BIENNIAL REPORT
OF THE
FISH AND GAME COMMISSION
OF CALIFORNIA

1920

California. Dept. of Fish and Game.
Biennial Report 1918-1920.

(bound volume) c.1

DATE DUE

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STATE OF CALIFORNIA

FISH AND GAME COMMISSION

TWENTY-SIXTH BIENNIAL REPORT

For the Years 1918-1920

CALIFORNIA STATE PRINTING OFFICE
J. M. CREMIN, SUPERINTENDENT
SACRAMENTO, 1921

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FIG. 1. The new Tahoe Hatchery located at Walker Springs at the north end of Lake Tahoe. The splendid water supply available will make this an important unit in the hatchery system. Photograph by E. Hess, Stockton, California.

LETTER OF TRANSMITTAL.

San Francisco, California,
July 1, 1920.

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

Sir: In accordance with section 332 of the Political Code of the State of California we have the honor to submit for your consideration the twenty-sixth biennial report of the Fish and Game Commission. Herein you will find a complete record of the activities of this Commission, for the period July 1, 1918, to June 30, 1920, together with the financial statement covering the two fiscal years, showing the receipts and expenditures for the biennial period.

The intimate details concerning the work of the different departments may be found in the reports of the several heads of departments. We commend them to your careful perusal.

There has been no change in the membership of the Commission itself but a change was made in its Executive Officer, Mr. Charles A. Vogelsang succeeding Mr. Carl Westerfeld to this important office on the twenty-eighth of April, 1920.

Respectfully submitted.

(Signed) F. M. Newbert, *President.*
(Signed) M. J. Connell.
(Signed) E. L. Bosqui.
Board of Fish and Game Commissioners.

By Chas. A. Vogelsang,
Executive Officer.

IN MEMORIAM.

Romer I. Bassler, Foreman in Charge Klamath Stations.
(Died 1918.)

Mr. Bassler entered the employ of the Fish and Game Commission in 1908 and was employed as a fishculturist and as an employee in the car messenger service until 1915. In 1915 he was appointed superintendent of Distribution Car No. 2, and served in that capacity until the spring of 1918, when his health broke down, owing in a great measure to the arduous duties of his position.

Frank Shebley, Superintendent Mount Whitney Hatchery.
(Died December 21, 1918.)

Mr. Shebley entered the service of the Fish and Game Commission in 1894 and was employed as fish culturist for several years at the Tahoe and Mount Shasta hatcheries. In 1898, he was made superintendent of the Eel River Hatchery. In 1905, he accepted a position as fishculturist for the county of Santa Cruz and established the Brookdale Hatchery, which he operated until 1912, when the property was turned over to the State Fish and Game Commission under a lease. He was appointed superintendent of the new Mount Whitney Hatchery in 1917, and investigated the lakes and streams of the southern Sierras.

O. H. Richling, Cashier.
(Died November 9, 1919.)

Mr. Richling was appointed a special deputy October 24, 1903, in Amador County. On account of excellent work he was given a regular appointment on March 24, 1908, in the San Francisco office. At the time of his death he held the very responsible position of cashier.

Frank Clessens, Assistant Mount Shasta Hatchery.
(Died November, 1919.)

Mr. Clessens entered the service of the Fish and Game Commission in 1903, and was employed as carpenter and assistant in general work at the Mount Shasta Hatchery from that date until his death. His services were marked by the highest degree of loyalty and dependability. He was always faithful in the discharge of his duties and was on hand at any hour of the night to see that everything was running properly.

Chester A. Scroggs, Deputy Fish and Game Commissioner.
(Died January 22, 1920.)

Mr. Scroggs was first appointed June 19, 1908, with headquarters at Loomis, Placer County. He was a fearless officer and made a most excellent record during his twelve years of service.

Forest Nesbitt, Deputy Fish and Game Commissioner.
(Died March 5, 1920.)

Mr. Nesbitt was the son of Sheriff Nesbitt, who has been reelected many times in Monterey County. He was in the service less than three years, but during that time his devotion to his work made him a thoroughly efficient officer.

TWENTY-SIXTH BIENNIAL REPORT.

The following review of the work of the Fish and Game Commission during the past biennial period shows that it has been one of constantly widening range in its activities, of increased results with respect to hatchery output and improvements, of higher scientific achievement by our Commercial Fisheries Department, and a closer enforcement of the fish and game laws by our patrol force.

With our increasing population, which includes a considerable alien element, and the almost universal use of the automobile, our responsibilities have been vastly increased.

Most of the alien class arrive here with but little regard for conservation laws, the result being that they are the chiefest offenders to engage the attention of our patrol force. The use of the automobile has given easy opportunity to hundreds of thousands to reach the habitat of fish and game at any hour of the day or night, which renders detection of violation much more difficult.

We believe there is no force of employees in any department of the state who have shown more loyalty and faithfulness to their respective tasks than can be found in the employees serving under this Commission, regardless of the department in which they are employed.

This Commission was fully and creditably represented in the great war. Happily every man who was privileged to go, returned safely and found his position open for him. Those who, from various causes, were unable to contribute their services to their country, bore heavy burdens uncomplainingly at home. This is the more remarkable when it is remembered that in all the industries and every transportation line compensation had been almost doubled. Our employees remained faithful to their work, with but an insignificant salary advance compared with the much greater cost of living. This Commission has therefore reason to feel proud of its loyal and devoted workers.

A special page is devoted to the list of those of our force who died in our service during the past two years.

Our Department of Fisheulture has at its head Mr. W. H. Shebley, who has been identified with the fisheultural work of the California Fish and Game Commission for upwards of thirty years, and who is regarded as one of the ablest and most successful fisheulturists in the United States. Combined with his practical judgment, Mr. Shebley unites the results of his many years of experience and study of the scientific side of all questions relating to fisheulture, with special reference to salmon and trout propagation, and has furnished a report on the details of his work that is worthy of careful consideration.

During the past biennial period sixteen hatcheries and six egg-collecting stations have been in operation. From them a total of 34,000,000 trout fry have been reared and distributed—the greatest number in the history of the Commission in a like period. In addition to the trout distribution a total of approximately 29,000,000 Chinook salmon were reared and distributed in suitable places in the Sacramento, Eel and Klamath rivers.

The outstanding feature in the work of this department has been a greatly improved system of fish distribution, increase in the number of and expansion of our pond system, for rearing both trout and salmon, and the successful propagation and distribution of the golden trout, considered to be the most beautiful of the trouts of the world.

Special attention is called to the color plate of a Loch Leven trout, on our report cover. This hardy, gamey fish hails from the lakes of Scotland. He has found a most congenial habitat in all of the colder waters of this state, either stream or lake. There is no more valiant fighter in the trout family, nor one whose food qualities are superior. We have distributed upwards of four million Loch Leven fry in suitable waters during the past biennial period, and desire that our people become better acquainted with and more appreciative of his sterling qualities.

Practically all of our hatchery stations are now provided with Ford auto trucks, which are utilized in re-stocking streams in the vicinity of the hatcheries or in other points remote from rail facilities. By this method the fish can quickly be taken to the streams and properly planted by trained men. Crews on our fish-distribution cars have been increased in order that we may use trained men to accompany the larger consignments from the railroad station to the waters that are to be stocked, thereby assuring successful transportation and proper distribution of the young fish.

A handsome new hatchery building, with four times the capacity of the old one that has done duty for about thirty years, has been completed on Lake Tahoe near Tahoe City, and will be ready for next season's operations. It is located about one mile north of the old hatchery, where an abundant supply of water sufficient to maintain it at full capacity can be had during the entire hatching season. Some necessary work upon the grounds and ponds for fish displays and a superintendent's cottage will be built in the spring and summer of 1921.

Another entirely new hatchery site has been selected on the Kaweah River, in Tulare County. Plans for the building are under way, which, when completed, will be an important link in our chain of hatcheries, enabling us to stock waters on the western slope of the Sierras to

greater advantage than is possible from either the Mount Shasta or Mount Whitney hatcheries. This hatchery is expected to be in full operation for the forthcoming trout season. The water rights have been secured, the supply guaranteed, and it has been thoroughly tested by the successful operation for the past two seasons of an experimental hatchery under canvas.

Extensive repairs which had been neglected at the Mount Shasta and Fall Creek hatcheries, due to war conditions, are now under way. The coming season will find these hatcheries fully equipped in all respects.

MOUNT WHITNEY HATCHERY.

Improvement work has steadily gone on at the magnificent Mount Whitney hatchery in Inyo County. The grounds and approaches have been improved to match its general scheme.

Among the other five and one-half millions of trout hatched and distributed from the Mount Whitney Hatchery were 300,000 golden trout during the past season, which were distributed under the direct supervision of Commissioner Connell, into barren lakes and streams in the southern Sierras. The location and water supply of this hatchery have amply justified its selection as an ideal hatching and rearing place for the rare and dainty trout of our southern Sierra, found in no other part of the world, the golden trout.

FISHWAYS AND SCREENS.

Although the building of fishways has been retarded by the drought of the past three years, in spite of it, remarkable progress has been made. Surveys were made of 82 new fishways, practically all of which have been constructed, the most important of them being the one located on the American River, at the Folsom dam. The surveys, plans and the construction of these ladders have been made under the constant supervision of deputy A. E. Doney, who has specialized in this work for more than fifteen years.

Surveys and legal notices to install screens to prevent the loss of young fish through irrigation canals and power wheels, have been made, on 171 streams, ditches and canals, practically all of them now working efficiently. This important work is under the supervision of Mr. A. E. Culver as screen inspector. In most cases our requests have been met with ready compliance. In fact, there has never been a time in the history of the state when the conservation of our fish by installation of screens and fishways has been needed more, owing to the constantly increasing amount of water that is being diverted for agricultural and industrial purposes.

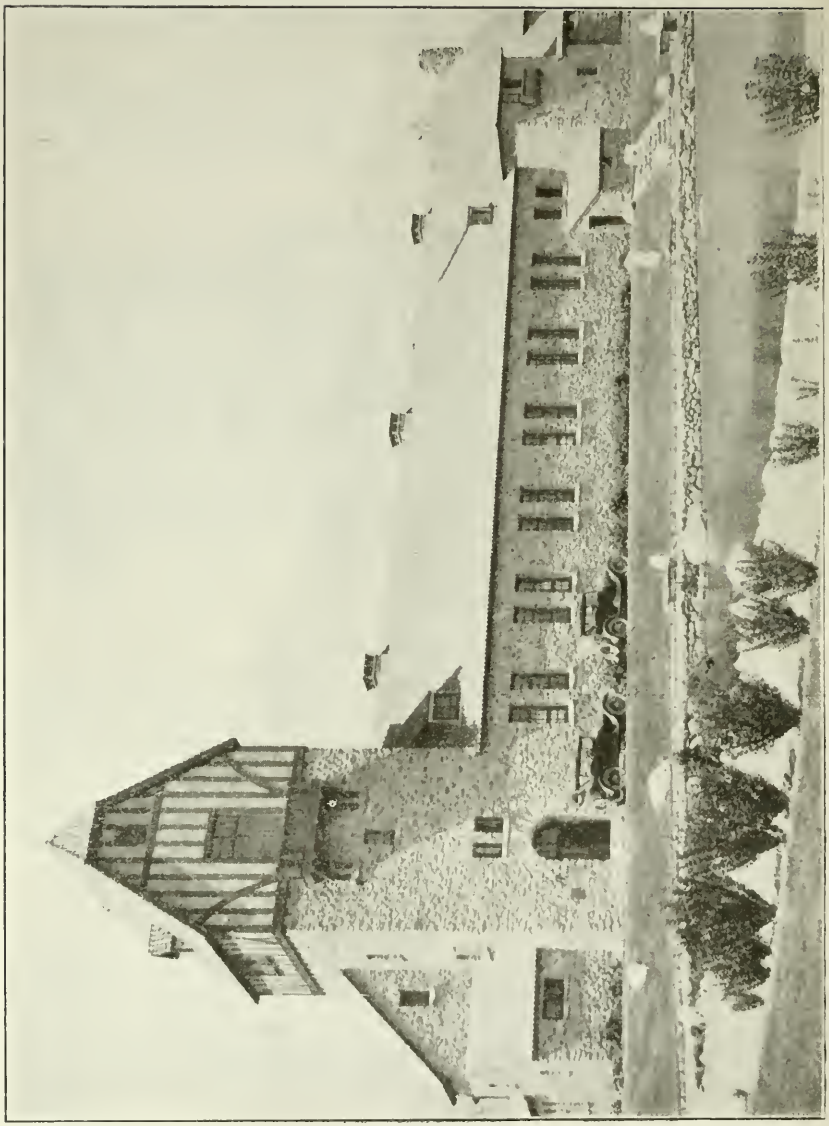


FIG. 2. The Mount Whitney Hatchery located at Independence, Inyo County, showing pond and hatchery grounds. Photographed by J. L. Von Blon.

COMMERCIAL FISHERIES.

This department is under the immediate direction of Mr. N. B. Scofield, a trained scientist who has devoted twenty years to the service of the state in the study, development and control of the commercial food fish industries. He is assisted by a thoroughly organized and efficient office and patrol force, and also by a corps of able scientific investigators headed by Mr. W. F. Thompson. Highly important discoveries have been made and valuable papers furnished, all tending to make of this department one of the most important maintained in this class of of work by any state or country.

Mr. Scofield's contribution to our report is a valuable document. We draw particular attention to that portion of it referring to the operations of the canneries along our coast, with special reference to the vexatious problems of fertilizer plants.

To assist in further development of this work and to preserve the valuable records and the statistical data already secured we have, with the approval of your Board of Control, set aside $25,000 for the construction of a fisheries laboratory to be located at San Pedro, adjacent to the large fish canning establishments.

With commendable foresight the city of Los Angeles granted free of cost a splendid building site for a period of thirty years, with the privilege of renewal for a like period on the same terms. Plans are now being drawn and we hope that this valuable addition to our scientific work will soon be an accomplished fact and performing, under more favorable conditions, still greater work than has been accomplished in the past.

MOUNTAIN LION BOUNTIES.

