sixteen-year-old boy was shot by a hunter near Mount Hamilton. That boy is lying on his death bed today hopelessly paralyzed. The man responsible for the shooting has never been to see him and has not contributed one cent to the hundreds of dollars paid out for medical treatment.

Another shooting occurred in Trinity County. A draftsman employed by the government was on his vacation and was shot in the arm by a companion. This man shot into the brush only a very few moments after the man who he had shot had disappeared from view. Fortunately the man's arm was saved but he had to give up his occupation and it is a question as to whether he will ever regain full use of the arm.

These two instances of many are cited in order to call the attention of readers to the fearful penalty that is frequently paid on account of the gross carelessness of an irresponsible individual. Careless hunters have also caused a great deal of complaint on the part of stockmen, setting fires, leaving gates open, killing and frightening cattle from water holes. Many cattlemen estimate that an actual loss of several dollars per head can be attributed to thoughtless hunters.

It is a serious question as to whether the deer supply, and in fact the supply of game and fish, will continue with our present laws. The development of the automobile, the construction of roads in the out of way parts of the state has caused such a drain on the game that it will probably make it necessary to have still shorter seasons. In the east, great benefit is gained by prohibiting Sunday hunting. This Sunday law is not a blue law but a game law that is necessary in states having heavy population and where there would be so great a number of hunters out on Sunday the game would have no show. Fortunately in California such a law is not necessary at this time, but we may have to come to it in time.

Suggestion has been made that it would be well to shorten the season for the taking of deer—primarily to reduce the number of deer killed and to assist in preventing the great number of forest fires that occur every year during the latter part of the summer. It is argued that by having a shorter season it would be easier to keep watch of the hunters who set fires and kill illegal deer.

It is quite probable that a short season would have just an opposite effect and make more violations and more fires. A short season would crowd the hunting grounds and all deer hunters would be in the field at the same time. The unscrupulous hunter knowing that there were so many others around and his time limited would be even more willing to shoot and look afterwards. There would be a great increase in the number of people wounded and killed and also a great increase in the number of does and spike bucks left in the hills to decay. Also the individual who unlawfully starts a fire would be more inclined to do so in order to better his chances in getting a deer in the limited time allowed by law.

The Fish and Game Commission has been urged by many good sportsmen to have the penalty for violating the various laws increased. They believe that there is particular necessity for increasing the penalty for killing a doe even so far as to make it a felony. At the present time the range of fines that may be imposed for doe killing is from $50 to $500 and in addition a jail sentence of 150 days may be imposed. For other violations of the fish and game laws a fine of $25 to $500 may be imposed and the same jail sentence.

Unfortunately many justices of the peace do not regard violations of the game law as seriously as do sportsmen and they are inclined to consider the defendant rather than the crime and the minimum fine is most frequently imposed and sometimes they deem this even too severe and either suspend sentence or put the violator under probation. If the minimum fines were increased there would be more suspended sentences and more probations. If the sportsmen who are interested in seeing the laws enforced would take it upon themselves to back up the justices of the peace who impose severe sentences and insist that the milder justice impose fines upon wilful and deliberate violators that are somewhere nearer the maximum, they will do more to stop the illegal killing of game than could be done in any other way.

WATERFOWL.

The 1919-1920 duck season was not good anywhere in the San Francisco District. In the San Joaquin Valley there was very little loafing water and the birds continued in their migration. At the opening of the season there were a good number of birds and many limits were taken. On one ground near Gustine, out of 400 hunters, 125 secured full limits and most of the others secured parts of limits. Shooting was better on the opening day than at any other time during the season. In the Suisun marsh shooting was also poor during most of the season.

The 1921-1922 season opened much better. On the same ground mentioned above, Gustine, there were twice the number of birds killed as were killed previous by approximately the same number of hunters. Shooting continued to be good during the remainder of the season but was not up to normal.

During the past several years there has been a very great decrease in the number of geese in the San Joaquin Valley. It is apparent that the settling of the country has driven the birds to other localities. This year better conditions should prevail as the heavy run-off from the Sierras resulting from the heavy snows has filled the lower country such as Tulare Lake covering 30,000 acres, and other loafing waters, sufficiently to hold the birds.

QUAIL.

While the dry years have not been favorable for duck shooting they have been excellent for quail. Birds were reported abundant in all sections of the district. Quail seem to have learned how to take care of themselves better and as soon as the season opens they take to the higher brush where the hunter has more difficulty in securing a bag limit. Likewise the brush, on account of the scarcity of fires, has grown higher and quail find better shelter.

Mountain quail are not hunted anywhere near as extensively as are the valley quail and have increased in many parts of the district. The mountain quail is even a better bird for the table than the valley quail, but it is not regarded as highly by the hunter as it does not lay as well to the dog and is seldom in open country.

TREE SQUIRRELS.

Tree squirrels are reported abundant in the coast section but in the Sierra region they have been greatly reduced in numbers by an epidemic which, according to reports, has almost exterminated them in some sections.

OTHER GAME.

Other species of game, grouse, rabbits and doves have afforded excellent hunting and are holding their own, if not increasing.

FISHING CONDITIONS.

On account of several dry years, trout fishing in the coast streams has been poor. In many streams the water was so low that practically all the fish disappeared and it was necessary to restock in order to bring them back. There has been so great an increase in the number of fishermen that all the streams in the vicinity of San Francisco have been over-fished. If it were possible it would be well to close certain streams until they can be restocked.

Respectfully submitted.

J. S. HUNTER,
In Charge.

REPORT OF LOS ANGELES DISTRICT.

The Honorable Board of Fish and Game Commissioners of the State of California.

GENTLEMEN: The biennium ending with this last fiscal year has been a peculiarly trying period of ever-increasing pressure upon your "Southern Division," and particularly its Los Angeles headquarters office.

We have fought faithfully to stay within sight of enormously swelling demands for every department of our work, despite the financial limitations inevitably imposed upon all expenditures by the dollar unit of license income.

Sportsmen constituents and the host of industries more or less directly dependent upon outdoor attractions persist in asking ever larger allotments of fish for planting, and more intensive patrol work. To our pleas that the dollar-license was established fifteen years ago when the dollar stood at par in purchasing power, these hunters and anglers reply that we have educated them to the fact that they must maintain all wild life conservation in California, and awakened them to the importance of keeping up these potent inducements to immigration as well as the

recreation of our resident citizens. It is they, rather than your humble servants, who ask increase in the license rates. They bring us demands that are to be met in no other way, and declare since the responsibility is theirs, they wish to finance the job upon a 100 per cent basis.

The biennium preceding was remarkable in its showing of sustained interest in outdoor sports which even the terrific distractions of world-wide war proved powerless to discourage. Following it, in logical sequence, the return of our young service men, hardened by military training, inured to roughest adversities of "camping-out" in climates far less charitable than their California, and further familiarized with firearms, naturally has brought quite the increase in rod and gun enthusiasm we predicted, and more; with all that entails from the intensely-interested viewpoint of those whose efforts are devoted to this great work of wild-life conservation.

After so undeniable a demonstration of the vitality of sporting enthusiasm as the last two years of war showed, surely no great stretch of foresight was needed to predict that with signing of the Armistice would start an entirely new era in the world of outdoors, requiring the redoubling of all official efforts toward maintaining our splendid sporting attractions in this great state of sportsmen.

That such predictions, however extravagant they then seemed, have fallen far short of post-war experience, scarcely calls for apology. Neither need we assume blame for a condition we could not change in our present financial inability to adequately meet such situation under the existing system of granting for one dollar, access to an aggregate tonnage of game or of fish which lawfully may be taken by the sporting licensee in quantities to be worth for food alone, a thousand times that modest sum.

Should this statement seem overdrawn, one needs only to measure mentally the mountain of game that our liberal seasons and bag limits allow the licensed hunter during the year. The appalling conclusion then is forced that were even a small percentage of our quarter-million hunting licensees fully to avail themselves of this privilege for which they have paid one paltry dollar, California's fields, marshes and mountains speedily would be depopulated of game; the ducks, geese, snipe; the deer, quail, doves, rabbits, grouse, squirrels but a memory—and a nightmare at that!

In the case of fresh-water game-fish, for which the same nominal dollar-license is collected, the annual tonnage becomes even more appalling when it is remembered that seasons are longer, without weekly limitations upon the bag. More particularly does this situation challenge the consideration of sporting conservationists when it is realized that our fresh-water game-fishing, when not actually artificially established, has been, at least for years past, virtually upon an artificially-maintained basis.

Herein, we have the anomalous and indefensible situation of a self-supporting sport with innumerable business aspects, which now threatens no longer to support itself because each additional licensee may prove a liability rather than the asset of antebellum days when his dollar paid for raising and distributing more trout than the average angler took from our streams during the year. Further complication is

added by the steadily-increasing skill of our sportsmen anglers, although this carries with it at least the crumb of comfort in a consistent growth of sentiment against the use of salmon eggs, which bait must be considered among the foremost unnatural enemies of the trout fry being planted in millions each summer by this Commission in California's streams.

Fortunately the average annual bag or creel would not show even a suggestion of these totals of legal-limit possibility; but the enormous multiplication of individual demands surely is alarming enough. It has become one of the most serious problems now facing wild-life conservationists, although but one among many. Aided by the automobile whose destructive possibilities through rapid and pleasant transportation are enormously enhanced by the ever-spreading system of cement boulevards, this increase of hunting and angling enthusiasm has suggested in itself the means to meet its demands. The sportsmen who pay for all wild-life work have embraced their responsibility with an ardor and an insistence upon raising their license contributions to an adequate figure which places us, their servants, in a peculiarly delicate position; for we do not wish to be misunderstood as attempting to evade their apparent willingness to finance further and more extensive work in their behalf.

As to the opportunity for greatly increasing expenditures, little need be said. All the present income of the Fish and Game Commission could be expended for rearing and distributing trout alone. Last year, although the Department of Fishculture broke all known records by taking 25,000,000 trout eggs and distributing over 24,000,000 fry successfully, applications were on file for considerably over twice that number. The amount of money that could be expended efficiently in patrolling this vast state, greater than many an independent nation, comprising every condition from alpine to oceanic, scarcely calls for any extended argument. Importation of promising alien species of game birds from Mexico, projected and perforce held up from lack of funds last year; sweeping antivermin campaigns and closer patrol of the game refuges; substantial improvements in behalf of the hunter, all would become possible were the revenues available to undertake them upon a wholesale basis.