The increasing number of does and fawns that can be seen in a day's journey through the deer country, and which are being continually reported by hunters and those living in the mountains, is conclusive evidence of the wisdom of continuing to pay a bounty to encourage the killing of these marauders, who not only prey upon deer of all ages, but upon the farmers' livestock. He seems to have a fondness for colts, calves, sheep or goats. This has been confirmed many times although the presence of deer meat in the stomach contents strongly indicates his preference.

The Commission began to pay the bounty in November, 1908, and has to this time paid for the pelts and scalps of 3170 lions, all of which were sent to this office accompanied by the applicant's sworn statement showing where the animal was killed and by whom, and further supported by the signatures of two witnesses. In addition, the claim must be accompanied by an account of the pursuit and killing, together with

such other evidence as is acceptable to us to justify presenting the claim to the Board of Control for approval.

There was a steady decrease from year to year in the number of pelts received and claims presented, until a specially trained hunter was employed. The largest number taken in any one calendar year was 482 in 1908. For the calendar year 1918, 243 bounty claims were paid, and for the calendar year 1919, 214 were paid. It was decided in 1917 to increase the bounty to $30 for the pelt of the female lion as a further inducement to those living in the mountain lion country to hunt them, as it requires trained dogs, as well as much patience and hard rough work, to locate and finally tree them.

As the game refuges increased in number and shooting not being permitted there, nor in the National Parks, the lions seemed to avail themselves of those shelters. The Commission in 1918 decided to adopt further measures and engaged the services of Mr. Jay C. Bruce, an experienced mountaineer and lion hunter, the possessor of highly trained dogs, to take up the work as a regular deputy and devote his time especially to the refuges and parks, but also to respond to the call from any section where lions were reported as doing damage.

The increased results have fully justified his employment, as in addition to the lions, he destroys all other predatory animals destructive to game.

A page showing the total number of lions killed to January 1, 1920, by counties, and for which the bounty has been paid, will be found in the appendix.

ARRESTS AND FINES.

The work of our patrol force is best shown by the official record of its accomplishments, which clearly indicates that the work has been thorough and far reaching; that it covers every class of offense relating to the fish and game laws, and that it has reached into every corner of the State. This statement is based upon the detailed history, shown in our book of arrests and fines, of each case made.

The number of arrests and amount of fines assessed upon offenders during the biennial period is the greatest in the history of the Commission, totaling 1891 arrests and $49,426 in fines.

We do not claim that all violators of the fish and game laws have been apprehended. The opportunities afforded through the now general use of the automobile renders detection and capture more difficult. Our force is placed at the same disadvantage thereby as our city and county officers charged with the enforcement of other sections of the Penal Code, but we do confidently claim that no other body of officers, city, county or state, can show a cleaner record or a higher state of

efficiency. Their work is not measured by certain hours of the day or night, but at all hours, in any weather, stormy or sunny, on the water or in the field, or as conditions seem favorable to the law breaker.

We do recognize, however, a marked improvement in general public sentiment towards the enforcement of the fish and game laws. Convictions by juries are no longer the exception. The attitude of magistrates particularly in the interior of the state, is reflected by the imposition of deterrent penalties.

Another hopeful sign is the courtesy shown, and assistance extended, to our deputies throughout the state while in the discharge of their duties.

THE UNITED STATES FOREST SERVICE.

At this time, we desire to speak of the valuable assistance rendered by the men of the United States Forest Service. Supervisor and ranger alike have been of great assistance in this work. They have assisted our deputies to the limit when necessary and many important cases were unknown to us until the court records came in, showing that the arresting officers were members of the Forest Service. They have taken a conspicuous part in the arduous work of distributing young trout in remote waters.

They have also kept a watchful eye and reported on the conditions of the streams as related to fishways and screens. Their intelligent cooperation is deserving of your unqualified approval.

EDUCATION AND PUBLICITY.

We believe that nothing will develop public sentiment in favor of fish and game conservation more quickly and thoroughly than a properly conducted campaign of education and publicity. Your attention is invited to the report of our Bureau of Education, Publicity and Research, under the immediate supervision of Dr. H. C. Bryant. A perusal of this report will indicate how wide a field has been covered by this bureau in preaching the gospel of conservation. It has reached universities and colleges, normal schools, high schools, grammar schools, parents and teachers' associations, boy scout camps and other vacation camps and mountain resorts of the state. The lectures are accompanied by motion picture films of wild life showing the home life of game birds and mammals, and also one reel showing our hatchery operations.

In addition, this bureau is charged with the responsibility of editing and issuing our quarterly bulletin, "California Fish and Game," which was first issued in October, 1914, and judging by the frequent letters of approval coming to this office, has steadily grown in public estimation.

It is becoming more and more apparent that the tremendous drain upon our trout streams, due to the facilities of approach by rail and especially by automobile, justifies us in urging that the trout season be shortened at least one month throughout every district, that the young fish planted each year may be given an opportunity to reach a sportsman's size and permit seed enough to remain to insure, if possible, reproduction of species.

We are also reminded by many sportsmen that owing to the unequal distribution of the deer in the state and the consequent stronger attack on those sections of the state where deer are still numerous, that the limit should be reduced to one buck per year. Whether such reduction shall be made at the forthcoming session of the Legislature is an open question, but there can be no doubt that it must soon come.

We would favor some slight changes in the existing deer law with respect to season, the evidence of which comes from those resident in the respective sections where deer are found and whose judgment and experience should, therefore, not be disregarded.

We receive suggestions of many sorts from different sections of the state proposing changes in the fish and game laws. Some are entirely of a selfish nature and would not treat with fairness, the neighboring localities. We desire to be fair to all.

It is our endeavor to conserve the supply of fish and game of this state for all of its people rather than to yield to the pressure of the few in one section to the detriment of those in adjoining sections.

We aim to cooperate with each county to the fullest extent and give careful consideration to their requests and to smooth out differences that are more apparent than real. We acknowledge our obligation to county officials of every class. Their support has been both cordial and helpful. In fact, we recognize a decided gain with respect to the general sentiment of the people regarding the observance of all conservation measures pertaining to fish and game.

ACKNOWLEDGMENTS.

To many departments of the state do we acknowledge our indebtedness for courteous assistance and cooperation.

To the officials and subordinates of the American Express Company, the Lake Tahoe Railway and Transportation Company, the San Francisco and Sacramento Railway, the Yosemite Valley Railroad Company, the Sacramento Northern Railroad Company, we extend our thanks for valuable assistance.

To the United States Bureau of Fisheries and assistants we acknowledge our appreciation for hearty cooperation and assistance in salmon culture.

To the United States Forest Service for its valuable aid in the enforcement of the fish and game laws and liberal cooperation in fish distribution.

We gratefully acknowledge our obligation to the University of California and to Leland Stanford Junior University for helpful assistance in investigations and in the solution of difficult problems.

And especially do we wish to express our appreciation to the thousands of sportsmen, hunters and anglers alike, who are the main stay of this organization in a financial sense, and who have by friendly advice and cooperation assisted in carrying on this great work to its present high standing among the Fish and Game Commissions of the United States.

REPORT OF THE DEPARTMENT OF FISHCULTURE

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

SIRS: We take pleasure in submitting for your consideration a report of the operations of your Department of Fisheulture for the biennial period July 1, 1918, to June 30, 1920.

In previous reports submitted to your Honorable Board, this department has called attention to the growing demand for trout fry for stocking the streams and lakes of the state, due to the ever increasing number of anglers seeking recreation in every section where the sport of angling is possible.

With the advent of the automobile and the good roads movement, the way has been opened, for one so inclined, to go in a few hours with the greatest ease from the very heart of our most closely settled communities into the utmost recesses of our mountain fastnesses. And the city dwellers have gone in a never-ending procession, literally by the tens of thousands, from the opening day in the spring to the closing of the fishing season on the approach of winter.

Sections of the state, in the most remote recesses of the high Sierras, which but a few years ago could be reached only by pack trains with the assistance of hardy mountain guides and days and often weeks of travel, are now reached in but a few hours from the main centers of population, by automobiles, over some of the finest highways in the world. There can be but one result from such a condition of affairs and that is the practical destruction of fishing in the majority of the waters of the state, unless the most stupendous efforts are put forth, and at once, to conserve our game fishery resources and to increase the extent of the operations of this department. Every effort has been made within the past four years to keep pace with the demands of the situation, but war and post-war conditions have seriously handicapped us in accomplishing our objective. During the war period it was impossible to attempt any construction and improvement work on account of scarcity of labor and materials, therefore, it was not until the spring of 1919 that we were enabled to proceed with our plans for constructing

new hatcheries and egg collecting stations and enlarging and modernizing our older plants, properly fitting them with egg collecting equipment and providing suitable quarters and accommodations for the men engaged in carrying on the work. We now feel that we are equipped to handle the situation in the future to far better advantage than we have been able to during the past two years.

There are now in operation sixteen hatcheries, the majority of which are also equipped to carry on egg collecting operations, and in addition thereto, six egg collecting stations. With this equipment we are confident that we will be able to keep pace with the demands for trout fry.

A vast improvement has been made in our system of fish distribution from the various hatcheries and with the fish distributing cars. The more important of our hatcheries are now provided with small auto trucks, which in addition to being of great assistance in carrying on all regular operations, are used very extensively in connection with distributing the fry in the localities in which the stations are located. The fish are taken out during the proper season, a few cans at a time, and are carefully planted by our own men, who are skilled in this line of work. Local sportsmen and prominent citizens of the various communities are cooperating in stocking the streams, to a greater extent than in previous years, for the people generally are coming to realize the importance of maintaining the fish in their streams as an attraction to lure the people into the healthful recreations of the wilds.

The crews on our fish distribution cars have been increased to permit our messengers to accompany as many as possible of the larger consignments of fish from the point of delivery to the streams, where the transportation and planting of the fish is at all difficult, and when the applicants are inexperienced in fish planting. Many of them are experienced in the work and no assistance from this department in the actual planting work is necessary. Many of the deputy fish and game wardens are also cooperating with the department and the applicants, as are also a great many of the United States Forest Service Rangers who have had experience in planting fish. The result, of this policy, and new system of trout distribution, is that a far greater proportion of the fish survive. Then too, with the better methods of planting and the ever increasing number of experienced men engaged in the work, the fish are better "scattered" and receive a much wider distribution than formerly.

TROUT.

For the biennial period, a total of 34,000,000 trout fry were reared and distributed in the waters of California. This is the greatest number of trout fry ever distributed by the Commission in a like period.

Although much has been accomplished in the distribution of trout fry, it is impossible to keep the streams in the more easily accessible

regions stocked to the satisfaction of the majority of the anglers, as the open season is too long. The trout fry do not have a chance to grow. Fry planted during the summer and early fall are caught the next spring, when they are not over four or five inches in length. The growing season in the Sierra Nevada range—where the great majority of the stocking streams and lakes are situated—is during the spring, summer and fall. Trout do not make much of a growth during the cold stormy weather of midwinter. To give the trout fry a chance to grow and the adult fish to propagate, the season should be shortened at least

FIG. 3. Sisson Lake, one of the three large salmon rearing ponds at the Mount Shasta Hatchery. Photograph by Homer Marston.

one month in the spring and one month in the fall. Five months out of the year should be ample time for the anglers to enjoy the privilege of taking trout.

There are streams in the Sierra Nevada Mountains in which there are very few breeding or adult fish left. The anglers fish some of the easily accessible streams until the only fish left in any great numbers are the fry that have been planted the season before. They cannot take all of the large fish out of a stream and expect to have good fishing. If the open season on trout is shortened to five months, the results will be apparent in several ways. The number of fish taken will be reduced. The fry will have a chance to grow during the spring and fall when there is an abundance of natural food, and the adult fish will be protected during the breeding season. The rainbow, blackspotted and steelhead species spawn in the spring, and the Eastern brook, Loch Leven and German brown trout, in the fall. Thus there

will be an increase of natural propagation, and the fry from the natural propagation, as well as from the hatcheries, will have a chance to live and grow to a larger size. And the anglers will have in turn a better sized fish to catch.

CHINOOK SALMON.

The propagation of Chinook salmon has engaged the attention of this department as in former years, and while no radical change in method or policy has been made, there has been a steady improvement in the work. The policy of holding and feeding a large number of salmon fry in the big salmon rearing ponds at the Mount Shasta

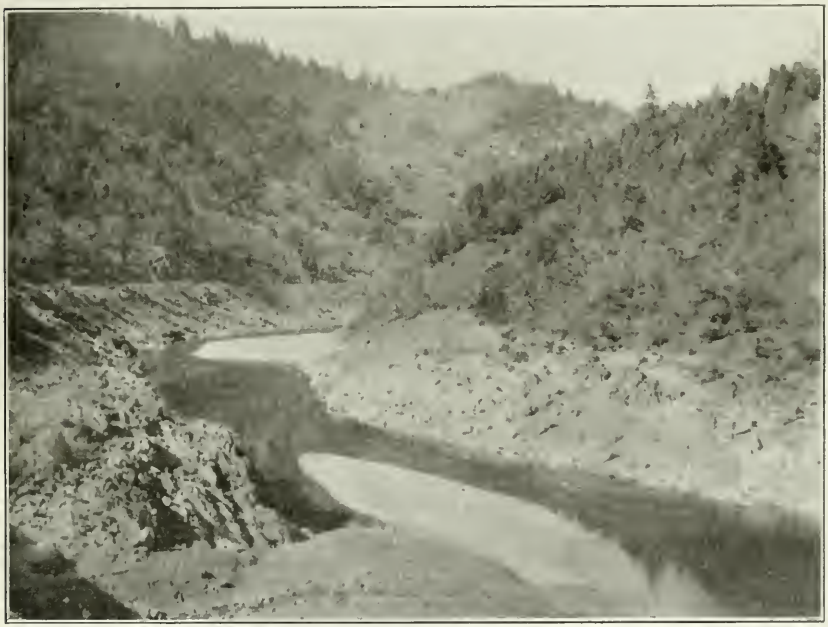


FIG. 4. Eel River, at the mouth of Fort Seward Creek, showing the extremely low water level on February 23, 1920—the lowest on record. Low water prevents the fish from reaching their spawning grounds. Photograph by M. K. Spaulding.

Hatchery throughout the summer months, and releasing them during the fall when conditions are propitious for their journey to the sea, has been strictly adhered to.