Foreseeing the post-war situation was one thing; financing its anticipated demands with a depreciated dollar is another, and vastly different. By no process short of the supernatural can one dollar do the work of five; but that is substantially the situation confronting your servants in conservation since the armistice. We have met it as well as we could. Substantial cooperation from county supervisory boards, the Forest Service, the sportmen's associations, chambers of commerce, has been enlisted wherever possible. As a result, we have now a patrolman in every southern county excepting one, and something of a localized organization in fish and game work. County supervisors are realizing that we are undertaking a big job under a financial handicap; some have contributed to the cost of planting fish, an item enormously increased throughout the state by the withdrawal of former free transportation of fish cars and messengers over the railroads. Others add to the state lion bounty and make the extermination of these vermin,

natural enemies of the stockman as well as the deer hunter, more attractive, thus encouraging men to make a business of hunting lions and maintaining packs of specially-trained dogs therefor.

Most of our southern counties cooperate with us in the most substantial and gratifying way by joint appointments, whereby the county game warden appointment is given to the state representaive upon a division of expense and salary basis. The arrangement has worked out decidedly well; the counties are awake to the importance of preserving their peculiar wild life attractions. Upon most of the national forest reserves, the rangers are giving all the time they can to fish and game patrol; the forest officers mostly are ardent and well-informed conservationists, our deputies cooperating to the extent of fire prevention also. But for such assistance from these allied sources, not nearly so much could have been accomplished.

GAME CONDITIONS.

Antelope. Special attention has been paid to preserving the remaining native big-game animals which have received from many past legislatures the statutory protection of entirely closed seasons and heavy penalties.

Rapid settling-up of the typical antelope range on the "plains" of western Mojave Desert to which valley they leave their name as a monument and perpetual reminder of their one-time plenty, probably has sealed the fate of these unique and interesting creatures, whose history has been so interwoven with the pioneering of the west. The "Prong-horn" and civilization can not co-exist. Civilization now has claimed Antelope Valley for its own. Preying principally upon the "kids" when snow and shortened rations have cut down the only physical resource of these animals—their great speed—the coyotes, the chief natural enemy of the species, take a considerable toll annually, and particularly in such heavy winters as last.

Upon resolutions from local chamber of commerce representatives, asking legal permission to "round-up" and "corral" the remnant of these antelope in an enclosure to be made by fencing off a relatively small part of the desert, the Commission conferred with the various societies interested in maintenance of wild-life as such, and found its verdict affirmed that the animals should be left in a state of nature, with all possible done in their behalf. Whenever any so inherently wild a species as the "Prong-horn" is reduced to slowly perish in the protracted misery of captivity, its status as "wild-life" is admittedly at an end.

Cooperation with the "Committee for Conservation of Wild-Animal Life" of the California Academy of Sciences has been whole-souled and not without results in this southern division. Enameled steel signs have been posted along principal routes of travel, giving access to haunts of antelope and mountain-sheep, warning the public that these animals are protected and their range is at hand. Arrangements to enlist public-spirited observers as incidental protectors also have been undertaken. Winter feeding is among the most effective methods of antelope conservation, its success having been demonstrated on the Mount Dome Antelope Refuge in northern California.

Mountain Sheep. An important and interesting example of effective big-game conservation by law is shown by the material increase of mountain sheep in the southern division. Reinforced by the relative remoteness of their habitat in the desert ranges of southeastern California, human depredations against the wholly closed-season have been confined to occasional Indians, prospectors, and a few case-hardened, chronic violators whose pernicious activities have engaged the attention of our resident patrolmen in Inyo, Riverside and San Diego counties. Offenders of this type, after exhausting every subterfuge and necessitating several trips of the Commission's attorney at the expense of law-abiding sportsmen's funds, finally were fined $500 plus large attorney's fees. There is satisfaction to big-game hunters, as well as other conservationists, in this increase of mountain sheep under "wise laws well enforced."

Deer. Deer conditions can not be considered at all satisfactory in the south, where intensive hunting has resulted in appalling increase of the all-too-charitably excused "hunting accidents," and a disproportionate upsetting of the natural sex-balance by killing-off of adult bucks. This, in light of recent practical demonstrations destroying vermin in Australia, tending to show that reduction of males is a material stimulant to fertility, is not necessarily so serious in itself as most hunters fancy; but the annual drain under a two-buck limit has been excessive. As an additional safeguard to human life, reduction of the limit to one forked-horn buck or bigger, now appears essential. Hunters, knowing they can lawfully kill but one, will be somewhat less rash in risking a shot at anything that looks like a buck. Practical conservation aspects of a limit in fact, which really can be enforced, suggest themselves. Whether the "forked-horn law" should be further reinforced by rendering it a felony to kill a man "by accident"—nine times out of ten, purely criminal carelessness and wanton disregard for a law which plainly says "look for forked-horns"—this is for the coming legislature to decide. The certainty is, that with our enormously-increasing concentration upon the remainder of deer left in our narrowing areas of deer country, further restrictions by cutting in two the limit and curtailing the total in open seasons, are necessary.

Mountain Lions. Our efforts to awaken county cooperation toward systematic reduction of lions, pests to stockraiser and sportsman alike, natural enemies of calves, colts, pigs as well as deer, continue bearing gratifying results as one county after another does what this Commission for financial and other reasons can not do—adds enough to make the state bounty attractive to professional lion hunters, enabling them to keep trained dogs and follow up the demonstration so effectively made by our state lion hunter, Jay Bruce. If current estimates are correct that every deer killed has put $100 into circulation, common sense would indicate that a lion which may kill 50 deer a year is cheap enough at that price.

Waterfowl. The congested character of southern California's artificially created shallow artesian-overflow duck shooting along the coastal plain has brought its own peculiar problems in a patrol way, offering work enough for half a dozen active deputies throughout the shooting season and a month before and after. Similarly, Big Bear Valley

and Buena Vista Lake, centers of interest among the "unattached majority," also call for closer attention than this Commission as yet has been able to finance.

In western Orange County particularly, concentration of duck preserves within an area of some six or seven miles square, traversed by intersecting roads every mile, inevitably has brought a considerable conflict between clubmen and their "uninvited guests", with which of course this Commission has only incidental concern; but the common interest of the law-abiding sportsman must be served by seeing that the opening of shooting is enforced to the legal minute, since the sport of a thousand may be spoiled for the day by rash selfishness of a few. Stopping shooting in the dusk when guns flash, is one of the most important means to maintain ducks in any locality which for reasons of food and fresh water they wish to frequent. Like most forms of conservation, sport as well as wild-life must benefit by the same action. A large bell, tolled at the legal minute, removes from the careless, any color of excuse for "early-shooting", which drives out the ducks for everybody.

The amounts of money wealthy sportsmen are paying to preserve duck shooting within an hour's drive of business is a very interesting sidelight upon wildfowl conservation, whose practical benefits speedily would be lost upon everybody were drainage and subdivision to deprive the ducks of any inducement for stopping off and wintering in our coastwise overflows, whose value now finds oil excitement added to the previously spectacular increase in acreage adjacent to the city incidental to southern California's growth. In one favored instance, development of oil, instead of destroying a world-famous duck preserve, appears to have perpetuated the sport by turning the property into an immense dividend payer of spectacular magnitude with duck shooting an additional, self-supporting and seemingly uninjured "interest". But in most cases, the sport is costing more and more.

FISHING CONDITIONS.

Importance of keeping pace with the rapid development of power and irrigation projects incidental to the unprecedented population growth of the southern division counties early was appreciated. While at first thought the menace to natural fishing might seem prohibitive, the possibilities of "wise laws well enforced" have been invoked to make in behalf of the angling licensees, best possible use of these water-impounding projects.

Of power and irrigation projects in these days of phenomenally growing population, there can be no end. One of the problems of this sportsmen's commission must be the maintenance of all possible public access to the fishing that it is developing therein. Throughout lowland valleys, bass lakes will become more and more plentiful; the black bass is the sporting fish of the future so far as the general public is concerned; and indeed that future is very nearly upon us now. Our mountain lake trout possibilities naturally are limited; but every water impounding scheme suggests bass possibilities.

After considerable negotiation, the city of Los Angeles finally arranged to continue the excellent sport of bass fishing on the large irrigation storage reservoirs of upper San Fernando Valley, and of

course farther on, beyond the city limits up along the line of the aqueduct where municipal jurisdiction ceases, there has been no objection. Since this sport within the city limits is so inexpensive and easily accessible, it is of prime popular importance; and efforts of this Commission to continue it upon a recognized and properly regulated basis, such as has proved so successful in San Diego's municipal lakes, have resulted in a better all-around understanding and general education of the public to the necessity of carefully respecting sanitary regulations to perpetuate the privilege.

The precedent thus established already is bearing fruit in setting an example to privately-controlled water companies throughout the south, several of which have found it paid them well to enlist all possible popularity through permitting the public to enjoy this cheap and good fishing right near home. Friends always are an asset in any enterprise; fishing might help float bond-issues—stranger things have happened.

Sport in the sea has had special attention despite the manifest difficulties of reaching conditions so vast as those of the changing ocean. Efforts to protect the rights of the sporting angler from unnecessary and unavoidable encroachment by the alien professional have on the whole, been fairly successful, although maintenance of any entirely efficient patrol is beyond present financial possibility until all who enjoy fishing of any sort from ocean wharves, piers, break-waters, etc., realize that to keep net-fishermen 750 feet away from them is a most practical form of protection, for which they must expect to pay the costs in the form of purchasing angling licenses, without hair-splitting technicalities as to whether the species they are angling for is technically classified as "game fish," or not.

LICENSE SALES.

Expansion of the license-sales system developed by this office has continued until now hunting and angling licenses are obtainable in every country village and most of the crossroads hamlets. Rendering licenses easy to obtain probably has played fully as great a part in stimulating sales as patrol work, since after all, the nominal dollar is regarded by the great majority in its proper light as virtually a voluntary contribution to improvement of their sporting conditions; "chipping-in" to a state-wide association of sportsmen. In the southern division during the fiscal year ending June 30, 1921, $54,114 was the net total of hunting license sales; the last year, a gain of 3620, or 6.6 percent; angling license showed a gain of over 10 percent, totalling $40,496 net to December 31, 1921. Sales of commercial fishermen's licenses, however, showed a serious falling off from $28,000 April 1, 1921, to $19,860 last April, due in great measure to the curtailing of the fish packing industry following the armistice, and slackening of the war demand. This class of revenue supports the research and regulation of commercial fisheries, together with tonnage taxes and privilege licenses for wholesale shellfish dealers, fish packers, kelp harvesters, etc.

LAW ENFORCEMENT.

Considerable comfort is derived from the steadily stiffening disposition of southern division judges to impose fines of sufficient size to really

have some deterrent effect upon the deliberate class of fish and game law violators, either for their own selfish pleasure, or personal profit. Our newspapers, city and country, have cooperated most effectively in a continual campaign of education aiming to impress the general public with the petty larceny nature of wilful violation, which amounts virtually to stealing the sport of the law-abiding class which leaves its guns and rods encased until the law says "let's go" for everybody. The economic injury of shooting nesting birds and thereby depreciating the attractions to outdoors has been impressed quite effectively. All of this finds statistical proof in records of the Los Angeles office, showing 137 convictions during the year ending June 30, 1921, with average fines of $28 and a conviction percentage of 92.7; which was increased during the last fiscal year to 219 cases, with average fine $28.26, and a conviction percentage of 94.5. In 1921, $3555 was collected in fines in the southern division; last year, this was substantially increased to $5850. As no less than 128 of these 219 cases were made for game law violations, almost equalling prosecutions for all classes of violation the year prior, the interests of the hunters would appear to have been fairly well served; while the diversification of patrol attention is proved by 29 cases for sport or game fish violations and 50 prosecutions for commercial fisheries infractions. To these might be added some cases made by the sea patrol of which the Los Angeles office lacks record; those given mostly were prosecutions by the regular warden force incidental to their general patrol work.

However, patrol efficiency must always remain relative; the increasing totals of cases does not indicate more violation or increasing lawlessness; rather, it suggests that the intelligent cooperation we have been able to enlist from all allied authorities is "rounding up" an ever-increasing proportion of offenders. Welcome as would be the day when patrol work could be dispensed with and its high costs spread upon more directly constructive operations, none but dreamers expect it short of the millennium; so our efforts will continue correlating and cooperating with local authorities in every practical way toward rendering fish and game law violation an increasingly bad risk, with certainty of ever stiffer penalties upon conviction.

EDUCATION AND PUBLICITY.

"Backing-up" of patrol by publicity as a part of our general educational program is a policy established and persistently amplified all possible in the southern division; the most important work in behalf of wild-life conservation is inculcation of a favorable sentiment, which can not be maintained by working with the better class alone and leaving the lawless to work their will. There is a small minority which does not read, has no sentiment about fish or game, and respects only one kind of "education". For such, we have the iron fist of the law. Those who respect all regulations not from fear or force but from recognition that restrictive laws are necessary and right, are entitled to protection, and deserve to know that they have been getting it. Hence the importance of public announcements of prosecutions is not limited merely to their deterrent effect upon the careless, whom fear of fines might restrain.

Incidentals of our publicity work, are announcements of laws, seasons, changes in the natural conditions; general information service to sportsmen; cooperation with such sterling organizations as the Automobile Club of Southern California, Los Angeles Athletic Club, and sportsmen's clubs in general. It has been an extensive service. This Los Angeles office never has lost sight of the peculiar and direct relation that exists between the sportsmen and their Fish and Game Commission; our slogan has been "service"; and so far as the physical and financial limitations placed upon us have permitted, our efforts consistently have been to make of this work a helpful stimulant of that wholesome outdoor enthusiasm which has done so much to bring people to California and keep them healthy and happy here. It has meant much work and activities that in a narrower interpretation of our duties might have been evaded; but on the whole, the warm and personal regard with which our southern sportsmen as a class appear to consider this Commission has been no small reward in itself.

Internal cooperation with our several departments, as a matter of course has been continuous and complete. Activities of the southern division in regulation of commercial fisheries, necessarily have been both comprehensive and considerable. In particular, the regulation of reduction to fertilizer, fish-meal, fish-oil, etc., by the fish-packing industry, and general patrol of our commercial fisheries alongshore and in town, while primarily responsibilities of our Commercial Fisheries Department, and properly a charge upon its special revenues, have called for and received our constant cooperation.

Cooperation with the Department of Fisheulture in arranging for the distribution and planting of trout fry, protection of spawn sources from every manner of ill-advised menace, such as agitations to plant bass in trout lakes; "holding fish" to six-inch size before liberation, and similar advocations of the inexperienced or uninformed, all have been among the daily activities of your southern division headquarters. So likewise has been the protection of the plantings by enforcing the screening of ditches, canals and other diversions of trout-carrying water. In Inyo and Mono counties, even up into the wilds of Alpine, the larger ditch and canal owners are bringing their diversions of water within the law. Thus far, this has been accomplished without prosecution. Large concerns cheerfully and promptly comply with every request made. For those which do not, the demonstrated success of injunction proceedings remains as a last resort. Gradually, the idea is spreading that whosoever is served with orders to screen, must comply in the end. Public sentiment has responded encouragingly to plain presentations of the facts. While much remains yet to do, the accomplishments of the last biennial period give ground for believing that the increasing development of water for power and irrigation can be so handled as not to imperil fish and fishing, but rather to enhance sport of the future.

Respectfully submitted.

EDWIN L. HEDDERLY,
In Charge.

APPENDIX.

FISH DISTRIBUTION BY COUNTIES, SEASON 1920.

Mount Shasta Hatchery.

County	Rainbow	Loch Leven	Eastern brook	German brown	Salmon
Alpine	180,000	40,000	20,000		
Alameda	14,000		2,000		
Amador	20,000	50,000	20,000		
Butte	208,000	385,000	138,000	135,000	
Calaveras	118,000	200,000		150,000	
El Dorado	226,000	294,000	124,000	114,000	
Fresno	161,000	150,000	105,000	80,000	
Inyo		70,000			
Kern		100,000	25,000		
Lake	10,000				
Lassen	16,000		4,000		
Madera		20,000	20,000	10,000	
Marin		100,000			
Mariposa	45,000	142,000	76,000	105,000	
Modoc	122,000	22,000	20,000		
Mono		40,000			
Monterey	100,000				
Napa	60,000				
Nevada	357,500	364,000	92,000	88,500	
Placer	263,000	220,000	140,000		
Plumas	235,000	169,000	70,000	69,000	
San Benito	30,000	45,000	4,000		
San Luis Obispo	60,000	50,000			1,000
San Mateo	11,000	1,000			
Santa Barbara		20,000	10,000		25,000
Santa Clara	16,000				
Shasta	264,000	395,000	58,000	50,000	
Sierra	30,000	185,000	92,000	5,000	
Siskiyou	133,000	718,000	121,000	50,000	5,250,000
Sonoma	40,000	15,000	6,000		
Tehama	80,000	130,000	12,000	50,000	
Trinity	40,000	55,800	34,000	18,000	
Tulare	20,000	40,000	5,000		
Tuolumne	220,000	180,000	10,000	150,000	
Yuba	47,500	90,000	20,000	42,500	
Totals	3,127,000	4,290,800	1,228,000	1,117,000	5,276,000

FISH DISTRIBUTION BY COUNTIES, SEASON 1920.—Continued.

Fall Creek Hatchery.

County	Rainbow	Salmon
Siskiyou County	587,500	2,354,000

Mount Whitney Hatchery.

County	Rainbow	Steelhead	Golden
Fresno	----------	14,000	----------
Inyo	116,000	----------	----------
Kern	200,000	----------	----------
Los Angeles	100,000	----------	----------
Madera	72,000	----------	125,000
Mariposa	18,000	----------	25,000
Mono	140,000	4,000	169,000
Riverside	46,000	----------	----------
San Diego	26,000	110,000	----------
Santa Barbara	3,000	53,000	----------
Tulare	220,000	26,000	----------
Ventura	169,000	117,000	----------
Totals	1,110,000	324,000	319,000

Fort Seward Hatchery.

County	Rainbow	Steelhead	Salmon
Humboldt	69,000	450,000	514,000
Marin	----------	35,000	----------
Mendocino	----------	140,000	----------
Sonoma	----------	60,000	----------
Trinity	10,000	----------	----------
Totals	79,000	685,000	514,000

Tahoe Hatchery.

County	Rainbow	Steelhead	Black-spotted
El Dorado	26,000	5,000	19,000
Nevada	10,000	----------	62,000
Placer	95,000	32,000	190,000
Sierra	20,000	----------	20,000
Totals	151,000	37,000	291,000

Mount Tallac Hatchery.

County	Black-spotted	Steelhead
Alpine	50,000	----------
El Dorado	417,000	36,000
Totals	467,000	36,000

FISH DISTRIBUTION BY COUNTIES, SEASON 1920.—Concluded.

Domingo Springs Hatchery.

County	Rainbow	Steelhead
Plumas	270,000	27,000
Shasta	20,000	
Tehama	125,000	
Totals	415,000	27,000

Clear Creek Hatchery.

County	Rainbow
Lassen	180,000
Plumas	71,000
Total	251,000

Bear Lake Hatchery.

County	Rainbow
San Bernardino	1,014,000

North Creek Hatchery.

County	Rainbow
San Bernardino	151,000

Brookdale Hatchery.

County	Steelhead
San Mateo	20,000
Santa Clara	200,000
Santa Cruz	530,000
Total	750,000

Wawona Hatchery.

County	Rainbow
Madera	10,000
Mariposa	283,000
Total	293,000

Kaweah Hatchery.

County	Rainbow
Tulare	295,000

FISH DISTRIBUTION BY COUNTIES, SEASON 1921.

Mount Shasta Hatchery.