The major portion of our Chinook salmon eggs has, as in years past, been received from the United States Bureau of Fisheries' stations at Mill Creek and Battle Creek, tributaries of the Sacramento River.

All rights to the use of their old station at Klamathon on the Klamath River, in Siskiyou County, were secured from the Bureau of Fisheries and this hatchery has been operated for the past two years. The first season we were not properly prepared to conduct operations and only

a small number of eggs were taken. Last fall a fine take of eggs was procured and the number received would have been much greater had it not been for the drought, which extended all over the state and materially interfered with the extent of our egg collecting operations. A portion of the salmon eggs taken at Klamathon Hatchery are hatched and the fry reared at the new Fall Creek Hatchery. Here a large number of the fry are held in ponds during the summer and released in the Klamath river as fingerlings during the fall months.

A total of approximately 29,000,000 Chinook salmon were reared and distributed in the Sacramento, Eel and Klamath rivers during 1918–1919.

We desire to call particular attention to the salmon run in the Sacramento river. It is threatened with extermination if measures are not taken in the immediate future to increase the pond rearing system on the Sacramento River. Fully 80 per cent of the natural spawning grounds of the Sacramento River basin have been destroyed by the mines, and dams constructed for the purpose of generating electricity, and by the diverting of water for irrigation purposes.

The salmon rearing ponds at the Mount Shasta Hatchery will soon be inadequate to keep up the supply, and if the Iron Canyon Project is completed, according to the plan of the promoters, all of the salmon fry will have to be hatched and reared below Red Bluff.

The run has been broken at Redding by the construction of the dam diverting the water into the canal of the Anderson-Cottonwood Irrigation District. At the time the dam was built during 1916-1917, we had an understanding with the engineer in charge of the District, that the dam was not to be raised above a certain level. This would allow all the salmon to pass the dam and proceed on their way up the McCloud and Pit rivers. This would allow natural propagation in the Pit River and the Bureau of Fisheries could collect the eggs from the salmon that entered the McCloud River at Baird Hatchery and hatch and rear them as in former years.

In spite of the heavy drain on the fish in Monterey Bay and elsewhere in the ocean and in the Sacramento River, the salmon culture operations, as carried on by the Bureau of Fisheries and the State Fish and Game Commission, kept the run of salmon up without an appreciable decrease until the last two or three years. But recently the large number of salmon taken in Monterey Bay, the fishing areas off the coast of Fort Bragg, and the fishing in the lower river, combined with the number speared during the so called closed season on the upper reaches of the river, have made a material reduction in the number of adult salmon and effective measures must be taken without delay to save the salmon that are the output of the Sacramento River system. The low water in the river caused by the diversion of the water to the rice fields,

and its contaminated condition, has a tendency to prevent the salmon from passing up the river. The water that returns from the rice fields is full of organic matter and the gases formed by the decomposition is deleterious to all fish life. In our opinion a careful study of this condition should be made next season with the object of determining the actual facts.

We respectfully recommend that the Legislature stop all market fishing for salmon above the City of Sacramento and make a closed season off the coast of Fort Bragg and in Monterey Bay so that at least one-third less salmon can be taken during the season along our coast. The dates for the closed season on the Sacramento River and in Monterey Bay, and along the the coast where the salmon fishing grounds are located, should be arranged from data collected by the Department of Commercial Fisheries and the Department of Fisheulture, so that the best results may be obtained. Further experiments should be carried on, at the Chico Experimental Station where the Fish and Game Commission has procured a lease from the City of Chico on Big Chico Creek in the Bidwell Park. These experiments should include the rearing of salmon fry in ponds, so that if the Iron Canyon Project is completed, the Commission will be in a position to save the salmon of the Sacramento River by a pond rearing system.

The installation of the dams in Pit River by the Pacific Gas and Electric Company to generate hydro-electric power will destroy that stream as a natural breeding ground for salmon. If work is begun on the Iron Canyon Project in the next year, the power company should be forced to erect a salmon hatchery and rearing ponds on Pit River to propagate the salmon that their project will destroy. This should be taken up at an early date and every effort made to save the salmon.

The last of the salmon breeding grounds on the San Joaquin will be destroyed this season by the completion of the Kerckhoff dam and powerhouse by the San Joaquin Light and Power Company. The water will be diverted through a tunnel 17,000 feet in length that will dry up about 12 miles of the river bed as well as prevent any salmon from ascending above the dam. A survey of conditions on the San Joaquin River has been made and an estimate of the number of breeding salmon that pass the Mendota Weir, about 50 miles below the Kerckhoff dam, is in preparation. A survey has been made for a fishway over the new Mendota Weir that is now under construction. This will allow the spring run of salmon to pass on up the San Joaquin River to a point where the large irrigation canals take the water out of the river. These salmon ascend the river during May, June and the first part of July. In the foot hills near Friants they congregate in the large pools and remain until such time in the fall as the temperature is right for them to spawn, then they ascend the river into the gorge of the San Joaquin

River where they spawn during the fall. This is the result of our observations and data gathered from the residents and deputies who have lived in that vicinity for years. If such proves to be the facts, the only way to save the remainder of this run of fish is to establish an egg collecting station near the Kerckhoff powerhouse, collect the eggs, and transfer them by truck to Powerhouse No. 1, a distance of about seven miles, and there hatch and rear the fry in ponds. The fry should then be held until the following spring, or it may be necessary to hold them in the ponds for 16 months, until the following spring after they are hatched, and then release them in the river during flood periods before the large canals are opened for the season's operations.

If the water is turned in the large canals before the fry are ready to be released or the water is not turned off from the large canals during the winter and early spring, the fry would have to be transported by truck down the river to where they could be distributed below the canal systems. All this work should be forced on the power companies. They construct impassable obstructions in our rivers and streams in the shape of dams and diverting tunnels and canals without regard to the enormous destruction of the runs of commercial fishes. The Legislature should enact laws at once, compelling the power and irrigation companies to erect hatcheries and pond rearing systems, when in the judgment of the Fish and Game Commission it is deemed necessary to do so, and to furnish the funds to the state for the maintenance of these hatcheries.

There has been no effort on the part of some of the power companies and irrigation districts to repair any of the damage that they are doing in destroying a valuable source of food supply for the people. While they are developing properties that are essential to the development and growth of the state, they should at least be compelled to maintain the run of commercial fishes that they destroy in so doing, when it can be done easily and at a nominal cost.

Some of the corporations have cooperated with us to the very fullest extent possible in this work, but others have consistently opposed or evaded our efforts to conserve our commercial fishes.

The commercial fish interests should wake up to the fact that their valuable business is being destroyed to create another industry, and everyone should assist the Fish and Game Commission in saving this important food supply before it is too late.

MOUNT SHASTA HATCHERY.

During the biennial period there were distributed from the Mount Shasta Hatchery a total of 14,948,000 trout fry. A small portion of these fish were distributed in local streams from the hatchery, but the

greater number of them were shipped away in the two fish distribution cars to other sections of the state.

While the department is operating a total of twenty-two hatcheries and egg collecting stations in various sections of the state, the greater portion of the streams are stocked with trout fry from the Mount Shasta Hatchery. It is at this station that the entire supply of brood stock is held in artificial ponds, which furnishes all of the Eastern brook, Loch Leven and Brown trout fry. A small stock of rainbow breeders is also carried at this hatchery. Under this system there is assured a never failing supply of trout fry, no matter to what extent adverse climatic conditions may affect the collecting of eggs from the wild fish in the streams and lakes on which our egg collecting stations are located. Especially during the past two seasons when our take of eggs from the wild trout fell far below normal, on account of the extreme drought it has been a source of gratification to this department to know that the breeding stock in the Mount Shasta Hatchery ponds could be relied upon to furnish at least a fair number of fry, all of desirable species, for keeping our streams stocked.

We believe that the general public does not sufficiently appreciate our accomplishments in this line of work. Even the applicants, with whom we are more closely in touch, are so accustomed to having their requests for thousands and tens of thousands of trout fry met annually, and substantially as requested, that they little realize all the work and planning it takes to produce the fish.

Mount Shasta Hatchery was established in 1888. The equipment consisted of a single building 40 feet by 60 feet with a capacity of 44 hatching troughs. The output of fish during the first few years was but a few hundred thousand fry annually. Today the station covers seventeen acres of land, practically every foot of which is utilized. There are five large hatchery buildings located on the site with a combined capacity of 450 hatching troughs, capable of handling at least 10,000,000 trout fry annually. Other buildings consist of a superintendent's residence, cottages for the foreman and assistants, barn, sheds, garage, spawning house and kitchen for the preparation of the fish food. There are 50 large rearing ponds, where the breeding fish are retained, nurseries for the young fish, etc. In addition to this equipment the Commission has leased outside the grounds, but within a radius of a quarter of a mile of the plant, three large ponds which are used for rearing salmon fry. The capacity of these ponds is 3,000,000 fry. A one and a half-ton truck is used for hauling materials and supplies from the town of Sisson, which is one mile distant, and for hauling fish and eggs to and from the trains.

During the past year a great deal of repair and improvement work has been undertaken, the most important accomplished being the installation of new hatching troughs in "Hatchery A." The entire station is in first class shape.

By far the greater portion of the salmon cultural operations of the department are carried on at Mount Shasta Hatchery. During the biennial period a total of 23,363,000 Chinook salmon were reared and distributed from Mount Shasta Hatchery. Of this number a little over 16,000,000 have been distributed in the upper reaches of the Sacramento and Klamath rivers during the spring and early part of the summer, and the balance of over 7,000,000 have been reared in the three salmon rearing ponds above referred to through the summer months. The fry have an abundance of natural food in these lakes and an unlimited flow of pure, cold, mountain water. They are also fed on artificially prepared foods.

The conditions under which the fry are reared are ideal and when the season is favorable for their release into the streams after the first fall rains, they are in most excellent condition for their long journey to the sea.

Located as it is at an altitude of 3500 feet above sea level on the southern slope of Mount Shasta and in the heart of Strawberry Valley, with a wonderful supply of pure cold water, as well as being within a mile of the main line of the Southern Pacific Railroad, which is but a couple of hours by rail from the rainbow trout egg collecting stations on the Klamath River, Mount Shasta Hatchery is ideally situated. It has a capacity for handling not only the bulk of trout fry which can be transported to practically every section of the state at a comparatively moderate cost with a minimum loss of fish, but is capable of also rearing a sufficient number of salmon fry to maintain the salmon run in the Sacramento River.

KLAMATHON HATCHERY.

In order that the run of Chinook salmon in the Klamath River might be properly maintained, it was deemed essential that the department increase the extent of its operations with reference to this locality.

For many years past the Klamath River has been stocked each season with Chinook salmon fry, the supply being principally obtained from eggs taken from the Sacramento River. The United States Bureau of Fisheries had operated the egg collecting station at Klamathon and the eggs here taken were mostly shipped to Sisson, where they were hatched, reared, shipped back and planted in the Klamath River. The Bureau also hatched some fry at Klamathon and these fry were planted early

in the spring. However, the station was not well equipped for general operations and the water supply was poor and uncertain and consequently the extent of the operations was limited and the results obtained far from adequate. After careful deliberation, it was decided that some radical changes in the method of stocking the Klamath River must be undertaken. The matter was taken up with the Bureau of Fisheries and they very kindly agreed to turn the station over to us and donated the use of most of their equipment, buildings, etc.

In our report of 1918, mention was made of the provisions of the law requiring the owners of dams to erect hatcheries in lieu of fishways, when in the judgment of the Fish and Game Commission the dams are too high for the successful operation of a fishway or for other reasons it is deemed best to establish hatcheries below the dams for the propagation of any species of fish that may be obstructed in their movements by the dams. In accordance with the provisions of this act, arrangements were made with the California-Oregon Power Company to erect a good hatchery and cottages for the help at Fall Creek, and to establish racks and an egg collecting station at Klamathon for the purpose of collecting salmon eggs from the salmon that could not reach the spawning grounds on the upper reaches of the river, because of the high dam constructed by the California-Oregon Power Company.

The racks at Klamathon are well constructed. The plans for the racks and buildings were furnished by the Department of Fisheulture and our employees had the supervision of the work. The egg collecting station at Klamathon and the Fall Creek Hatchery were built by the power company at an expense of over $20,000.

Construction of the racks was begun during the fall of 1918, and was finished in time to secure a small number of salmon eggs. Under our plan of operation it was decided to take the eggs at Klamathon Station and ship them to the new Fall Creek Hatchery, which was under construction at the same time, where they would be hatched, reared and planted in the Klamath River and tributaries. Nearly a million Chinook salmon eggs were secured during the fall of 1918. Early in September, 1919, a crew was put to work at Klamathon Hatchery and everything was put in excellent shape for the season's operations. The season proved to be very unfavorable for egg collecting operations. The fall rains came unusually late in the season and were insufficient to raise the Klamath River to levels necessary for a good run of fish. However, we were fairly successful and secured 5,000,000 eggs before the run was finally over. Should next season be favorable for salmon egg collecting operations, double this number will undoubtedly be secured.

FALL CREEK HATCHERY.

As above mentioned, the Fall Creek Hatchery was constructed and paid for by the California-Oregon Power Company in lieu of constructing a fish ladder over their dam at Copco in the Klamath River.

A site on Fall Creek, a tributary of the Klamath River, at a distance of sixteen miles from the town of Hornbrook and along the line of the old Klamath River railroad was selected. A substantially constructed hatchery building, with a capacity of one hundred hatching troughs, a cottage for the foreman and living quarters for assistants comprise the equipment. The hatchery, completely equipped for fish-cultural operations and with a capacity sufficient to adequately take care of requirements in that section, was completed and ready for operation in the spring of 1919. The Chinook salmon eggs, taken at the Klamathon Hatchery during the previous fall, were hatched here and the fry reared for distribution in the Klamath River and tributaries during the spring and summer of 1919.