County	Rainbow	Loch Leven	Steelhead	Eastern brook	German brown	Salmon
Alameda	18,000	17,000	66,000	6,000		
Alpine	26,000	40,000		30,000	54,000	
Amador	105,000	166,000	16,000	95,000	50,000	
Butte	269,000	350,000	20,000	119,000	114,000	
Calaveras	124,000	180,000		15,000	96,000	
Colusa	130,000	16,000	30,000	12,000		
El Dorado	166,000	317,000	100,000	179,000	220,000	
Fresno	275,000	296,000		117,000	50,000	
Glenn	40,000	44,000				
Kern		100,000		50,000		
Lake	10,000	8,000	30,000		6,000	
Lassen		26,000		6,000		
Madera	102,000	8,000	16,000	30,000	10,000	
Mariposa	66,000	159,000	54,000	62,000	102,000	
Marin		75,000	115,000			
Modoc	158,000	30,000		62,000		
Mono	28,000			39,000	2,000	
Monterey	180,000	170,000			10,000	
Napa	44,000	8,000	140,000		4,000	
Nevada	443,000	592,500		158,000	140,000	
Placer	180,000	212,000		197,000	10,000	
Plumas	140,000	208,000		94,000	20,000	
San Benito	30,000	30,000	12,000	12,000		
San Mateo	30,000		115,000	15,000		
Santa Barbara		20,000		10,000		25,000
San Luis Obispo	82,000	34,000	16,000	6,000		2,000
Shasta	365,000	460,000		60,000	60,000	
Sierra	37,000	85,500		55,000	16,000	
Siskiyou	247,500	273,000	20,000	125,500	84,000	5,663,000
Sonoma	26,000	8,000	50,000			
Tehama	102,000	90,000		12,000		
Trinity	82,500	40,000		62,500		
Tulare	30,000	150,000	25,000	25,000	20,000	
Tuolumne	155,000	225,000	50,000	50,000	150,000	
Ventura				8,000		
Yuba		49,000				
Totals	3,691,000	4,427,000	875,000	1,703,000	1,218,000	5,690,000

Fall Creek Hatchery

County	Rainbow	Salmon
Butte	30,000	
Plumas	95,000	
Siskiyou	472,000	3,132,000
Totals	597,000	3,132,000

Mount Whitney Hatchery.

County	Rainbow	Loch Leven	Steelhead	Eastern brook	Large lake
Fresno	4,000		4,000		20,000
Inyo	136,000	60,000	80,000		10,000
Kern	178,000				50,000
Los Angeles	120,000		20,000		
Madera	20,000	20,000	10,000		
Mono	173,000	160,000	52,000		53,000
Riverside	36,000	4,000	10,000		
San Bernardino	8,000			6,000	
San Diego	35,000		125,000		
Santa Barbara			80,000		
Tulare	181,000	42,000	186,000		32,000
Ventura	201,000	4,000	195,000		
Totals	1,092,000	290,000	762,000	6,000	165,000

FISH DISTRIBUTION BY COUNTIES, SEASON 1921.—Continued.

Fort Seward Hatchery.

County	Rainbow	Steelhead	Large lake	Salmon
Humboldt	214,000	728,000	46,000	476,000
Mendocino	30,000	67,000	2,000	
Totals	244,000	795,000	48,000	476,000

Tahoe Hatchery.

County	Rainbow	Steelhead	Black-spotted	Large lake
El Dorado	36,000	150,000		20,000
Nevada				90,000
Placer	94,000	180,000	240,000	80,000
Sierra	30,000	20,000		50,000
Totals	160,000	350,000	240,000	240,000

Mount Tallac Hatchery.

County	Black-spotted	Large lake
Alpine		50,000
El Dorado	280,000	485,000
Totals	280,000	535,000

Domingo Springs Hatchery.

County	Rainbow
Plumas	293,000
Tehama	200,000
Total	493,000

Clear Creek Hatchery.

County	Rainbow
Lassen	275,000
Plumas	80,000
Total	355,000

Bear Lake Hatchery.

County	Rainbow
San Bernardino	1,211,000

North Creek Hatchery.

County	Rainbow
San Bernardino	1,005,000

FISH DISTRIBUTION BY COUNTIES, SEASON 1921.—Concluded.

Brookdale Hatchery.

County	Steelhead
San Mateo	100,000
Santa Cruz	573,000
Santa Clara	210,000
Total	883,000

Wawona Hatchery.

County	Rainbow	Steelhead
Madera	30,000	31,000
Mariposa	269,000	67,000
Totals	299,000	98,000

Kaweah Hatchery.

County	Rainbow	Steelhead
Tulare	293,000	94,000

Ukiah Hatchery.

County	Rainbow	Steelhead
Mendocino	30,000	342,000
Sonoma	20,000	120,000
Totals	50,000	462,000

Snow Mountain Hatchery.

County	Steelhead
Mendocino	162,000

Feather River Hatchery.

County	Rainbow	Steelhead
Nevada	15,000	----------
Plumas	398,000	66,000
Sierra	131,000	45,000
Yuba	145,000	----------
Totals	689,000	111,000

San Joaquin Experimental Station.

County	Salmon
Fresno	95,000

SUMMARY OF FISH DISTRIBUTION, SEASON 1920-21.

Hatcheries	Rainbow	Loch Leven	Steel-head	Eastern brook	Black-spotted	German brown	Golden trout	Salmon	Large lake
Bear Lake	2,228,000								
Brookdale			1,633,000						
Clear Creek	606,000								
Domingo Springs	968,000		27,000						
Fall Creek	1,184,500							5,986,000	
Fort Seward	323,000		1,480,000					990,000	48,000
Feather River	689,000		111,000						
Kaweah	588,000		94,000						
Mount Shasta	6,818,000	8,717,800	875,000	2,931,000		2,335,000		10,966,000	
Mount Tallac			36,000		747,000				535,000
Mount Whitney	2,202,000	290,000	1,086,000	6,000			319,000		165,000
North Creek	1,159,000								
San Joaquin								95,000	
Snow Mountain			162,000						
Tahoe	311,000		387,000		531,000				240,000
Ukiah	50,000		462,000						
Wawona	592,000		98,000						
Totals	17,658,500	9,007,800	6,451,000	2,937,000	1,278,000	2,335,000	319,000	18,037,000	988,000

RECAPITULATION, SEASON 1920-1921.

Trout	40,974,300
*Salmon	18,037,000
Grand total	59,011,300

*There has been hatched and distributed 19,000,000 salmon fry from eggs collected from the Klamathon station during the last winter and spring that will not appear in the statistical report until the next biennial report of the Commission.

ANGLER'S LICENSE SALES, 1920-1921.

Counties	Actual sales, 1920	Actual sales, 1921
Alameda	$6,438 00	$7,842 00
Alpine	269 00	223 00
Amador	675 00	733 00
Butte	4,137 00	4,057 00
Calaveras	842 00	1,007 00
Colusa	641 00	491 00
Contra Costa	339 00	447 00
Del Norte	208 00	446 00
El Dorado	568 00	708 00
Fresno	8,599 00	10,076 00
Glenn	352 00	324 00
Humboldt	5,054 00	4,952 00
Imperial	206 00	217 00
Inyo	1,995 00	2,327 00
Kern	702 00	988 00
Kings	894 00	1,118 00
Lake	336 00	331 00
Lassen	1,532 00	1,430 00
Madera	736 00	916 00
Mariposa	105 00	84 00
Mendocino	2,055 00	1,931 00
Merced	1,185 00	1,328 00
Mono	651 00	796 00
Modoc		385 00
Monterey	623 00	776 00
Napa	1,362 00	1,749 00
Nevada	1,005 00	1,134 00
Orange	1,034 00	1,243 00
Placer	1,796 00	2,086 00
Plumas	2,429 00	2,440 00
Riverside	564 00	749 00
Sacramento	526 00	623 00
San Benito	247 00	337 00
San Bernardino	362 00	331 00
San Diego	1,532 00	1,540 00
San Joaquin	528 00	531 00
San Luis Obispo	893 00	785 00
San Mateo	100 00	76 00
Santa Clara	4,175 00	4,950 00
Santa Cruz	438 00	375 00
Shasta	2,195 00	2,750 00
Sierra	487 00	546 00
Siskiyou	4,578 00	4,862 00
Solano	2,595 00	2,756 00
Sonoma	3,833 00	4,543 00
Stanislaus	2,476 00	3,532 00
Sutter	367 00	277 00
Tehama	293 00	149 00
Trinity	485 00	530 00
Tulare	4,811 00	5,434 00
Tuolumne	1,403 00	1,897 00
Ventura	2,103 00	2,048 00
Yolo	609 00	512 00
Yuba	1,151 00	1,281 00
	$83,519 00	$93,999 00
San Francisco office	33,878 00	39,387 00
Sacramento office	9,058 00	9,430 00
Los Angeles office	36,728 00	40,497 00
Totals	$163,183 00	$183,313 00

HUNTING LICENSE SALES.

County	Fiscal year 1921	Fiscal year 1922
Alameda	$11,205 00	$10,433 00
Alpine	122 00	86 00
Amador	1,042 00	1,082 00
Butte	4,728 00	4,471 00
Calaveras	1,250 00	1,242 00
Colusa	1,979 00	1,761 00
Contra Costa	1,188 00	1,279 00
Del Norte	449 00	735 00
El Dorado	555 00	638 00
Fresno	11,235 00	10,697 00
Glenn	1,169 00	1,061 00
Humboldt	5,654 00	5,275 00
Imperial	526 00	402 00
Inyo	1,288 00	1,332 00
Kern	3,512 00	3,576 00
Kings	1,950 00	1,615 00
Lake	818 00	704 00
Lassen	1,899 00	1,854 00
Madera	1,219 00	1,420 00
Mariposa	259 00	248 00
*Mendocino	3,613 00	2,950 00
Mereed	2,701 00	2,574 00
Modoe		251 00
Mono	341 00	1,332 00
Monterey	1,432 00	2,619 00
Napa	2,976 00	1,097 00
Nevada	1,087 00	2,805 00
Orange	2,300 00	2,781 00
Placer	2,411 00	1,354 00
Plumas	1,507 00	1,328 00
Riverside	1,368 00	524 00
Sacramento	752 00	1,248 00
San Benito	1,190 00	285 00
San Bernardino	387 00	2,523 00
San Diego	3,335 00	629 00
San Joaquin	709 00	1,672 00
San Luis Obispo	1,504 00	246 00
San Mateo	225 00	6,759 00
Santa Clara	7,098 00	522 00
Santa Cruz	699 00	2,649 00
Shasta	2,454 00	245 00
Sierra	268 00	5,493 00
Siskiyou	6,234 00	3,493 00
Solano	3,631 00	7,729 00
Sonoma	7,898 00	4,043 00
Stanislaus	3,958 00	518 00
Sutter	613 00	176 00
Tehama	368 00	966 00
Trinity	1,031 00	5,393 00
Tulare	5,900 00	1,940 00
Tuolumne	1,745 00	2,807 00
Ventura	2,636 00	1,764 00
Yolo	1,982 00	1,958 00
Yuba	2,112 00	2,596 00
	$128,922 00	$125,304 00
†San Francisco office Fish and Game Commission	19,368 00	46,807 00
Sacramento office	7,949 00	8,083 00
Los Angeles office	54,114 00	57,734 00
Totals	$240,353 00	$237,928 00

Fiscal year ends June 30. Residents, $1; nonresidents, $10; aliens, $25.
*Account not settled.
†Account not closed, refunds still to be paid.

COMMERCIAL FISHERIES LICENSE SALES BY DISTRICTS.

District	1920-1921		1921-1922	
	No.	Amount	No.	Amount
Del Norte, Humboldt	203	$2,030 00	130	$1,300 00
Mendocino, Sonoma, Lake	200	2,000 00	252	2,520 00
Marin	62	620 00	73	730 00
Solano, Yolo	264	2,640 00	220	2,200 00
Sacramento, San Joaquin	199	1,990 00	117	1,170 00
Glenn, Colusa, Tehama	62	620 00	90	900 00
Contra Costa, Alameda	350	3,500 00	367	3,670 00
San Francisco, San Mateo	405	4,050 00	472	4,720 00
Santa Cruz	91	910 00	74	740 00
Monterey	683	6,830 00	429	4,290 00
San Luis Obispo, Santa Barbara, Ventura	109	1,090 00	130	1,300 00
Los Angeles	1,704	17,040 00	1,235	12,350 00
Orange	32	320 00	46	460 00
San Diego	746	7,460 00	571	5,710 00
Miscellaneous	159	1,590 00	256	2,560 00
Totals	5,269	$52,690 00	4,462	$44,620 00

Fiscal year ends March 31. Residents, $1; nonresidents and aliens, $10.

TRAPPERS' LICENSE SALES.

Total sales for fiscal year 1921	$3,392 00
Total sales for fiscal year 1922	3,103 00

Fiscal year ends June 30. License fee: citizen, $1; alien, $2.

GAME BREEDERS' LICENSE SALES.

Total sales for year 1920	$85 00
Total sales for year 1921	82 50

License year ends December 31. License fee: $2.50.

SUMMARY OF PROSECUTIONS FOR VIOLATIONS OF STATE GAME LAWS.
July 1, 1920 to June 30, 1922.

Offense	Number of arrests	Convictions	Acquitted and dismissed	Pending	Sentence suspended and probation	Number of days imprisonment	Fines imposed	Fines collected
Violations—hunting license law	183	169	14	-----	8	27	$3,147 50	$2,995 50
Deer—killing, pursuing, possession; closed season; excess bag limit. Hides—female; evidence of sex removed; not properly tagged; failure to retain portion or head bearing horns	205	179	26	-----	12	646	6,960 00	6,720 00
Female deer and fawns—killing and possession	84	69	15	-----	4	68	5,550 00	5,021 60
Spike bucks—killing and possession	59	58	1	-----	-----	35	2,775 00	2,726 80
Ducks—killing and possession; closed season	72	64	8	-----	7	235	1,855 00	1,825 60
Ducks—excess bag limit	21	20	1	-----	-----	35	816 00	816 00
Ducks—night shooting; shooting from power boat in motion	109	99	10	-----	8	------	2,165 00	2,080 00
Quail—killing and possession; closed season; excess bag limit	118	110	8	-----	5	102	3,687 50	3,610 50
Quail—Trapping or holding in captivity without permit	1	1	-----	-----	-----	------	25 00	25 00
Doves—killing or posesssion; closed season; excess bag limit	47	45	2	-----	1	2	1,275 00	1,273 00
Snipe, curlew, rail, plover and other shore birds—killing and possession	45	39	6	-----	3	24	1,000 00	975 00
Pheasants—killing and possession	18	17	1	-----	3	90	950 00	950 00
Grouse, sage-hen—killing and possession; closed season; excess bag limit	8	8	-----	-----	-----	------	200 00	200 00
Wild pigeons—killing and possession; closed season	5	5	-----	-----	2	------	75 00	75 00
Non-game birds—killing and possession	103	94	9	-----	2	------	1,936 00	1,936 00
Cottontail and brush rabbits—killing and possession; closed season; excess bag limit	55	49	6	-----	1	------	1,235 00	1,235 00
Tree squirrels—killing and possession; closed season; excess bag limit	10	8	2	-----	-----	25	175 00	160 00
Wild geese—killing and possession; closed season; excess bag limit	10	9	1	-----	2	------	175 00	175 00
Mountain sheep—killing and possession	2	2	-----	-----	-----	------	100 00	100 00
Swan—killing and possession	3	3	-----	-----	1	------	100 00	50 00
Beaver—killing and possession	1	1	-----	-----	-----	------	25 00	25 00
Bear	15	13	2	-----	-----	------	220 00	220 00
Trapping license law violations	10	10	-----	-----	-----	------	125 00	125 00
Trespassing in game refuge	37	36	1	-----	2	------	955 00	680 00
Total game cases	1221	1108	113	-----	61	1289	$35,527 00	$33,998 80

SUMMARY OF PROSECUTIONS FOR VIOLATIONS OF STATE FISH LAWS.
July 1, 1920 to June 30, 1922.

Offense	Number of arrests	Convictions	Acquitted and dismissed	Pending	Sentence suspended and probation	Number of days imprisonment	Fines imposed	Fines collected
Fishing (market) without license	92	89	3	-----	9	-----	$1,120 00	$1,110 00
Fishing (angling) without license	104	104	-----	-----	13	25	1,882 00	1,852 00
Illegal fishing apparatus (nets, lines, spears, etc.)	29	28	1	-----	12	-----	2,050 00	1,865 00
Salmon—taking and possession; closed season; excess limit; Sat. Sun. fishing	21	19	2	-----	1	-----	1,725 00	1,355 00
Striped bass—closed season; buying and selling; underweight; excess limit	116	111	4	1	20	-----	2,525 00	2,443 00
Black bass—taking and possession; closed season; undersized; excess limit	24	22	2	-----	2	-----	550 00	550 00
Trout—closed season; excess limit; taking other than by hook and line; offering for sale; shipping parcel post	80	77	3	-----	8	-----	1,980 00	1,905 00
Catfish—undersized; offering for sale; closed season	3	3	-----	-----	-----	-----	60 00	60 00
Sturgeon—taking or possession	6	6	-----	-----	1	-----	105 00	105 00
Sunfish—taking or possession; closed season	5	4	1	-----	-----	-----	95 00	95 00
Perch—Sacramento and salt water: possession; sale; shipment; closed season; excess limit	2	2	-----	-----	1	-----	20 00	20 00
Smelt—taking or possession; closed season	8	4	4	-----	-----	-----	85 00	85 00
Halibut—underweight; possession and sale	7	7	-----	-----	2	-----	325 00	250 00
Barracuda—underweight; possession and sale	23	23	-----	-----	2	-----	1,500 00	1,400 00
Salt water eels—taking undersized	1	1	-----	-----	-----	-----	20 00	20 00
Taking fish from pond	14	14	-----	-----	1	-----	310 00	310 00
Using explosives to take fish	4	3	1	-----	1	100	-----	-----
Polluting waters—oil, sawdust, etc.	6	4	-----	2	-----	-----	625 00	475 60
Fishing with nets in restricted districts	97	85	12	-----	39	647	4,765 00	4,093 00
Selling young fish for bait	2	1	1	-----	-----	-----	25 00	25 00
Crabs—closed season; undersized female	63	57	6	-----	16	-----	1,290 00	1,245 00
Lobsters—closed season; undersized	37	33	4	-----	2	-----	1,065 00	1,050 00
Clams—excess limit; undersized	129	129	1	2	5	185	3,420 00	3,375 00
Abalones—closed season; undersized; excess limit; drying	141	136	5	-----	6	-----	4,767 50	4,757 50
Crawfish—closed season; under or oversize	2	2	-----	-----	1	-----	20 00	20 00
California dried shrimp and shells	5	5	-----	-----	-----	-----	165 00	165 00
Night fishing	16	16	-----	-----	-----	37	400 00	398 00
Total fish cases	1037	983	49	5	142	994	$30,894 50	$29,028 50

TOTAL ARRESTS FOR A PERIOD OF TWENTY YEARS

1902-1904	550
1904-1906	774
1906-1908	1,192
1908-1910	1,771
1910-1912	2,063
1912-1914	1,993
1914-1916	2,087
1916-1918	1,797
1918-1920	1,891
1920-1922	2,258
Total	16,376

Recapitulation.

Arrests:			
Fish cases	1,037		
Game cases	1,221		
Total			2,258
Convictions:			
Fish cases	983		
Game cases	1,108		
		2,091	
Acquittals and dismissals:			
Fish cases	49		
Game cases	113		
		162	
Pending cases:			
Fish cases	5		
Game cases	0		
		5	
Total			2,258
Fines imposed:			
Fish cases			$30,894 50
Game cases			35,527 00
Total			$66,421 50
Fines collected:			
Fish cases			$29,028 50
Game cases			33,998 80
Total			$63,027 30
Number of days imprisonment:			
Fish cases			994
Game cases			1,289
Total			2,283

SEIZURES OF FISH, GAME AND ILLEGALLY USED FISHING APPARATUS.

July 1, 1920 to June 30, 1922.