Five hundred thousand Chinook salmon fry were planted during the early spring months and a large pond was constructed in which were held and reared, to the fingerling stage, 648,000 fry. They were released in the stream during the months of October and November. In addition to handling the salmon work during the season of 1919, 670,000 rainbow trout eggs were received from the Bogus Creek Station that spring and were reared and planted in the Klamath River, above and below the dam and in tributary streams, during that summer. A large portion of the rainbow trout eggs taken at the Bogus Creek Station are immediately transferred to the Fall Creek Hatchery, where they are "eyed" and later all surplus eggs over and above the amount required for stocking the Klamath River are shipped to other stations to be hatched and reared for general distribution.

BOGUS CREEK STATION.

For a number of years rainbow trout egg collecting operations have been carried on in the Klamath River section by trapping the spawning fish as they ascend Bogus Creek and Camp Creek. The racks, traps and holding tanks in both of these creeks were in a very poor state of repair and accordingly, during the fall of 1919, the old egg collecting plant was removed and new equipment installed.

Spawning operations at these two creeks are carried on by the same crew, as they are but a short distance apart, Bogus Creek being on one side of the Klamath River and Camp Creek a short distance above on the opposite side of the stream. Accordingly, the two camps are operated under the name of Bogus Creek Station.

In the spring of 1918, 2,000,000 rainbow trout eggs were collected from this station and in 1919, 2,500,000 were taken. During the spring

of 1920, we procured over 2,600,000 eggs from this station, despite the extreme drought and unfavorable weather conditions, which obtained throughout the state. The success of our operations at this station this season was due to the installation of the new equipment. The eggs were shipped to Fall Creek Hatchery and to Mount Shasta Hatchery, where they were "eyed" and reared for distribution throughout different sections of the state.

HORNBROOK STATION.

Hornbrook Station, which is located on Cottonwood Creek, near the town of Hornbrook, Siskiyou County, produced 715,000 rainbow trout eggs in the spring of 1919 and this number could have been materially increased had the racks been placed in the stream lower down and had we been better equipped for egg collecting operations.

A careful investigation of Cottonwood Creek with reference to the collecting of rainbow trout eggs was made during the spring and early summer of 1919. A lease for a new site was obtained from Mr. Marshall Horn and a permanent system of racks was installed therein to trap the spawning trout as they ascend the stream. A new and larger holding tank for the fish was also installed and with the new equipment it was possible to obtain 1,600,000 trout eggs in the spring of 1920. These eggs were shipped, as soon as taken, to the Mount Shasta Hatchery.

MOUNT WHITNEY HATCHERY.

The Mount Whitney Hatchery, which is located near the town of Independence, Inyo County, and which was completed in the spring of 1917, has been operated each season to better advantage. This hatchery has the most extensive and complete equipment of any of our stations and the results obtained, especially during the past two years, have demonstrated the success of the hatchery. The trout fry produced at this hatchery are larger and more vigorous than those of any other hatchery. This condition is due to the wonderful supply of pure, cold water with which the hatchery is supplied from Oak Creek, and to the fact that the fishcultural equipment is superior to that of any other station. While it is true that the station is located at a considerable distance from some of the Southern California and San Joaquin Valley sections, which receive their supply of trout therefrom, the transportation facilities are very good, the trains being run on schedules which permit of the fish being delivered to the applicants within but a very short time of their leaving the hatchery. Consequently, the fry are in the very best possible condition when planted in the streams. While it may appear, to one not familiar with the existing conditions, that the distribution of the fish from Mount Whitney Hatchery is more

expensive than from other stations, on account of the high rate of fares from Mojave to Owenyo, the very reverse is true; for the trips of our distribution car are all comparatively short ones and we are enabled to complete the distribution work within a short time, which materially lessens the cost of distribution. But the most important feature of the advantage to Southern California of this hatchery is the excellence of the fry produced. They are truly wonderful fish and the advantage to the southern waters of our planting such fry is really inestimable.

During the biennial period, we distributed a total of nearly 5,000,000 trout fry from Mount Whitney Hatchery. The most interesting work undertaken at this station during the two years, from a fish cultural standpoint, has been the propagation of golden trout, obtained from the Cottonwood Lakes Station. The propagation of this species is very difficult owing to the weakness of the embryos. The eggs are fertilized with but an ordinary loss, but the embryos hatched seem to lack vitality and it is only by exercising the greatest care and patience in handling the eggs during incubation and in caring for the embryos, that the fry survive at all. However, golden trout are being successfully reared, and some very excellent results are expected from the stocking of the streams and lakes of the southern high Sierra, in which section conditions are propitious for the successful development of this species.

Owing to the failure to collect the usual number of eggs this spring, we were not able to carry out the plans of stocking all the barren lakes and streams of this region this season, but plans are being made to carry on the work next season. A well equipped pack train in charge of an experienced fish planter will be placed in charge of the work. This is an important work as it will stock the barren waters in advance of the army of anglers that each season advance farther into our mountain regions in search of sport and recreation.

The work of improving the grounds around the hatchery has been continued and the gardens are beginning to show the results. A large pond has been constructed, in which there are a number of adult trout of different species. Surrounding the pond are extensive lawns and beautiful flower gardens, roadways, paths, etc. The shrubs and trees set out a year ago last spring are thriving exceptionally well, and the time is not far distant when the Mount Whitney grounds will take rank with some of the finest garden spots of the state.

COTTONWOOD LAKES STATION.

As above stated, the propagation of golden trout fry for the stocking of streams and lakes of the southern high Sierra, has engaged the attention of the Department for the past two years. The eggs of this variety are obtained by trapping the spawners as they ascend the

streams flowing into Cottonwood Lakes. These operations are carried on under extreme difficulties. The fish commence "running" as soon as the ice on the lakes commences to break up in the spring, which is generally during the middle of June. The remoteness of the site of operations from railroads, highways or, indeed, any human habitations, the high altitude, and prevalence of snow storms, make the trip into this remote section at this season of the year actually dangerous at times. Nevertheless the work has been continued and crews have gone into the "lakes" each season and successfully accomplished their mission. Five hundred thousand eggs were taken in the spring of 1918, and in 1919, nearly a million eggs were procured. Immediately after each spawning pack trains were started out to take the eggs to the Mount Whitney Hatchery where they were hatched and reared. The Cottonwood Lakes Station is being opened up again this season and about three quarters of a million eggs will be taken, if conditions are favorable.

FIG. 5. On the way to the Rae Lakes Egg-collecting Station, on June 7, 1920. It takes ingenuity and hard work to reach some of the spawning stations. Photograph by G. McCloud Jr.

RAE LAKES STATION.

The Rae Lakes Station was established during the late spring of 1917 and operated that season. At the site of operations the altitude is 10,500 feet above sea level. It is a beautiful chain of lakes set in the heart of the high southern Sierra in Fresno County, and is well stocked with rainbow trout. To reach the site in time to trap the fish as they enter the streams to spawn is extremely difficult. The trip into the lakes must be made via Oak Creek pass at an elevation of over 11,000 feet. There are few trails and one must make the trip through the blind mountain

FIG. 6. Shoveling snow to release a pack animal on the Rae Lake trail, June 9, 1920. Crossing the Sierras in summer is not always an easy thing. Photograph by G. McCloud Jr.

passes over great depths of snow. Severe snow storms in this section, even in June when the fish are spawning, are frequent. Even when the days are clear and warm, the nights are freezing cold and the journey through the passes is at best a difficult one, taxing the strength

FIG. 7. Spawning rainbow trout at the Rae Lakes Egg-collecting Station.

and resourcefulness of the hardiest mountaineers. Owing to the difficulties attending the opening up and operation of this station, and to the fact that sufficient skilled help to operate all of our hatcheries to capacity could not be obtained, this station was not utilized during 1918 and 1919.

On account of the extreme drought obtaining throughout the entire state during the winter and spring of 1920, which materially reduced our take of trout eggs, it was decided that every effort should be made to take at least a half million rainbow eggs at the Rae Lakes Station in

FIG. 8. Cabin at the Rae Lakes Egg-collecting Station as it appeared at the end of June, 1920. Photograph by L. J. Stinnett.

order that Mount Whitney Hatchery might be supplied with an ample number of trout eggs to stock the streams and lakes of southern California. Some rainbow and a few steelhead eggs had been shipped to Mount Whitney Hatchery from some of the northern stations, but the hatchery was still half a million eggs short of requirements.

Accordingly, on June 7, our crew left Mount Whitney Hatchery for the Rae Lakes district. The Oak Creek trail was in very bad shape, rocks and slides having made it very rough. The snow banks were very deep and the snow soft, making it extremely difficult to get the pack animals through in places. Several times the men had to shovel out paths for the horses. The party was four days in making the trip, but fortunately they got in ahead of the run. The ice on the lakes was just

commencing to break up and it was several days before the fish began to run into the creeks to spawn. In the meantime, the crew had ample opportunity to install the racks, traps and holding pens.

The run of fish was very heavy but being of small size they produced only an average of 250 eggs each. Approximately 500,000 eggs were taken, about what we expected to obtain. The eggs were brought down to the Mount Whitney Hatchery immediately after being taken.

LAKE TAHOE HATCHERY.

The Tahoe Hatchery, located on the shores of Lake Tahoe, one mile from the town of Tahoe, was established in 1889. The water supply is furnished from springs rising on the land used as a hatchery site. Thirteen acres were purchased at the time the hatchery was constructed, so as to secure all the available water to be had near the site. The water is pure and very good for the purpose of rearing fish, but the supply, ten miners inches, is not sufficient for a hatchery of the size necessary to supply the Tahoe basin outside of the territory supplied from the Mount Tallac Hatchery.

During the fall of 1917, this Department began a survey of all the available and suitable streams flowing into Lake Tahoe and after a careful examination we selected the Walker Springs, one mile north from the present site, on the state highway. The Walker Springs run during the minimum flow is 30 inches of water and during the maximum flow is a couple of hundred inches, and this during the season of greatest hatchery activity. Therefore the state has secured a most desirable site to carry on hatchery work. It is the only suitable water for hatchery purposes in the Tahoe basin proper. The streams that have their sources in the mountain range surrounding Lake Tahoe carry too much detritus and are too roily during the time the snow is melting. After purchasing the property, plans were made by the state architect for a modern stone hatchery with four times the capacity of the old hatchery. The contract was given to Mr. Matt Green during the summer of 1919. Work was begun on the new hatchery that fall and will be completed this summer (1920). At the request of Governor Stephens and the citizens of Placer County, the old hatchery grounds were converted into a public camping ground by an act of the Legislature during 1918, and the management of this public park was placed with the Fish and Game Commission, who have improved and maintained it from the funds collected from hunting and angling licenses. The old hatchery at Tahoe is being used until such time as the new hatchery shall be completed.

During the past two years there were hatched and reared 857,000 rainbow and black-spotted trout fry at the Lake Tahoe Hatchery and

these were given a wide distribution in the streams tributary to Lake Tahoe.

The new hatchery will have a capacity of 3,000,000 fry up to the swimming stage. Then the surplus fry can be placed in nursery ponds until such time as they can be distributed. The work of fencing the grounds, building roads, cottages for the superintendent and the help, and a small building for the preparation of the fish food, will be carried on during the coming fall and spring.

An endeavor has been made to add a new variety of game fish to the native species of trout in Lake Tahoe, by the introduction of the renowned golden trout of the Mount Whitney region. Last summer a consignment of 250,000 golden trout eggs were shipped from the Mount Whitney Hatchery to the Lake Tahoe Hatchery. The resulting fry were carefully reared and planted in the streams flowing into the lake, where conditions appeared to be most favorable for them. If the golden trout thrive in the waters of Lake Tahoe, it will mean much to the anglers of the state, who enjoy the fishing in this region.

MOUNT TALLAC HATCHERY.

The Tallac Hatchery has been operated for the past two seasons as formerly. Some changes have been made in the building to improve the light and water supply. During the last three seasons of drought, the water supply at Tallac Hatchery was effected as in other parts of the state.

Since the construction, by the Tallac Hotel management some years ago, of a dam at the outlet of Fallen Leaf Lake, which holds back the water that enters the lake from Glenn Alpine Creek, the principal feeder of Fallen Leaf Lake, the water in Taylor Creek, the stream that is the outlet of Fallen Leaf Lake, has been very low. Owing to the light rainfall in the autumn, and the unusually light fall of snow and rain during the winter months, the water that has entered the lake, during the last three winters, has been held back by the dam at the outlet of the lake. Consequently, the flow of water in Taylor Creek has not been great enough to attract the spawning fish to its mouth, where it pours its waters into Lake Tahoe, and where our egg-collection station is located.

As a result of the conditions, the take of black-spotted trout eggs was considerably less than in other seasons of normal rain and snowfall. The Tallac egg collecting station at the mouth of Taylor Creek has been one of the best egg collecting stations in the state. From three to five million eggs have been collected annually from this station for the last fifteen years.

While there are fifteen other streams entering Lake Tahoe on the California side of the lake where the trout have a chance to spawn

naturally, a greater number entered Taylor Creek than any other stream flowing into the lake, and our supply of black-spotted trout eggs has been secured from this creek almost exclusively for the last twenty-five years. This fact alone is positive proof of the beneficial results of artificial propagation, as no more than 5 per cent of the eggs collected annually from Taylor Creek are returned to it as fry, after being reared at the Tallac Hatchery. The remainder of the fry are distributed in other streams entering the lake and throughout the Truckee and Tahoe basins. The number of trout entering this stream was undiminished during twenty years of our egg collecting operations until the water was held back during the last two unusually dry winters by the dam at the outlet of Fallen Leaf Lake.

What the effect will be later on when the seasonal storms are normal again cannot be foretold, but it is probable that we will have to restock this stream heavily for a couple of seasons to restore the run that has been depleted by storage of the water in Fallen Leaf Lake.

We are planning to collect eggs from the Upper Truckee River, that has its source in the water shed of the mountain range to the south of the lake and empties into the head of Lake Tahoe, about two and one-half miles from the mouth of Taylor Creek. This is a larger stream than Taylor Creek and should produce as many eggs as it has, if the run has not been depleted during the years that the market fisherman and others were carrying on their illegal fishing.

The new hatchery at Tahoe City will require a larger number of eggs, as its capacity is four times as great as that of the old station which will be abandoned this season. Therefore our efforts to collect eggs from some of the other streams flowing into the lake will have to be increased. We have introduced rainbow and steelhead trout into Lake Tahoe in considerable numbers during the past two years, and in a few years these desirable species should increase in numbers great enough to give an added attraction to the already remarkably good fishing to be had in Lake Tahoe. The introduction of new species into the lake should improve the fishing conditions, as each new variety has different habits from the others. It often happens that in a lake as large as Tahoe the native species will not take the bait or lure offered them during certain periods in the summer, as the temperature and winds have caused the plankton to descend to greater depths than is practicable to take game fish. The native trout during these periods follow the minnows that are feeding on plankton. Consequently they are too deep to reach with ordinary tackle and, if they are reached, have no inclination to bite freely as their natural food supply is concentrated where they can easily obtain all the food that they require without much effort.

New species of fish introduced will have a tendency to feed nearer the surface and the anglers will enjoy better fishing. The introduction of rainbow and steelhead trout should be kept up for a number of years in as large numbers as possible, as it takes a long time to stock a body of water as large as Lake Tahoe with a new species.

In 1918, there were hatched and reared at Mount Tallac Hatchery, 149,000 rainbow, 1,133,000 black-spotted and 335,000 steelhead trout fry, and 1919, 51,000 rainbow, 685,000 black-spotted and 185,000 steelhead fry were distributed in Lake Tahoe and other waters of that section.

The steelhead trout have made such a remarkable growth, and produced such a fine, gamey, fighting fish when planted in inland lakes of the high Sierra that it was deemed essential that an effort be made to introduce this species in the waters of Lake Tahoe, hence a shipment of steelhead trout eggs is being sent to Mount Tallac Hatchery each season and the fry are planted in the most favorable locations.

FORT SEWARD HATCHERY.

The hatchery established in 1916 on Fort Seward Creek, Humboldt County, has more than filled our expectations, the fry produced at this hatchery being the best reared in any of the hatcheries located in the Coast counties.

The hatchery building is situated near the creek in a steep-walled canyon and the superintendent's dwelling on an eminence overlooking the hatchery. As our funds were limited at the time the hatchery was established, only a poorly constructed cabin could be built for the help besides the cottage for the superintendent. During the fall of 1919, two four-room cottages, of plain interior finish and shingle outside, were built so that men with families could be employed. It is a difficult matter to find competent help that will stay for any length of time in an isolated place such as this, sixty miles south of Eureka on the main line of the Northwestern Pacific Railroad and five miles from the post office and store at Fort Seward, unless every comfort is provided.

The water in Fort Seward Creek is the only water suitable for hatchery purposes on the line of the Northwestern Pacific Railroad. There are several streams between South Fork station and Fortuna, but they all have their sources in the same sedimentary formation as Price Creek, where we were compelled to abandon the hatchery owing to the great amount of sediment carried in the water during the winter and spring when the rainy season was at its height.

We have endeavored to find a location from which an ample supply of salmon and steelhead eggs could be collected for this hatchery, so that Eel River may not be depleted of the valuable run of salmon and

steelhead to be found in that river and its tributaries. Investigations have been made for rack and trap sites in the lower reaches of the river, but none have been found that can be operated for any sum of money that is available for such purposes from the present income of the Commission. The river is so wide and deep and subject to such tremendous floods that it is impracticable to attempt to collect eggs near the mouth of it.

It has been urged on our Department several times, by persons not familiar with fishcultural operations and who are not educated to the habits of the anadromous fishes that enter Eel River, that we catch the breeding fish for our egg supply from the fish that congregate in the large pools from the mouth of Bull Creek to the large pool at the mouth of the river. The fish that enter the river and linger in the large pools early in the season are not ripe and consequently they can not be spawned. Several attempts have been made during the last few years to collect eggs from the salmon on the lower reaches of the river, but for the reasons above mentioned all efforts have failed.

The Fort Seward Hatchery has been supplied with steelhead eggs from the Snow Mountain Egg-collecting Station located on the south Eel River, one of the tributaries of the main or middle Eel River. A careful examination of the Eel River system was made during 1918 and 1919 in an effort to locate an egg collecting station on the upper reaches of the river that would furnish both salmon and steelhead eggs enough for the whole Eel River in northern Humboldt County, and several other streams. The most favorable location found so far, is near Branscoms on the South Fork of the main Eel River in northern Mendocino County. The eggs can be collected at this point from fish that are ripe, as the site is located approximately 120 miles from the junction of the south fork and the main Eel River.

The south fork must not be confused with the South Eel River, as the two streams are miles apart and have their sources in different ranges of the coast mountains. The South Eel River, which in reality is the head of the main Eel River, rises in the middle range of the Coast Mountains. The south fork of the Eel River rises in northern Mendocino County in the Coast Range proper and follows the basin near the coast all the way to its junction with the main river. It is the principal tributary of the Eel River system and flows through a heavily wooded country from its source to the mouth and carries the largest amount of water during the fall months of any of the forks of the Eel River.

Judging from the amount of water, the topographical formation of the country through which it flows, and the temperature of the water, it is the branch of the river which the great majority of the steelhead and salmon enter to spawn. This cannot be determined to a certainty until an experimental station is operated for one or two seasons.

We are, at this writing, negotiating for a site near Branscombs to rack and trap the river and carry on the experiment. It is necessary for the maintenance of the run of the steelhead and salmon in Eel River, that a permanent egg collecting station be established where a sufficient number of steelhead and salmon eggs can be collected annually to furnish the Ft. Seward Hatchery with a regular supply of eggs as well as enough of the steelhead trout to furnish a supply for some of our other stations. If the station at Branscombs is established and should prove to be too far up the river, another location farther down must be found, if the fishing conditions in Eel River are to be maintained. It is necessary that a sufficient number of fry be planted each season to insure a good run of fish.

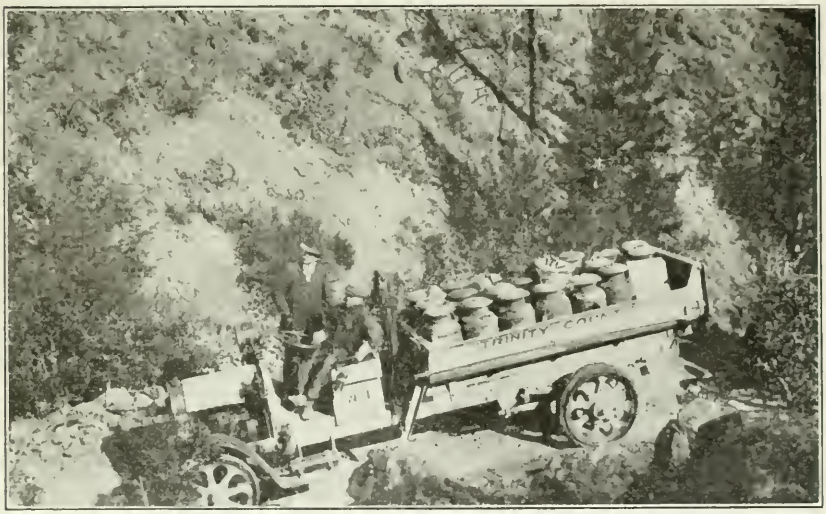


FIG. 9. A truck load of trout fry for planting in the streams of Trinity County. Although these fry traveled one hundred and one miles over mountain roads, only one hundred and one fish were lost during the entire trip. Photograph by John Gray.

A total of 1,757,000 trout fry have been distributed in the streams of the northwest coast counties, Humboldt, Mendocino and Trinity, during the seasons of 1918 and 1919, from the Ft. Seward hatchery. The fry were given a very wide distribution, most of them being steelheads and being planted in the Eel River and tributaries. The Mad River section was also given a fine lot of fry and fishing is reported to be excellent in that district as a result of the continued stocking of the streams.

During the biennial period two million Chinook Salmon were reared at the Fort Seward Hatchery and planted in Eel River, Mad River and the tributaries of Humboldt Bay.

UKIAH HATCHERY.

The steelhead trout eggs taken at Snow Mountain Station have been "eyed" at Ukiah Hatchery each season, and the surplus eggs shipped from this point to other stations. Of the eggs retained and hatched at this station, 1,030,000 fry have been reared and distributed in the streams of Mendocino and Sonoma counties, during the season of 1918 and 1919.

Ukiah Hatchery was opened for operations in the spring of 1920, and the eggs taken at Snow Mountain Station were sent down to be "eyed," but on account of the extreme drought which affected our operations in this section to a greater extent than in any other locality, there was not a sufficient number of eggs taken to justify the hatching and rearing of fry at Ukiah. Then too, the water supply absolutely failed during the latter part of May and even had there been an adequate number of eggs available the station could not have been operated. As it was, we were fortunate in being able to "eye" the eggs and prepare them for shipment before the water supply gave out entirely. Consequently, all of the eggs were shipped to Fort Seward Hatchery, from which station they will be distributed in the waters of Humboldt, Trinity, Mendocino, Sonoma and Marin counties.

SNOW MOUNTAIN.

During the spring of 1918 a total of 3,600,000 steelhead trout eggs were taken at Snow Mountain Station, and in 1919 we obtained 5,400,000. During both seasons the number of eggs taken could have been very materially increased had we been provided with adequate facilities for holding the spawning fish.

This station is located at the Cape Horn dam in the Eel River. The dam and the fish ladder over the same are the property of the Snow Mountain Water and Power Company. We secured from the Company a lease to the fish ladder, together with such buildings as are located on the site, and the privilege of operating thereon a hatchery and egg collecting station. A small battery of hatching troughs was installed and holding pens, etc., for the spawning fish were provided. As the fish ascend the fish ladder they are automatically trapped and swim directly into the holding pens, from which they cannot escape. It is a very cleverly arranged scheme and in addition to being a saving, by eliminating a great deal of work, lessens the loss of fish from handling. However, the capacity of the holding pens and "eyeing" equipment was not sufficient to enable us to handle the maximum of the capabilities of the plant, for the run of spawn fish in Eel River is enormous during favorable seasons.

To increase our equipment presented some unusual difficulties, however, and the expense would necessarily be considerable, so it was not

until the early winter of 1919 that we were enabled to undertake the work. While there were many unexpected delays in completing the construction, the station was all ready for operations by the middle of February, 1920, and the crew on the ground and in readiness for handling the largest take of eggs since the establishment of the station. But all of our efforts were unavailing. Week succeeded week of clear warm summer weather. There was no snow in the mountains and none of the usual spring freshets to increase the flow of water in the Eel River sufficiently to permit the breeding fish to ascend to the upper reaches of the river. During April the country in this section was as dry as it generally is in September. Springs, which normally flow throughout the entire year, dried up in April and May.

Only a very few fish succeeded in getting up as far as our station, and only 750,000 eggs were obtained as a result of our entire season's work. These were shipped to Ukiah Hatchery where they were "eyed" and from there sent to Fort Seward Hatchery.

During the biennial period 375,000 steelhead trout fry were hatched and reared at Snow Mountain Station and distributed in tributaries of the Eel River.

BROOKDALE HATCHERY.

All of the steelhead trout eggs taken at Scott Creek Station are immediately transported to Brookdale Hatchery where they are properly "eyed" and where all surplus eggs are packed and shipped to other stations. During the two years 1,559,000 steelhead trout were distributed in the waters of Santa Cruz and Santa Clara counties and a few also in Monterey and San Mateo counties.

Brookdale Hatchery is the property of Santa Cruz County and is operated by this Commission under an agreement providing that a half million steelhead trout fry be planted each year in the waters of Santa Cruz County under the direction of the board of supervisors.

Owing to the steady decrease in the water supply at Brookdale Hatchery during the last four years of drought and the increased amount used by the residents of Brookdale during the early summer, when the hatchery should have its maximum supply, we were greatly embarrassed in carrying on our hatchery operations. There was not sufficient water to keep the fish in good condition after the first of July, and the fry had to be distributed too early to get the best results. We are of the opinion that a new hatchery site should be selected in Santa Cruz County, if conditions do not improve next season. It is very doubtful if water conditions will improve at Brookdale Hatchery, as the water has been getting less each season for the last five years.

SCOTT CREEK STATION.

During the past two years the Scott Creek Station has produced 3,900,000 steelhead trout eggs all of which, as above mentioned, have been sent as soon as taken, to Brookdale Hatchery.

During the spring of 1920, the same conditions prevailed in this section as in other parts of the state, although there was a little heavier rainfall than in the Snow Mountain section. During most of the season the water levels in Scott Creek were considerably below the normal, and the breeding fish were unable to enter the creek from the lagoon on account of the sand bars at the mouth of the stream. From time to time, however, the spring storms were sufficient to raise the waters to levels which permitted some of the fish to pass over the bars and ascend the stream as far as our station. As a result of our efforts 1,060,000 eggs were taken. While this number is only about half of our usual take, we feel that in view of the adverse conditions for egg collecting operations, we did very well to obtain this number. It insured the adequate stocking of Santa Cruz and Santa Clara county streams, as well as providing a limited number of eggs for Mount Whitney Hatchery. The steelhead fry hatched at the latter station will be distributed in streams of the southern counties from Santa Barbara to San Diego.

ALMANOR HATCHERY.

Almanor Hatchery has been operated each season as an egg collecting station. It produced 261,000 rainbow eggs in 1918, and 282,000 in 1919. The water supply fails too early in the summer to permit the hatching and rearing of fry at the station, and accordingly, the eggs are transferred to Clear Creek or Domingo Springs Hatchery as soon as they are "eyed."

DOMINGO SPRINGS HATCHERY.

This station was established as an experimental hatchery in 1916. Improvements were made during 1917, when the temporary plant was moved to Rice Creek, one of the main branches of the North Fork of the Feather River above Lake Almanor. A thorough test of the water and an investigation of the run of fish resulted in the establishment of a permanent egg collecting station and hatchery at this place. Accordingly, during the summer and fall of 1919, a permanent building was erected and a substantial trap constructed, one-quarter of a mile below the falls in Rice Creek. The site was procured from the United States Forest Service and we now have a very desirable station at that place which will furnish fry for the entire region surrounding the west side of Lake Almanor, as well as the lakes and streams in the Mount Lassen National Park and surrounding country.

During the two years 850,000 rainbow and steelhead trout fry were distributed in the streams and lakes in this district from Domingo Springs Hatchery. A total of 2,200,000 rainbow trout eggs was collected at this station during the two seasons.