Rabbits (cottontail and brush)	99	
Quail	557	
Doves	84	
Wild pigeon	13	
Ducks	4,538	
Geese	184	
Sage hens	40	
Pheasants	15	
Shore birds	53	
Non-game birds	153	
Miscellaneous game	9	
Miscellaneous game	70	pounds
Deer meat	5,752	pounds
Deer hides and heads	15	
Beaver skins	16	
Marten skins	5	
Aigrettes	25	
Illegally used fishing apparatus, nets, lines, etc.	11	
Salmon	3,907	pounds
Trout	777	pounds
Striped bass	6,860	pounds
Black bass	42	pounds
Halibut	9,749	pounds
Barracuda	25,448	pounds
Catfish	35	pounds
Yellow fin croaker	3,500	pounds
Sturgeon	404	pounds
Smelt	969	pounds
Perch	151	pounds
Shad	143	pounds
Miscellaneous fish	72	pounds
Abalones	2,214	
Abalones (dried)	21	
Abalones (canned)	6,094	pounds
Abalones (prepared)	3,276	pounds
Crabs	12,364	
Crabs (canned)	193	pounds
Lobsters	14,875	pounds
Clams (Pismo)	6,499	
Clams (cockle)	1,537	pounds
Dried shrimps and shells	6,300	pounds

Illegally used fishing apparatus, after condemnation in superior courts, is destroyed or sold by the board in accordance with law. All wholesome fish and game is donated to public and charitable institutions, from whom many grateful letters of acknowledgement have been received.

LION BOUNTIES.

Statement of Lion Bounties Paid by the Fish and Game Commission from January 1, 1920, to December 31, 1921.

	1920	1921	Total from October, 1907
Alameda			1
Alpine			1
Amador			9
Butte			33
Calaveras		3	16
Colusa		1	18
Del Norte	1	3	101
El Dorado	6	14	68
Fresno	2	6	30
Glenn	3	3	49
Humboldt	19	16	599
Imperial	1		2
Inyo		1	8
Kern	12	8	154
King			1
Lake	11	10	127
Lassen		2	9
Los Angeles	12	7	68
Madera	1		40
Mariposa	4	6	87
Mendocino	13	15	247
Merced	1	1	3
Modoc			4
Monterey	12	7	124
Mono	1	2	10
Napa			3
Nevada			7
Orange			9
Placer	9	13	59
Plumas			9
Riverside	6	8	43
Sacramento			1
San Benito	2	2	37
San Bernardino	6	2	31
San Diego	4	2	47
San Joaquin			2
San Luis Obispo	9	12	97
San Mateo			1
Santa Barbara	5	15	119
Santa Clara	2	4	25
Santa Cruz			2
Shasta	8	8	277
Sierra			6
Siskiyou	2	9	252
Sonoma	2		24
Stanislaus		1	10
Sutter			2
Tehama	17	18	94
Trinity	13	21	294
Tulare	23	17	135
Tuolumne	4	15	94
Ventura	8	4	52
Yuba			4
Totals	219	256	3,645

CANNED, CURED AND MANUFACTURED FISHERY PRODUCTS OF CALIFORNIA FOR THE YEAR 1920.

Canned (shown in cases).

Species of fish	San Diego district	San Pedro district	Moterey Bay district	Northern Califronia district	Total
Abalone—					
1-pound	1,800		250	961	3,011
½-pound			328	120	448
Albacore—					
1-pound	6,809	36,503			43,312
½-pound	36,825	256,304			293,129
¼-pound	4,599	34,524			39,123
Barracuda—					
1-pound		676			676
Bonito—					
1-pound		100			100
½-pound	579	4,366			4,945
¼-pound	2,561	2,681			5,242
Chicnic, smoked bonito—					
5-ounce glass		1,078			1,078
Mackerel—					
1-pound		3,244	67		3,311
½-pound	6	75			81
¼-pound	13				13
Salmon—					
1-pound (flat)				8,938	8,938
½-pound (flat)				22,081	22,081
Sardines—					
1-pound (oval)	50,302	213,714	682,165	5,612	951,793
1-pound (round)	103	12,355			12,458
½-pound (oval)	1,395	7,054	4,154	135	12,738
½-pound (round)	2,660	8,746			11,406
½-pound (square)	7,287	516	13,675		21,478
¼-pound (round)	1,260	464			1,724
¼-pound (square)	48,363	2,015	658		51,036
10-pound		36	327		363
Shad—					
1-pound				1,448	1,448
Shad roe—					
½-pound				311	311
Squid			196		196
Striped tuna—					
1-pound	2,630	2,488			5,118
½-pound	32,634	48,637			81,271
¼-pound	16,009	24,511			40,520
Tuna—					
1-pound	7,401	27,498			34,899
½-pound	36,304	184,690			220,994
¼-pound	20,952	41,903			62,855
5-pound	330	3,807			4,137
Yellowtail—					
1-pound	200	218			418
½-pound	1,433	238			1,671
Total	282,455	918,441	701,820	39,606	1,942,322

FISHERY PRODUCTS OF CALIFORNIA FOR THE YEAR 1920—Concluded.

Salted and Dried.

Species of fish	San Diego district	San Pedro district	Moterey Bay district	Northern California district	Total
Albacore—					
Smoked, pounds		58,589			58,589
Anchovy (salted)—					
1-pound cans, 48 to case			120		120
5-pound cans, 24 to case			184		184
24-pound cans, 6 to case			112		112
10-pound kits			553		553
25-pound kits			23		23
200-pound barrels			21		21
620-pound casks			5		5
Barracuda (dried)—					
Pounds	70,402				70,402
Herring (salted)—					
Pounds				337,200	337,200
Mackerel (salted)—					
160-pound barrels		50			50
200-pound barrels			50		50
25-pound kits			560		560
Smoked, pounds		39,341			39,341
Sablefish (salted)—					
200-pound barrels				130	130
Salachini—					
30-pound tubs			800		800
50-pound tubs			1,250		1,250
60-pound tubs			50		50
65-pound tubs			2,309		2,309
100-pound tubs			500		500
Salmon (hardsalted)—					
200-pound barrels				167	167
Mild cured, 825-pound casks			320	2,849	3,169
Sardines—					
4-pound cans, 24 to case			750		750
5-pound cans, 24 to case			680		680
10-pound boxes			4,000		4,000
100-pound barrels			1,625		1,625
700-pound casks			25		25
Sea bass, black—					
Dried, pounds	40,675				40,675
Yellowtail (salted)—					
Pounds	4,000				4,000
Kegs		323			323
Bonita (smoked)		35,311			35,311
Miscellaneous data					
Fish meal, tons	1,559	3,328	3,382	587	8,856
Fish oil, gallons	39,174	152,937	383,648	35,826	611,585
Estimated value of pack	$3,299,594	$9,401,233	$5,397,777	$1,103,714	$19,202,318
Number of employees	1,148	3,405	1,823	721	7,097
Value of plants	$1,296,721	$3,677,617	$1,713,990	$1,234,259	$7,922,587

CANNED, CURED AND MANUFACTURED FISHERY PRODUCTS OF CALIFORNIA FOR THE YEAR 1921.

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

Canned.

Species of fish	Size of cans	Northern California district. cases	Monterey district. cases	San Pedro district. cases	San Diego district. cases	Total cases
Abalone	1-lb.		2,061	125		2,186
Albacore	1-lb.			36,357	15,066	51,423
	½-lb.			172,286	59,185	231,471
	¼-lb.			16,551	7,906	24,457
Barracuda	1-lb.			1,390		1,390
	½-lb.			10,107		10,107
Kamaboko	½-lb.			400		400
Mackerel	1-lb.			255		255
Mussels	½-lb.	110				110
Salmon	1-lb. flat	3,334				3,334
	½-lb. flat	14,076				14,076
Sardines	1-lb. oval		287,954	77,048	1,189	366,191
	½-lb. oval		10,554	3,765		14,319
	½-lb. square		375		148	523
	¼-lb. square		46		8,033	8,079
	10-lb. round		2,028			2,028
Squid	½-lb.				556	556
Striped tuna	1-lb.			190	37	227
	½-lb.			4,470	3,930	8,400
	¼-lb.			2,429	2,662	5,091
Tuna, bluefin	1-lb.			2,704	266	2,970
	½-lb.			21,462	1,856	23,318
	¼-lb.			4,648		4,648
Tuna, yellowfin	1-lb.			1,147	101	1,248
	½-lb.			14,913	1,221	16,134
	¼-lb.			37		37
Tuna, unclassified	1-lb.			88	327	415
	½-lb.			15,730	11,462	27,192
	¼-lb.			2,069	6,007	8,076
	4-lb.			2,523		2,523
Yellowtail	1-lb.				48	48
Total cases		17,520	303,018	390,694	120,000	831,232

CANNED, CURED AND MANUFACTURED FISHERY PRODUCTS OF CALIFORNIA FOR THE YEAR 1921.—Concluded.

Salted, Smoked and Miscellaneous—1921.

Species of fish	Size or quantity	Northern California district	Monterey Bay district	San Pedro district	San Diego district	Total
Anchovies—						
Salted	200-lb. barrels		8			8
	1-lb. cans, cases		48			48
	Casks	25				25
Barracuda—						
Salted	Pounds				5,000	5,000
Fish cakes—						
	Pounds			18,000		18,000
Herring—						
Salted	Casks	12				12
Smoked	Pounds	8,375				8,375
Mackerel—						
Salted	200-lb. barrels		6	321		327
	Pounds				20,000	20,000
Sablefish—						
Salted	200-lb. barrels	200				200
	100-lb. barrels	15				15
Mild cured	Casks	2				2
Smoked	Pounds	72,563				72,563
Salachini—						
	50-lb. tubs		900			900
	50-lb. boxes		1,000			1,000
	65-lb. tubs	296				296
Salmon—						
Mild cured	Casks	1,843	215			2,058
Salted	200-lb. barrels	65				65
Smoked	Pounds	28,964				28,964
Sardines—						
Dried	Pounds			120		120
Marinated	1-lb. glass, cases			2,500		2,500
Salted	200-lb. barrels		60	282		342
	Casks		36			36
	80-lb. boxes		700			700
Sea bass, black—						
Salted					15,320	15,320
Shad—						
Mild cured	Casks	6				6
Striped tuna—						
Dried	Pounds			200		200
Tuna—						
Smoked	Pounds			35,277		35,277
Yellowtail—						
Dried	Pounds				22,166	22,166
Salted	100-lb. barrels			107		107
	Pounds				40,000	40,000
Miscellaneous data						
Fish meal—						
	Tons	538	1,577	3,566	636	6,317
Fish oil—						
	Gallons	21,677	205,149	93,305	16,607	336,738
Estimated value of pack		$627,900	$1,879,596	$3,099,903	$1,055,227	$6,662,626
Number of employees		491	1,140	1,862	1,195	4,688
Capital invested in plants		$798,214	$1,465,180	$3,683,619	$1,536,179	$7,483,192

Note.—Casks contain 825 pounds net.