Each season a consignment of steelhead trout eggs is shipped to Domingo Springs Hatchery and the resulting fry are planted in the high Sierran lakes of that region which are suitable for this variety. The steelhead trout have thrived remarkably well in the lakes of this section and afford some of the finest fishing in the state.

FIG. 10. Eyeing house and tank at Canyon Dam, Lake Almanor, Plumas County, April, 1919. Spawning operations must be begun under such conditions as these. Photograph by S. Campbell.

CLEAR CREEK HATCHERY.

The Clear Creek Hatchery and Egg-collecting Station was established in the fall of 1918, on the creek that bears its name, one and one-half miles from the town of Westwood, Lassen County. Clear Creek is a tributary of the Hamilton Branch of the Feather River. Before the construction of the dam forming Lake Almanor, it flowed into the valley known as Big Meadows, and united its waters with those of the North Fork of the Feather River, which entered the Big Meadows basin from the north. Hamilton Branch flows into the basin from the east. The Hamilton Branch has a run of rainbow trout that ascend the stream to spawn from Lake Almanor. Clear Creek being one of the principal tributaries of the Hamilton Branch a good portion of the spawners enter this creek. The distance from the Clear Creek Station to the Domingo Springs Station is approximately twenty miles. Clear Creek has its source in a large spring and the water is pure and cold as all the waters are that rise in a lava formation.

The Red River Lumber Company furnished the site and material for the Clear Creek Hatchery and the Fish and Game Commission furnished the labor for construction. We have operated there for the last two seasons with good results.

Clear Creek Station was first operated during the summer of 1918, 189,000 rainbow trout eggs being shipped in from Almanor Hatchery and the resulting fry reared to a good size and given a wide distribution in the waters in the vicinity of Westwood. During the season of 1919, 157,000 rainbow trout fry were reared and distributed from Clear Creek Hatchery.

BEAR LAKE HATCHERY.

In our Biennial Report of 1918, we made mention of the necessity of increasing the capacity of the Bear Lake Hatchery at Green Spot

FIG. 11. The old and new hatchery at Green Spot Springs, Big Bear Valley, San Bernardino County, May 21, 1920. Photograph by L. Philips.

Springs. We had been using the old buildings that had been erected by the Southern California Trout Association, but it was poorly constructed and the arrangements of the troughs were not right to do good work.

After procuring a permit from the Forest Service for a site adjacent to the site leased to us by San Bernardino County, a new hatchery with modern troughs was erected and fully equipped for the hatching and rearing of trout fry. The site at Green Spot Springs is about twelve miles from the egg collecting station at North Creek. This is the only water available for hatchery purposes near Bear Lake. All the

creeks dry up as the summer advances, except some small springs used for domestic purposes.

The Green Spot Springs rise near the foot of Sugar Loaf Mountain and flow through a shallow ravine towards Baldwin Lake. The water is used by the Shay Brothers, on their stock ranch after it leaves the hatchery. There is approximately twenty inches of water in the spring. It is cool and free of any organic substances and is excellent hatchery water.

During the summer and fall of 1919, we planned to make general improvements at North Creek Egg Collecting Station and to erect a new hatchery at Green Spot Springs, with a capacity of 1,500,000 fry. The work was begun early in September, but owing to delays in getting materials, was not finished until late in November. At the hatchery at North Creek Egg Collecting Station, a portion of the eggs are hatched each season and the fry held until they are swimming well; then they are distributed in the most favorable places in Bear Lake, where there is an abundance of natural food. The fry can not be held in North Creek Station later than the middle of July as the water in North Creek fails by that time. The remainder of the fry reared for Bear Lake are held in the hatchery at Green Spot Springs until later in the season, when they are distributed in the lake in the shallows and other favorable spots. The condition of the water in Bear Lake has been very murkey and discolored for the last three seasons. Owing to the growth of algae and its decomposition during the period of low and warm water, the fish are compelled to go to the deep water, where the effects of the decomposing algae are not so great. The minnows and aquatic insects are in a measure affected in the same way and consequently, they seek the depth for the same reason that the trout do. The trout having an abundance of feed do not bite well or take any kind of a lure to a great extent during the warm weather. This condition will change when the normal amount of rain and snow falls on the water shed surrounding the lake, filling the streams running into the lake and thus carrying the organic matter away by the flood waters.

During the spring of 1918 a total of 3,500,000 rainbow trout eggs were collected at the North Creek Station. Eight hundred thousand eggs were transferred to the Bear Lake Hatchery at Green Spot Springs and the resulting fry were liberated in Big Bear Lake and in streams of San Bernardino County. The balance of the eggs were shipped to Mount Shasta, Mount Whitney and Mount Tallac hatcheries.

Four million eight hundred thousand eggs were collected at North Creek Station in 1919. Owing to the extreme drought and unfavorable weather conditions generally, in the Big Bear Lake country during the spring of 1920, our operations were practically a failure as far as egg collecting work was concerned. Despite all of our new equipment for

egg collecting operations and larger crews of spawn takers, we procured only 1,500,000 rainbow trout eggs. All of the eggs taken were hatched and reared at the North Creek Station and at the Bear Lake Hatchery, from which stations they will be given a wide distribution in the streams and lakes of San Bernardino County.

NORTH CREEK EGG COLLECTING STATION.

The egg collecting station at the mouth of North Creek was operated in a tent; the employees have also lived in tents since the spring of

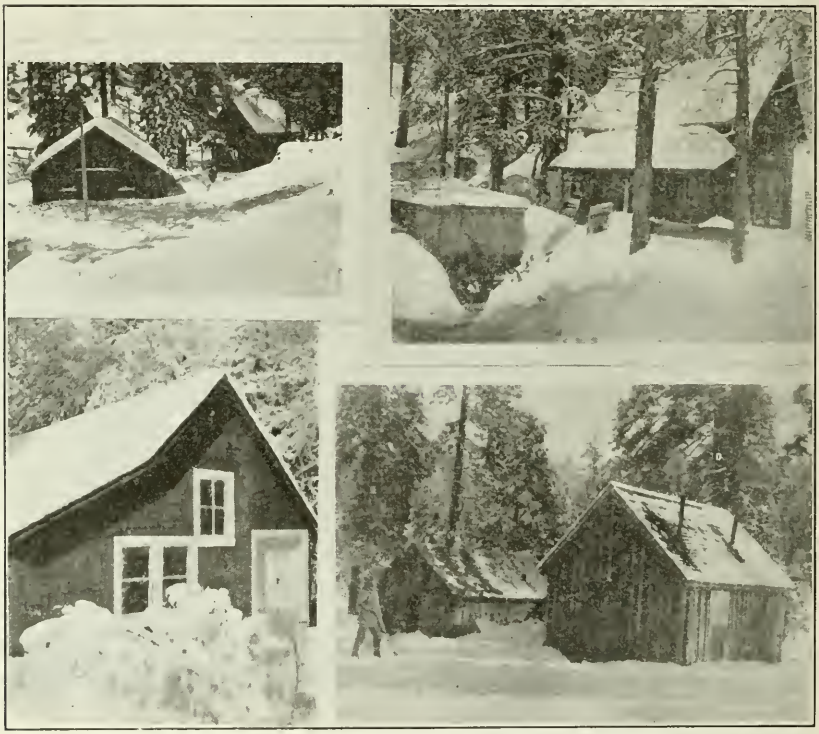


FIG. 12. State hatcheries as they appear when spawning operations begin. In some instances employees are able to reach the egg-collecting stations by means of pack trains, but in other instances they must cover a considerable distance on snowshoes. a, b. Views of North Creek Station, San Bernardino County, March 25, 1920. Photographs by L. Phillips. c. Wawona Hatchery, Mariposa County, April 15, 1920. Photograph by M. K. Spaulding. d. Cabins at Almanor Hatchery, Plumas County, April, 1919. Photograph by S. Campbell.

1915, when the Fish and Game Commission first began the work of collecting eggs from Bear Lake.

Bear Lake is situated at an elevation of 6700 feet above sea level and the weather during March and April in this altitude is severe in any locality, particularly so in the Bear Lake region. The winds sweep unbroken over the deserts until the air currents strike the San Bernardino Mountains, when they drive with relentless fury down on the lake

and through the open timber near the lake shore where our men are camped. Snow storms and squalls follow each other in rapid succession, during the early spring. Our men endure hardships that very few appreciate, unless they have spent the spring months in a tent on the shores of Bear Lake. During 1919 plans were made to build suitable quarters for the help at North Creek Egg-collecting Station, a cabin a new trap on Metcalf Creek, and a cabin and trap on Grout Creek. A new trap was built in North Creek and the egg collecting station and hatchery was repaired and improved.

The principal streams entering Bear Lake, North Creek, Metcalf Creek, Butler Creek and Grout Creek were filled with sand from the high water mark on the lake shore to the waters edge, averaging in length from one-fourth to one-half mile. The creeks are all short, but carry a large amount of granitic sand caused by the disintegrated granite formation through which these streams flow. These creeks had been filling up for several years, until in the spring of 1919 it was almost impossible for the breeding trout to enter them, as the water was spread over such a wide area of sand deposits that the fish could not find water of sufficient depth for them to swim in. We planned to open these channels so that the fish could enter the streams and reach our traps. Teams and scrapers were hired and the channels excavated through the sand deposits so that the water would have sufficient depth at the mouth of the creeks. The spawning area above the traps is so small that it does not justify allowing any of the fish to spawn naturally. The streams nearly all dry up before the eggs are hatched, even if they are allowed to ascend the streams and deposit their eggs. The majority of the eggs deposited by the breeders below the traps do not hatch, as they are covered over with the sand that packs so tight over the eggs that they are smothered. Consequently, the stock of fish in Bear Lake must be kept up by artificial propagation almost entirely.

Years ago when the lake was first stocked the sand deposits were not so great, as the flood waters scoured the streams out each season, but during the last five or six years the sand has accumulated to such an extent that the creeks must be kept open by removing the sand every two or three years so that the fish can reach the traps.

Bear Lake has an abundance of natural feed for the trout. Besides the minnows, there are a great many varieties of aquatic insects that abound in the lake in great numbers. During the last three seasons of drought, these insects have increased, so that it is safe to say that there is not another body of water of equal size anywhere that has the same amount of natural food for trout.

The excessive fishing during the last five years on Bear Lake has no doubt considerably reduced the number of fish in the lake, although good fishing can be had when conditions are right. But owing to the

great numbers of persons who fish in Bear Lake and the easy manner in which the trout are taken when conditions are favorable, indicates in our judgment the necessity for a longer closed season. We do not believe any lake of the size of Bear Lake can stand the drain on its fish supply for years, without there being a marked decrease in numbers of adult fish. Bear Lake can easily be kept stocked by artificial propagation, but there is a limit to the area in which fish can thrive in Bear Lake during periods of low water, and as a precautionary measure we would recommend that the people who have the greatest interest in Bear Lake assist us in asking the Legislature for a longer closed season.

YOSEMITE EXPERIMENTAL STATION.

With the intention of keeping the streams of the Yosemite Valley adequately stocked with trout fry, the Commission, during the fall of 1917, made a survey of conditions obtaining in the Valley with reference to the establishment of a hatchery. A suitable site was obtained for a fine hatchery near Happy Isles and application was made to the Department of the Interior for a lease to the property required for our operations. We were given every assurance by the Yosemite Park officials that the Department would give us a suitable lease, and pending the outcome of negotiations for the same, we took advantage of a temporary permit granted us to establish an experimental hatchery on the site, in order that it might be definitely determined as to the practicability of the location for the propagation of trout. Arrangements were made with the State Department of Engineering for the preparation of suitable plans for the permanent hatchery.

The experimental station was established during the fall and winter of 1918 and was opened up for operations in the spring of 1919. Four hundred thousand rainbow, black-spotted and steelhead trout eggs were shipped to the station and the resulting fry were reared and planted in the streams and lakes of the Yosemite Valley with the cooperation of the Park officials. The fry were held in the hatchery until the middle of October and it was thoroughly demonstrated that the location was in every manner suitable for fishcultural purposes. The fry produced were vigorous and healthy and attained an unusual size in the few months that they were reared in the hatchery. Owing to improvements and repairs being made at the other stations, the work on the Yosemite Hatchery was deferred until such time as conditions were more favorable.

WAWONA HATCHERY.

The Wawona Hatchery was operated during the last two years in the building constructed in 1918, on the site of the old hatchery. All of the old equipment was installed in the new building, as at that time,

it was not possible to put in new equipment. Five hundred and fifty thousand trout fry were reared at the station during the two years, and were distributed in the streams of the Yosemite Valley and the region near the Wawona Hatchery.

All of the equipment removed from the Yosemite Experimental Station was taken to the Wawona Hatchery, where it was substituted for the old equipment, which had been in use for many years. With the new equipment from Yosemite Station, Wawona is much better equipped for taking care of the fishery requirements of that section. When it is possible to do so, it is planned to enlarge and properly equip this hatchery so that a larger number of fry can be reared for that section.

On account of the limited number of trout eggs taken this season, it was possible to ship only 300,000 rainbow trout eggs to Wawona Hatchery but this number are being held in the hatchery longer than usual and reared to a much larger size. This has been made possible by the better equipment.

KAWEAH HATCHERY.

Early in the spring of 1919, it was decided by the Commission, that to adequately stock the streams of Fresno, Tulare and a portion of Kern County, a hatchery should be located in the most favorable situation in that district. Accordingly, the proper investigations were made and the site located on the Kaweah River, near the town of Hammond, in Tulare County chosen as the most favorable for the purpose.

The site is located on the property of the Mount Whitney Light and Power Company, on the main highway to the General Grant and Sequoia National Parks, and has a water supply which is most excellent for hatchery purposes. It is the central distributing point for stocking the streams in that entire section. The location being all that could be asked for, an experimental station was established to determine the suitability of the water supply for fishcultural purposes. Three hundred thousand rainbow, 50,000 black-spotted and 100,000 steelhead trout eggs were shipped to the station during the latter part of May. The resulting fry were reared to an advanced stage and were given a wide distribution in the streams of the Sequoia and General Grant National Parks, and the entire Kaweah River system during the months of August and September. The fry were strong and vigorous and at the time they were planted, had attained an unusual size. It was demonstrated by the season's operations that the site selected is entirely satisfactory for the establishment of a permanent hatchery.

Negotiations were entered into with the Mount Whitney Light and Power Company, the owners of the site, for a lease extending over a

period of thirty years to cover the land necessary for the establishment of a permanent hatchery, together with a right to an adequate supply of water. Considerable difficulty in obtaining a lease which would satisfactorily safeguard the interests of the Commission was experienced and the matter dragged along until so late in the spring of 1920 that there was not time to sufficiently complete a permanent building in order to operate this season. The matter was therefore held in abeyance and operations for this season were carried on in the temporary quarters.

This hatchery received 300,000 rainbow eggs and the resulting fry will be distributed in the waters of that section as soon as they have attained the proper size. As soon as possible after the fry have been distributed, construction of the permanent hatchery will commence.

FISHWAYS AND SCREENS.

Fishways.

The work of our fishway inspection service, has been retarded somewhat by the prevailing drought of the last few years, but in spite of this and other obstacles, remarkable progress has been made. As a result of several improvements on the types of fishways made by our surveyor, all the fishways installed under the plans made and approved by this Department have proved more efficient and practicable. Some of the old fishways installed several years ago have been improved now, so that the fish have no trouble in passing them.

The fishway over the Folsom Dam that has been a source of trouble for many years, because it was not built according to the plan designed, has been remodeled, and is now in good order. The steelhead trout that ascended the American River this spring had no trouble in passing this dam. Several other important fishways have been improved during the last two years in addition to surveys for eighty-two fishways located as follows:

Date 1918	Name of dam	Stream	County
Jan. 3	Samoza	Rector Creek	Sonoma
Jan. 9	State Asylum, Napa	Rector Creek	Napa
Jan. 18	Merced Falls	Merced River	Merced
Jan. 19	Crocker Hoffman	Merced River	Merced
Jan. 22	Crescent Weir	Kings River	Kings
Jan. 23	Peoples Weir	Kings River	Kings
Feb. 1	Lucerne Water Company	Shasta River	Siskiyou
Feb. 3	Wm. Rupert	Bear Creek	Shasta
Feb. 3	Sheridan	Bear Creek	Shasta
Feb. 14	Kittridge	Merced River	Mariposa
Feb. 27	Playter Dam	San Lorenzo River	Santa Cruz
Feb. 27	Riverdale Dam	San Lorenzo River	Santa Cruz
Feb. 27	Wildwood No. 2	San Lorenzo River	Santa Cruz
Feb. 27	San Jose Water Company	Los Gatos Creek	Santa Clara
Feb. 27	San Jose Water Company	Cavanaugh	Santa Clara
Mar. 5	Gilroy Water Company	Uvas Creek	Santa Clara
Mar. 5	Matteis Dam	Uvas Creek	Santa Clara
Mar. 5	Sepeda Dam	Uvas Creek	Santa Clara

Date 1918	Name of dam	Stream	County
Apr. 17	High School Dam	San Luis Creek	San Luis Obispo
Apr. 17	Jackson Dam	San Luis Creek	San Luis Obispo
Apr. 17	City Dam	San Luis Creek	San Luis Obispo
Apr. 17	Banning Dam	San Luis Creek	San Luis Obispo
Apr. 18	P. Tognazini	Cayucos Creek	San Luis Obispo
Apr. 18	Ida Tognazini	Cayucos Creek	San Luis Obispo
Apr. 18	J. Gnesa	Olds Creek	San Luis Obispo
Apr. 18	A. Storni	Olds Creek	San Luis Obispo
May 2	Murphy Dam (Sloat)	Long Valley Creek	Plumas
May 6	Western Power Company Dam	Estray Creek	Plumas
June 17	Celio Dam	Little Truckee	El Dorado
June 17	Kent Dam	Wards Creek	Placer
June 18	Hobart Dam	Independence	Nevada
June 18	Truckee Light and Power Dam	Truckee River	Nevada
June 18	Pacific Fruit Express Dam	Donner Creek	Nevada
June 18	H. G. May	Cold Stream	Placer
July 13	Sutter Butte Dam	Feather River	Butte
July 28	Barker Dam	Kidder Creek	Siskiyou
July 28	Wright Dam	Kidder Creek	Siskiyou
July 30	Mallow Dam	Moffit Creek	Siskiyou
July 31	Grouse Creek	Scott River	Siskiyou
Aug. 10	Goodwin Dam	Stanislaus River	Calaveras
Aug. 11	Melones Dam	Stanislaus River	Calaveras
Aug. 17	F. W. Hickox Dam	Uvas Creek	Santa Clara
Aug. 17	Giles Bradley	Uvas Creek	Santa Clara
Aug. 17	Upper Gilroy Water Company	Uvas Creek	Santa Clara
Aug. 17	Lower Gilroy Water Company	Uvas Creek	Santa Clara
1919			
Feb. 25	Pastorris Dam	San Anselmo	Marin
Feb. 26	Saint Helena Water Company	Rock Creek	Napa
Mar. 6	Government Dam	Merced River	Mariposa
Mar. 12	Krobitsch Dam	San Gregorio	San Mateo
Mar. 17	Filmore Irrigation Dam	Sespe River	Ventura
Apr. 2	Mendota Weir	San Joaquin River	Fresno
Apr. 8	Wm. Watt Dam	Millican Creek	Napa
Apr. 10	Intake Dam	Feather River	Butte
Apr. 25	Neck Dam	Hayward Creek	Amador
Apr. 28	Walters Dam	Chorro Creek	San Luis Obispo
Apr. 28	Biaggimi Dam	Cayucos Creek	San Luis Obispo
Apr. 29	J. Quintana Dam	San Suitro Creek	San Luis Obispo
Apr. 29	Griggs Dam	Sea Canyon Creek	San Luis Obispo
May 4	Ganby Dam	Cachagua Creek	San Luis Obispo
May 16	Pudding Creek Dam	Pudding Creek	Mendocino
May 17	Lower Greenwood Dam	Greenwood Creek	Mendocino
May 17	Upper Greenwood Dam	Greenwood Creek	Mendocino
May 25	Golden Dam	Salmon River	Siskiyou
May 26	Bonally Dam	Salmon River	Siskiyou
May 28	Beaudry Dam	Scott River	Siskiyou
May 31	Redding Dam	Sacramento River	Shasta
Aug. 2	Bablieu Mines Dam	Rush Creek	Trinity
Aug. 9	Little River Dam	Little River	Humboldt
Sept. 29	Western Canal Dam	Butte Creek	Butte
Sept. 29	State Land Settlement	Butte Creek	Butte
Oct. 4	Rowardeman Dam	San Lorenzo	Santa Cruz
Oct. 4	Knowles Dam	Love Creek	Santa Cruz
Oct. 4	Southern Lumber Company	San Lorenzo	Santa Cruz
Oct. 6	Loma Prieta Dam	Aptos Creek	Santa Cruz
Nov. 18	Kern River Dam	Kern River	Kern
Dec. 28	Hazel Creek	Hazel Creek	Shasta
Jan. 15	Stinson Weir	By pass	Fresno
Jan. 27	Folsom Dam	American River	El Dorado
Jan. 29	Truckee River	Truckee River	Nevada
May 12	Red River Lumber Company	Hamilton Branch	Lassen
July 6	Gray Eagle Dam	Gray Eagle Creek	Plumas
July 7	Slaot Dam	Long Valley Creek	Plumas

The work of maintaining effieient fishways over dams becomes more important each season, as the number of dams being built by the hydro-electrie plants and irrigationists are increasing very rapidly. Every

time that a dam is constructed, the natural movements of the fish are obstructed and the fish in that stream are affected by it.

The fish in the great majority of our streams ascend the streams during the spawning season to reach their natural and most favorable breeding places. They also move from one part of the stream to another in search of food, as well as to adapt themselves to temperature conditions. The fish descend to the lower reaches of the large rivers that drain the Sacramento, San Joaquin, Kings, Kern, Kaweah, Tule, Klamath, Eel and other river basins during the fall and winter, when the water is cool, and ascend these streams when the temperature of the water rises in early summer. If their movements are obstructed by dams, the natural propagation is seriously interfered with as well as their movements to the upper reaches of the streams when the temperature rises. It is essential that proper fishways be constructed to allow of the free passageway of the fish as the law provides. The amount of water necessary to allow fish to ascend the fishways and pass above the dams is very small compared with the normal flow of any stream. Spring and fall, the period of the year when the fish are moving, is the period of the maximum flow in the majority of the streams, and there is always sufficient water for the fishways, as well as for the power plants and irrigationists.

There is a tendency on the part of some of the water-users to take all the water from the streams regardless of the fish life that is destroyed. While we realize the importance of the water to generate electricity and for irrigation purposes, there is always enough in our streams to allow the migratory fishes to ascend the streams above the dams at the time they are naturally inclined to do so. In a great many instances where large dams are constructed, and lakes formed, the fishing area is increased instead of diminished, if the owners of the dams will allow the public the right to fish in the waters stored behind their dams. The provision in Section 637, relative to the "right to fish" in any of the waters impounded by dams should be rigidly enforced as the owners of the dams deprive the public of valuable waters by the construction of dams, even if enough water is allowed to pass the dam, to maintain fish life.

The flows of the streams are generally reduced to such an extent below the dams that the value of the stream for angling purposes is greatly reduced, particularly during the period of the minimum flow in the late summer and fall. Therefore, the owners of dams should be compelled to allow the public to fish in all waters held in storage or where it is dammed up for any purpose, as the right of the public to fish in the waters of the state should not be denied. It is one of the greatest sources of recreation known and is growing more popular with all classes every season.

Screens.

During the last two seasons it has been very difficult to install screens, owing to the drought that has prevailed all over the state for the past three years, but in spite of the difficulties, we have managed to have some important screens installed as well as to have others, which were installed several years ago, maintained in good order.

The large pumping plants that take their water supply from the Sacramento River for the rice fields have been examined from time to time and it has been found that the screens that have been installed are very effective. Our screen inspector has made regular trips, examining and reporting on the condition of all the pumping plants, ditches, and canals in the different sections of the state. A large portion of his time has been given to the district north of Sacramento, as this is the most important field. Several types of screen are used, depending on the location and general conditions.

The majority of the owners of pumping plants and canals have met our requests to screen their intakes without opposition. A few have been lax in their cooperation with this Department, but we are pleased to state that they are in the minority.

Surveys and legal notices to install screens for the biennial period ending July 1, 1920, in the different counties, numbered 171. They were made as follows:

Alpine	11
Butte	7
Calaveras	4
Colusa	2
El Dorado	6
Glenn	5
Inyo	27
Kern	1
Lake	1
Lassen	1
Mono	28
Placer	1
Riverside	4
Sacramento	6
Sierra	2
San Bernardino	1
Shasta	3
Siskiyou	41
Stanislaus	5
Sutter	1
Tehama	4
Trinity	2
Tuolumne	5
Yolo	4
	171

The follow up work by the Legal Department has been very satisfactory. Very few hearings were held as most of the owners of ditches and canals realize the importance of conserving the fish and as a rule do not resist efforts to have efficient screens installed.

There is one part of the present law regarding screens and fishways that we would respectfully recommend the Legislature to repeal, and

that is that part of Section 629 and 637 relating to hearings. We would suggest that whenever there is a difference of opinion between this Department and the owners of a ditch, pumping plant, canal or dam, regarding the advisability of installing either a fishway or a screen, that the case be taken directly to the Superior Court, which is the proper tribunal to determine whether the ditch, canal or intake should be screened, or a fishway constructed.

In our judgment the hearings held by our Commission under the present law are not satisfactory. Before ordering anyone to install a screen or fishway, we make an investigation and satisfy ourselves of the necessity of the expense. Therefore, we deem it a waste of time and money to hold hearings before one of our employees to satisfy the demand of some one for a hearing. If any of the owners of ditches, canals or dams are not satisfied or question the necessity of installing a screen or fishway on their particular property, they have their redress in the courts, where all such cases will eventually end, if the persons on whom legal notices have been served resist the orders to install screens and fishways.

There never was a time in the history of our state when legislation to conserve our fish by the installation of proper screens and fishways is needed more than at the present time, owing to the great amount of water that is being diverted for agricultural and industrial purposes. The fish can be saved without material injury or damage to the hydro-electric plants and the irrigationists if proper and stringent laws are passed and enforced, as all plans for fishways and screens are practicable and efficient.

In some instances we have found the district attorneys were not in favor of prosecution for violations of these laws, but it was generally found to be a matter of politics more than any just reason for not standing by the rights of the people.

The fish of the inland waters, both food and game species, are one of our most valuable assets and everyone concerned in the progress of our state should assist in protecting and conserving them.

PLANTING FOOD FOR TROUT.

In some of the lakes of the southern High Sierra and in the Tahoe Basin, attempts to introduce aquatic insects where the waters were barren of certain species have been made. The large Corydalis, or salmon fly, has been introduced into several streams running into Lake Tahoe, during the last two seasons and our foreman reports that they are thriving. In the lakes of the southern High Sierra where all kinds of insect food is secured aquatic plants and the scuds or gammarus have been planted. We have not received any reports regarding the success

of this work as yet. It may be that the aquatic plants will need to be well established before the success of this work is assured.

It is the plan of this department to take up this work systematically during the next season and stock with insects and aquatic plants certain lakes that need an added stock of natural food. Examinations will be made to determine the larvæ of the different species that abound in the lakes that seem to require an added amount of natural food and new species will be introduced wherever the conditions justify the expense. This is an important work and should be carried on systematically each season so that the best results may be attained.

COOPERATION WITH THE WATER COMMISSION.

We respectfully recommend that an act be passed by the coming session of the Legislature that will arrange for the coordination and cooperation of the Water Commission with the Fish and Game Commission in regard to appropriated waters. It should be understood and agreed that the fish in certain streams of the state be allowed water enough to survive during the minimum flow of late summer and fall.

The State Water Commission should be authorized to force all applicants for water appropriations to comply with the law regarding fishways before accepting any plans for diversion of the water. The applicant for water rights should have the plan of the fishway made and approved by the Fish and Game Commission strictly in conformity with the law before granting applicants the right to appropriate water from any river or stream.