CALIFORNIA FRESH FISHERY PRODUCTS FOR YEAR 1920.

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

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Tehama, Colusa, Glenn	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Imperial	Totals	Mexican, Imported Into California
Albacore											500	16,718,941	3,697	2,153,509		18,876,647	
Anchovies			3,153					218,080	150	313,589		4,572		30,230		569,774	
Barracuda	25							8,560	29,353	67,905	181,158	3,118,681	39,106	1,140,600		4,585,388	3,615,947
Blackfish									197	32,032						32,229	
Boccaccio	334	20						154,987	346,844	964,978						1,467,163	
Bonito									365	51	24,602	546,801	2,711	97,713		672,243	201,255
Carp				9,877	80,900		35,665	2,748					5,230			134,420	
Catfish	97	29,144		22,243	38,981		21,900									112,365	
Chilipepper								91,400	192,441	155,159						439,000	
Cultus cod	2,970	54,260	83				864	395,789	79,572	154,038	365	13				687,954	
Eels													180			180	
Flounders	4,367	16	299	10,666			4,821	418,272	34,825	1,658	3,005	3,654	4			481,587	
Grayfish			180				1,234	126,970	1,375	1,000	300	148,984	234	518,444		798,721	12,628
Greenfish												412				412	
Hake								140,801	1,125	55						141,981	
Halibut	29,174	98,204	3,128					38,669	11,755	6,906	234,857	1,181,964	126,137	1,036,557		2,767,351	1,677,539
Hardhead					12,998		325									13,323	
Herring	7,575		83,519				40,140	143,130								274,364	
Kingfish			8					8,682	80,851	107,043	843	258,181	1,049	4,754		461,411	48
Mackerel									12,695	379,447	28,611	2,305,054	35,310	236,191		2,997,308	50,732
Mullet													226	12,791	4,496	17,513	90
Perch	25,218		40,085	40			278	56,520	5,309	16,984	1,741	28,726	3,475	2,755		181,131	5,240
Pike				750	2,253		5,135									8,138	
Pompano								1,722	1,336	1,600		25,242	21	205		30,126	231
Rock bass											2,098	128,021	11,774	65,182		207,075	3,305
Rockfish	15,894	4,206	133					780,582	330,868	526,556	83,255	936,618	14,724	904,188		3,597,024	97,661
Sablefish								736,982	7,385	36,665						781,032	
Salmon	1,307,568	3,015,130	8,662	1,738,577	422,061	139,266	1,560,408	1,451,270	199,139	1,291,738						11,133,819	
Sanddabs								571,377	135,669	7,887	25	6,382		470		721,810	
Sardines			113				200	1,104,776	7,342,699	69,719,517		28,182,847	378	12,167,199		118,517,729	3,185
Sculpin												31,502	323	3,849		35,674	
Sea bass (black)											1,383	38,266	702	49,518		89,869	58,168
Sea bass (white)			32,183					9,413	110,417	6,613	122,066	1,863,167	9,081	205,591		2,358,531	246,900
Sea trout	54							593				10,499	270	6,346		17,762	5,562
Shad			100	7,172	520		20,252	30,155	142	104						58,445	

Shad (buck)				189,606	25,557		230,065	1,075									446,303	
Shad (roe)				300,675	40,693		562,254	1,398									905,020	
Sheepshead											779	3,245	14	10,364		14,402	14,402	165
Skates								75,251	10,937	140		2,424	114	65		88,931		
Skipjack									147	3		4,949,618	2,621	2,989,949		7,942,338	7,942,338	15,089
Smelt	52,027	245	41,764				7,097	92,018	51,182	146,805	69,861	133,376	115,381	20,719		730,475	730,475	13,712
Sole	546	4		29				3,107,782	628,126	15,714	10,507	54,555	522	3,238		3,821,023	3,821,023	725
Splittail				23	8,211		5,850									14,084	14,084	
Striped bass			3,390	170,936	38,359		317,888	141,122	40	17						671,747	671,747	
Stingaree			134,300	273										231,423		365,996	365,996	24,885
Suckers					2,712											2,712	2,712	
Surf fish												10				10	10	
Swordfish												10,638		1,602		12,240	12,240	273
Tomcod	111						48	36,598	480							37,237	37,237	
Trout (steelhead)	6,999															6,999	6,999	
Tuna											410	1,443,296	1,267	3,800,439		5,245,412	5,245,412	237,162
Tuna (bluefin)												10,530,272				10,530,272	10,530,272	
Tuna (yellowfin)												1,477,905				1,477,905	1,477,905	487,119
Turbot			821					34								855	855	
Whitebait			620					58								678	678	
Whitefish												4,277	150	4,432		8,859	8,859	4,852
Yellowtail											1,278	1,993,493	3,223	488,543		2,486,537	2,486,537	218,400
Miscellaneous	1,154		6	271	7		90	39,902	39,826	10,448	116,080	41,838	4,201	4,585		258,408	258,408	630
Total fish	1,454,113	3,201,229	352,547	2,451,138	673,252	139,266	2,814,509	9,986,716	9,655,250	73,964,652	883,724	76,183,474	382,125	26,191,451	4,496	208,337,942	6,981,503	
Crustaceans:																		
Crabs (doz.)	2,709		757				1	46,902	470	18						50,857		
Shrimps								817,091				951				818,042		
Spiny lobsters											37,233	154,981	10,237	44,705		247,156	942,020	
Mollusks:																		
Abalones	405	10	475					35		590,455	215,336					806,716	95,110	
Clams (cockle)	4,745	80	5,951								800		6,478			18,054		
Clams (mixed)	16,576	36	34,805				908	1,508					485			54,318	25,557	
Clams (Pismo)									210		298,805					299,015		
Clams (softshell)	440	8,017	17,150				174,798	32,719								233,124		
Cuttlefish			64					25,036	9,475	35,422		743				70,740		
Limpets													18,835			18,835		
Mussels		510					5,224	648	1,125		390	577	24,638			32,512		
Oysters, Eastern (No.)			919,910					4,146,272								5,096,182		
Oysters (native)			59,741													59,741		
Snails												340				340		
Squid	90								171	372,446		135,512				508,219		
Miscellaneous:																		
Turtles																	76,918	
Scallops													743			743		

All amounts shown in pounds unless otherwise specified.

CALIFORNIA FRESH FISHERY PRODUCTS FOR YEAR 1921.

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

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Glenn, Tehama, Colusa	Sacramento, San Joaquin	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Imperial	Totals	Mexican, Imported Into California
Albacore												11,499,958	6,753	3,767,817		15,274,528	2,199
Anchovies								175,255		1,482,869		10,438		278,319		1,946,881	
Barracuda								71			204,046	3,189,179	16,609	1,178,995		4,588,900	3,036,262
Bluefish									11,526	62,252						73,779	
Boccaccio		125						71,316	176,418	812,630	4,697					1,065,186	
Bonito									287	23	13,488	173,340	430	50,291		237,859	82,878
Carp			67	18,274		42,871	34,970	5,944								102,126	
Catfish		85,277		9,585		36,076	17,178									148,116	
Chilipepper								25,288	110,402	82,928						218,618	
Cultus cod	7,293	14,524	785					249,809	27,669	123,723		297	26	1,417		425,543	
Flounders	12,150		531	2,005			9,148	218,108	39,331	2,971	2,951	5,048		640		292,883	773
Grayfish							1,743	83,807	774	585	800	18,106	5,235	428,283		539,333	
Hake								81,143	9,075							90,218	
Halibut	30,740	48,667	2,041					67,164	2,745	11,115	265,828	1,222,114	118,241	713,669		2,482,324	1,313,433
Hardhead				356		40,760	34,695									75,811	
Herring	7,186		12,789				26,057	494,513		1,300	279					542,124	
Kingfish								10,813	61,562	44,090	2,052	266,238	534	4,101		389,390	1,695
Mackerel									1,394	280,198	73,627	2,231,006	32,686	295,702		2,914,613	60,646
Mullet												301		16,551	288	17,140	11,815
Perch	22,401	62	36,489				338	53,682	3,657	28,227	45	90,654	1,547	5,672		242,774	10,125
Pike				1,357	59	2,593	5,111									9,120	
Pompano								2,307	55	354	144	13,291	52	130		16,333	370
Rock bass											396	221,415	31,088	102,803		355,702	8,154
Rockfish	21,304	9,243	190					686,564	225,824	686,661	71,318	1,053,753	42,323	560,172		3,357,352	46,723
Sablefish								388,141	624,623	9,878						1,022,642	
Salmon	1,212,879	2,084,080	1,434	718,007	174,732	537,076	1,081,312	937,452	383,558	860,402						7,990,932	
Sanddabs								683,828	82,128	5,824		12,213	18			784,011	
Sardines			236					153,742	3,985,196	28,941,654	6,500	23,261,376	823,382	2,160,218		59,323,305	
Sculpin												45,433		12,635		58,068	312
Sea bass (black)											3,496	27,092	553	56,055		87,196	40,235
Sea bass (white)			8,785				280	30,823	15,213	705	54,706	1,659,218	5,569	285,320		2,060,619	490,107
Sea trout								30			1,300	163	6,210	1,222		8,925	9,968
Shad				6,456		8,050	61,216	17,870	10							93,602	
Shad (buck)				37,845		24,155	156,897									218,897	
Shad (roe)				7,306		26,849	450,484									550,298	

Sheepshead											501	3,554	67	19,803		23,925	
Skates								53,753	1,625	1,930		2,241	615			60,164	
Skipjack									4,000			413,820	159	720,874		1,138,853	140
Smelt	57,914		14,493				9,377	117,076	66,340	95,985	80,765	153,981	129,996	29,811		755,738	9,335
Sole	86	53						4,179,425	538,384	46,130	18,612	76,525	1,391	9,552		4,870,158	712
Splittail				211		12,609	348									13,168	
Striped bass			1,901	58,966	167	68,215	368,225	104,125		15						601,614	
Stingaree												203		9,565		9,768	
Suckers						4,073	85									4,158	
Swordfish												14,353		450		14,803	
Tomcod							20	39,434	2,325							41,779	
Trout (steelhead)	3,605															3,605	
Tuna											26	520,853	5,935	857,925		1,384,739	168,106
Tuna (bluefin)												1,971,813				1,971,813	59,835
Tuna (yellowfin)												1,200,600				1,200,600	37,016
Turbot			219													219	
Whitebait			1,743					3,486								5,229	
Whitefish											540	22,585		5,514		28,639	800
Yellowtail											8,057	1,443,469	5,742	682,358		2,139,626	351,170
Miscellaneous	29	1,390		49			2,312	62,509	20,568	1,071,387	23,188	50,839	2,184	5,258		1,239,713	2,467
Croakers												69,626	8			69,634	295
Total fish	1,375,587	2,243,421	81,703	926,176	174,968	803,327	2,259,796	8,997,478	6,394,689	34,653,837	837,362	50,945,095	1,237,353	12,261,123	288	123,192,193	5,745,871
Crustaceans:																	
Crabs (doz.)	3,258	183	412				13	29,364	137	6						33,373	
Shrimps			111,064				117,661	678,752		1,006		1,335	26			909,844	30
Spiny lobsters											46,530	155,310	6,325	126,106		334,271	943,547
Mollusks:																	
Abalones	3,578		405							1,446,871	30,316					1,481,170	8,094
Clams (cockle)	7,066	431	6,413								276	83		235		14,504	
Clams (mixed)	14,167		42,806				2,125				579	155				59,832	
Clams (Pismo)									1,362		218,145					219,507	
Clams (softshell)	656	7,436	37,131				120,731	50,646								216,600	
Cuttlefish			63					7,361	9,213	39,281		348				56,266	
Mussels							749	415	600	7,230	137	65				9,196	
Oysters (Eastern, No.)			2,703,258					783,670								3,486,928	
Oysters (native)			6,760													6,760	
Squid										262,086		44,027		126,446		432,559	
Miscellaneous:																	
Terrapins (doz.)		5														5	
Turtles										75		160	61			296	2,275
Scallops											1,371					1,371	

All amounts shown in pounds unless otherwise specified. Albacore and skipjack cleaned. All other fish in round

NATIVITY OF COMMERCIAL FISHERMEN LICENSED APRIL 1, 1920, TO MARCH 31, 1921, SHOWN BY COUNTIES.

Native of	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Tehama, Glenn Colusa	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Miscellaneous district s	Total
Austria			1	1	1		5			1		423	4	69		505
Canada	1				1	1					2	3		2	1	11
Chile					2											2
China							2	10		6				1	1	20
Cuba										1						1
Dalmatia					2							63	1	37		103
Denmark	4	7	3	1	5	1	2	6		1	1	12		4		47
England	1		2		2	1			1			7	1	4	1	20
France	1	1			1					5	1	2				11
Finland	13	49		1	1	1	6	1	1							73
Germany	3	8	7	4	15	1	2	2	3	1	3	3	1	6	1	60
Greece			5	82	13		2	2		3		4		7		118
Holland												1				1
Hungary				1												1
Ireland			1	1	1	1				1						5
Italy	10	1	4	49			249	333	36	375	13	102		174		1,346
Japan					15		1			100	5	814		203		1,138
Mexico		1												9		10
Montenegro										1						1
Norway	4	10	2	2	4		1	3	3		1	30		7		67
Poland												1				1
Portugal	1	4	2	28	24		2	3	1	24	3	1		36		134
Russia		1	1		2		1	1		1	2	17		2	2	30
Scotland					1				1		1			1		4
Slav								1		4		21		3		29
Spain							2			53						55
Sweden	1	5	4	4	4		2	7	1	4	2	13		12		59
Switzerland	1								1	1			1	2		6
Turkey												1				1
United States	161	113	30	90	105	56	73	36	43	101	70	186	24	167	39	1,294
Wales	2															2
Miscellaneous															114	114
Total	203	200	62	264	199	62	350	405	91	683	109	1,704	32	746	159	5,269

NATIVITY OF COMMERCIAL FISHERMEN LICENSED APRIL 1, 1921 TO MARCH 31, 1922, SHOWN BY DISTRICTS.

Native of	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Tehama, Glenn Colusa	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Miscellaneous district s	Total
Austria				1	1		5	1		8		131	9	8		164
Canada	4			1							3	3	1			12
Chile										2						2
China			1				5	15		3						24
Cuba																
Dalmatia					3					2		55		4		64
Denmark	1	6	5	1	2		2	3		5		13		9		47
England	3	4				1			3		3	5		2	2	23
France	1									3	1	1				6
Finland	14	58				1	1	2				2				78
Germany	4	7	5	3	9		3	4	2	4	3	4	1	6	1	56
Greece			7	58	13		2	5		1	1	2		4	1	94
Holland		1					1				1	1				4
Hungary																
Ireland										2						2
Italy	11	1	1	61		1	266	367	39	193	12	124		174		1,250
Japan					14		1			88	10	673		188	1	975
Mexico		1						1				3		10		15
Montenegro										1						1
Norway	5	13		1	1		6	1	2	2	3	31		2		67
Poland											1					1
Portugal	1	10		25	11		5	1		23	7	1		32	1	117
Russia		1	1		1		1	4		3		22		1		34
Scotland																
Slav												22		1		23
Spain		3						4		34				2		43
Sweden	1	6	8	2	1	1	2	4	2	1	5	13		5		51
Switzerland									1				1	1		3
Turkey																
United States	85	140	45	67	61	86	67	38	25	54	80	129	34	122	30	1,063
Wales																
Miscellaneous		1						22							220	243
Total	130	252	73	220	117	90	367	472	74	429	130	1,235	46	571	256	4,462

STATEMENT OF EXPENDITURES FOR THE FISCAL YEARS 1920 - 1921 AND 1921 - 1922.

	—Fiscal year— 1920-1921	1921-1922
ADMINISTRATION:		
Commissioners	$1,115 49	$740 32
Executive offices	26,443 43	23,646 26
Printing	8,073 62	8,899 68
Research and publicity	6,073 62	5,293 23
Accident and death claims	1,754 69	462 76
Totals	$43,460 85	$39,042 25
COMMERCIAL FISHCULTURE AND CONSERVATION:		
Superintendence	$15,731 18	$15,515 96
Inspection and patrol	31,488 15	28,677 50
Research	30,491 93	27,318 98
Statistics	10,269 64	9,207 29
State Laboratory construction	765 95	23,218 11
Market fishing license commissions	535 50	534 50
Propagation and distribution of salmon	26,164 92	27,146 32
Totals	$115,447 27	$131,617 96
SPORTING FISHCULTURE AND CONSERVATION:		
Superintendence	$15,058 43	$15,038 17
Printing	299 54	315 05
Prosecutions and allowances	496 15	2,210 87
Angling license commissions	16,879 50	16,692 60
Fish exhibits	4,323 19	4,593 04
General patrol (pro rata share):		
San Francisco District (40 per cent)	$39,296 85	$40,672 45
Los Angeles District (40 per cent)	16,981 60	14,902 07
Sacramento District (40 per cent)	28,774 32	28,909 49
Propagation and distribution of trout	150,405 57	130,103 85
Totals	$272,515 15	$253,437 59
GAME CONSERVATION:		
Printing	$461 13	$1,228 65
Prosecutions and allowances	1,057 45	832 27
Hunting license commissions	24,605 60	23,532 90
Mountain lion hunting (and bounties)	8,489 98	10,021 71
General patrol (pro rata share):		
San Francisco District (60 per cent)	$58,713 22	$61,008 67
Los Angeles District (60 per cent)	25,370 37	22,353 10
Sacramento District (60 per cent)	43,158 88	43,364 24
Totals	$161,856 63	$162,341 54
TAHOE CAMPING GROUND	$684 04	$701 62
Total expenditures	$593,963 94	$587,140 96

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FISH AND GAME COMMISSION.

Statement of Income for the Fiscal Years 1920-1921 and 1921-1922.

	Fiscal Year. 1920-1921	1921-1922
License sales:		
Hunting	$234,936 00	$243,640 00
Angling	133,414 00	203,697 00
Market fishermen	49,790 00	41,200 00
Wholesale fish packers	1,720 00	1,100 00
Fish breeders	40 00	50 00
Fish importers	5 00	5 00
Trapping	3,465 00	3,101 00
Game breeders	87 50	77 50
Kelp	20 00	
Total license sales	$423,477 50	$492,870 50
Court fines	30,651 50	31,260 75
Fish tags	3,468 55	3,560 87
Fish packers' tax	31,878 00	26,346 66
Crawfish inspection	882 62	365 72
Game breeders' tags	34 97	22 50
Sale of nets	190 00	436 85
Miscellaneous, sales, etc.	1,214 78	132 00
Total income	$491,797 92	$554,995 85

Comparative Balance Sheets at Beginning and End of each of the Seventy-second and Seventy-third Fiscal Years.

Debits.

	July 1, 1920	June 30, 1921	June 30, 1922
Fish and Game Preservation Fund	$169,155 35	$31,266 93	$35,000 85
Cash, State	151 60	36,187 83	137 00
Warrants receivable	21,169 98	31,849 36	28,936 62
Revolving Fund	500 00	500 00	500 00
Unissued licenses available	691,921 55	701,306 00	686,800 00
Bond deposits (licenses sold to agents)		13,316 00	41,591 00
Total debits	$882,898 48	$814,426 12	$792,965 47

Credits.

Claims filed	$21,169 98	$31,849 36	$28,936 62
Revolving Fund liability to Board of Control	500 00	500 00	500 00
Accountability for licenses	691,921 55	701,306 00	686,800 00
Liability for bond deposits		13,316 00	41,594 00
Abatement of expense (special)		313 83	
Accumulated excess income	169,306 95	67,140 93	35,137 85
Total credits	$882,898 48	$814,426 12	$792,965 47

CALIFORNIA STATE PRINTING OFFICE, SACRAMENTO
FRANK J. SMITH, SUPT.