The rights of the people should be safe-guarded as far as possible when not detrimental to greater interests. No stream should be entirely diverted without some effort being made to protect the rights of the people. There are cases now where the entire flow of water has been taken without any consideration for the fish life in the stream. The valuable food and game fishes of California should be protected as well as all other interests and it can be done without injury to the hydro-electric plants or the irrigationists, if the Water Commission and the Fish and Game Commission cooperate in the plans of allowing sufficient water to pass the dams on the larger streams during the period of minimum flow as well as to see that plans for efficient fishways are made by the Fish and Game Commission before the appropriations are granted.

A great many other recommendations will be made during the session of the Legislature regarding changes in the trout and salmon seasons, and means of strengthening by amending some of our present laws regarding other subjects.

Respectfully submitted.

(Signed) W. H. Shebley,
In Charge, Department of Fisheulture.

REPORT OF DEPARTMENT OF COMMERCIAL FISHERIES.

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

SIRS: The growth of California's fisheries in the past few years has been rapid and spectacular. So very recent has been this growth that few in this state realize that we have gained first place in the list of states both in the quantity and value of our fishery products. In 1919 California produced over 250,000,000 pounds of fish and about 8,000,000 pounds of shell fish. These fish had a wholesale value as fresh fish and manufactured products of over $25,000,000.

If this great industry is to be fostered and the exhaustion of any of the varieties of fish upon which it depends guarded against, and if at the same time the fishery resources of the state are to be adequately utilized and the industry expanded along proper lines, it is necessary to carry on a great deal of investigation work and to get intelligent legislation and to see that the conservation laws are enforced. The state, which has sole jurisdiction over its fisheries and is alone responsible for their protection, has charged the Fish and Game Commission with this conservation work. As the state laws defining the duty of the Fish and Game Commission in regard to fisheries investigation work were not very definite, the Legislature of 1919 passed the following law:

> It shall be the duty of the Fish and Game Commission to gather data of the commercial fisheries and to prepare the data so as to show the real abundance of the most important commercial fishes; to make such investigations of the biology of the various species of fish as will guide in the collection and preparation of the statistical information necessary to determine evidence of overfishing; to make such investigations as will bring to light as soon as possible those evidences of overfishing as are shown by changes in the age groups of any variety of fish; to determine what measures may be advisable to conserve any fishery, or to enlarge and assist any fishery where that may be done without danger to the supply.

This, together with laws which provide the means for gathering complete and accurate statistics of the fisheries, as well as laws which provide a revenue from the fisheries, puts the fisheries conservation work of the state on a firm and definite foundation, and assures the continuation of investigation work which owes most of its value to the fact that it is continuous.

To the Department of Commercial Fisheries falls the duty of carrying out the commercial fisheries work of the Commission.

STATISTICS OF THE FISHERIES.

In the appendix to this report will be found statistical tables gathered and compiled by this department which show in detail the magnitude of California's fisheries. Complete recent statistics of most of the other states are lacking but we believe none will contest California's claim to

first place in both quantity of catch and value of its fishery products. Only six years ago she held a place of insignificance among the states in value of her fisheries.

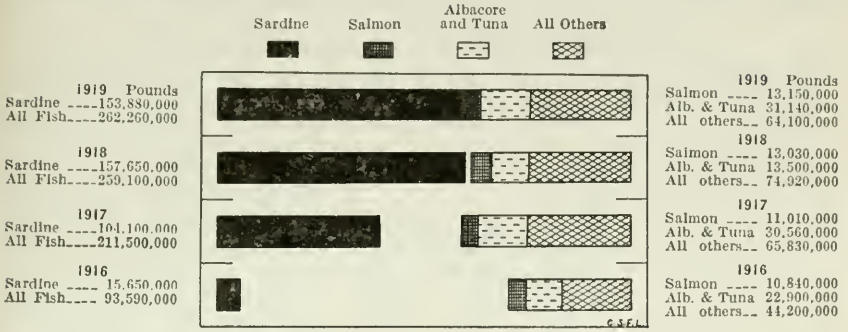


FIG. 13. The growth of the sardine fishery. Quantities landed as compared to those for other species.

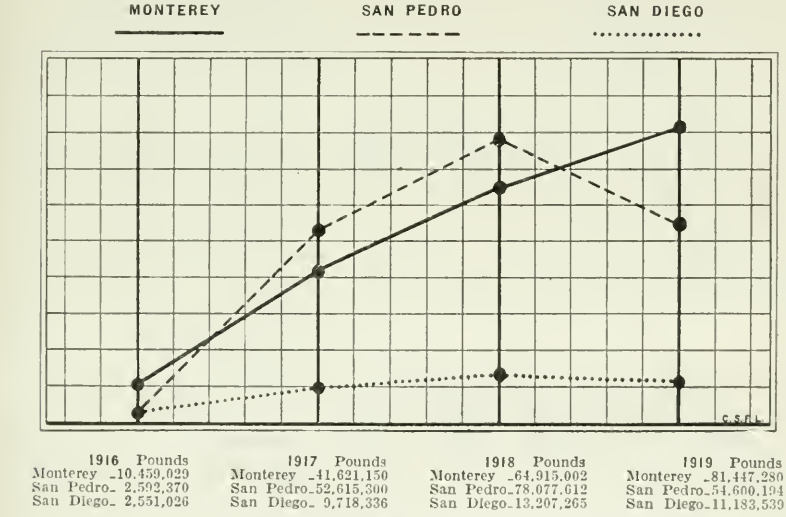


FIG. 14. Sardines landed at Monterey, San Pedro and San Diego.

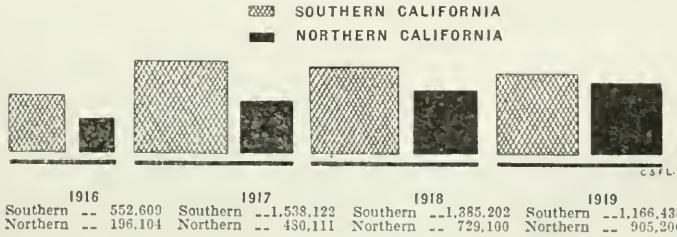
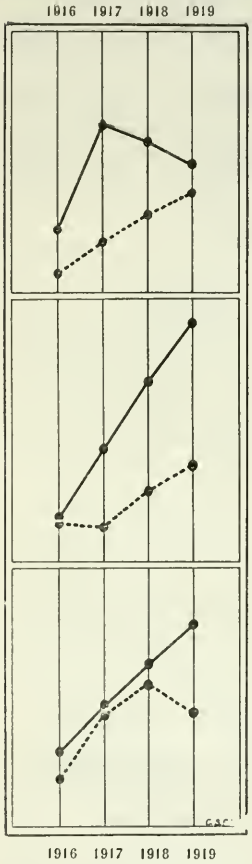


FIG. 15. Comparison of cases of fish of all kinds packed in northern and southern California.

The greatest growth has taken place in the tuna and sardine fisheries. The accompanying graphic charts show the growth of the principal fisheries during the years from 1916 to 1919, inclusive.

SYSTEM FOR GATHERING FISHERIES STATISTICS.

As statistics must be the basis of all earnest fisheries conservation work, this department early in its history began gathering data of the catch. Laws were passed requiring fish dealers and packers to submit monthly reports of the fish catch by varieties. Later it was realized that to be of the greatest service to the fisheries investigator such data must be made more complete and accurate than is possible by that method. Therefore, a system was inaugurated which has worked out in an entirely satisfactory manner. At first the data under this system was furnished voluntarily by the industry, but in order to make it permanent a law was enacted by the State Legislature in 1919, which makes the giving of the data compulsory. Every effort is being exerted to make this data as accurate as possible, realizing that accuracy is the main requisite of the investigator. Such data increases greatly in value with the passing years. As this system of gathering the data of the catch is unique and superior to that employed by any government or state fisheries board, we quote the law governing it:



ALL FISH CANNED IN CALIFORNIA BY CASES

	Northern	Southern
1916--	196,104	522,609
1917--	480,111	1,538,122
1918--	729,100	1,385,202
1919--	905,206	1,166,435

VALUE OF FISH PACKING PLANTS

	Northern	Southern
1916--	$860,590	$948,702
1917--	786,197	2,573,453
1918--	1,569,330	4,089,660
1919--	2,272,514	5,436,357

NUMBER OF EMPLOYEES IN FISH PACKING PLANTS

	Northern	Southern
1916--	1,573	2,289
1917--	3,090	3,261
1918--	3,829	4,210
1919--	3,123	5,119

FIG. 16. Comparison of number of cases canned, value of packing plants and number of employees.

Sec. 2. Every person, firm or corporation engaged in the business of buying, canning, curing or preserving fish, or manufacturing fish meal, fish oil or fish fertilizer, or dealing in fish, mollusks or crustaceans, shall make a legible record in the form of a receipt, said record to be in triplicate carbon copies and on forms to be furnished by the Fish and Game Commission, which shall show the name of the fisherman and boat or the dealer from which the fish, mollusks or crustaceans were received, together with the date received, the weight of the fish, mollusks or crustaceans by species, the price received by the fishermen and the name of the person receiving same.

It shall be stated in the record for what use the fish are intended, whether to be sold fresh or whether they are to be canned, cured, made into fish meal or fertilizer, or any other disposition to be made of them, or if a commercial distinction is made

between different sizes or qualities of any species or variety, it must be so stated on said record or receipt, and the record shall also state if the fish were taken in foreign waters, or in the high seas off another state or foreign country. The names used in the record for designating the variety or species of fish handled must be the name which is in common usage, and the Fish and Game Commission shall have the power to decide what is the common usage name of any variety.

The original copy of this record shall be delivered to the fisherman at the time of the purchase or receipt of the fish, the duplicate copy shall be kept by the dealer or person receiving the fish and the triplicate copy shall be delivered to the Fish and Game Commission or any duly authorized assistant thereof.

Where a fish dealer, canner or preserver catches his own fish, he shall fill out the above record as required when he purchases the fish from fisherman or dealer, or if it so desires the Fish and Game Commission may furnish a separate form for such cases. It shall be the duty of the Fish and Game Commission to preserve all such records of the fisheries as are obtained by it in places adequately safeguarded from fire or other destructive agencies and such records are to be kept in such manner as to render them accessible for reference or research, the intention being to guard against the destruction or such neglect of the records as will detract from their future value.

This system is now in use all over the state and from the records gathered can be obtained the daily catch of any variety of fish by any boat, which, it will be realized, is of the greatest value in keeping track of the trend of any fishery and in detecting any evidences of depletion. Supplementing this data must be a record of the boats and the fishing gear used, therefore a section of the same law requires that every boat fishing in the state or out of any port in the state, must file with the Fish and Game Commission a statement giving the dimensions of the boat, the motive power, number in crew, equipment and description of fishing gear.

A section of the law also provides that large fishing vessels, such as otter or beam trawls or those operating paranzella nets can be required to keep a record of their trips, number and place of hauls and quantities of each variety of fish caught in each.

Fisheries data is being gathered and tabulated under these laws and published in the Commission's quarterly magazine California Fish and Game. The permanent records in the form of the triplicate receipts of the catch and the boat registration cards are being filed in such manner that they may be of the greatest good to the fisheries investigator when they may be needed. The need of a building for the filing of these records where they will be safeguarded from destruction by fire or other causes as required by the law, as well as to provide a proper place for investigators to work, is taken up elsewhere under the title, "A State Fisheries Laboratory."

During the principal fishing seasons the data of the catch of some of the fisheries have been gathered and tabulated daily for the accommodation of the fish packers. During the present year the catch of the more important canning varieties have been tabulated four times a month for the use of canners of the San Diego, San Pedro and Monterey districts.

To gather the statistics of the catch, to register the boats and fishing gear and to do the necessary tabulating, has necessitated putting on an extra assistant in the branch offices of the Department of Commercial Fisheries in San Diego, San Pedro and Monterey, as well as an extra statistical assistant in the San Francisco office. It is difficult to estimate the cost of this system of gathering the records of the catch as each statistical assistant has other duties to perform which have little to do with statistics and as assistants in other lines give some help in gathering the records. But, as we have had several inquiries as to the cost of the system, we have estimated it as near as we can. The books of receipts which are furnished the dealers and packers are costing us approximately $485 a year. It will be fair to charge to the system the services of one assistant at the four fishing centers, San Diego, San Pedro, Monterey and San Francisco, which with traveling expenses will amount to approximately $650 a month. Any state adopting the system would require one assistant at each fishing center. Each should have a suitable place to work upon the tabulations and should be provided with adding machines. This covers only the cost of gathering the records and roughly tabulating them. To work out the boat catches for conservation purposes is work for the investigator. A proper place should be provided for storing the triplicate receipts in such a manner that they may be readily accessible for future study and where they will be safe from destruction or damage. On account of the large number of small boats fishing, California uses more triplicate receipt books than would be used where larger catches per boat are made.

INVESTIGATION.

Our statistical program is only a part of the work. While it is the basis upon which much of the work of the investigator must rest, it must be supplemented by a study of the biology of the species upon which our principal fisheries depend. The investigations are not being conducted merely through a scientific interest in the species dealt with; they are conducted for the primary purpose of conservation and the intelligent expansion of the fisheries. The investigations are all based on the needs of the fisheries and in all there is a well defined program which has been arrived at through the experiences of fisheries investigators of this and other countries. The object and method of the investigation work has been stated very fully in the Fish and Game Commission's Fish Bulletin No. 2 by W. F. Thompson, entitled "The Scientific Investigation of Marine Fisheries, as Related to the Work of the Fish and Game Commission in Southern California." We will not discuss here the needs of scientific investigations or the methods of the work as they are given full treatment in this Bulletin.

Albacore Investigations.

The investigation work on the albacore or longfinned tuna has progressed under Mr. W. F. Thompson and his assistants until now very definite results have been obtained and are being prepared for publication.

Very complete data have been gathered from the very beginning of the albacore industry and this wealth of material, more extensive we believe than that ever gathered from any one fishery, is in its final analysis disclosing facts of great value to the fishery. As long ago as 1915, a paper was read before the Western Division of the American Association for the Advancement of Science, at San Diego, by one of the leading tuna packers, in which paper this packer stated that it was feared the albacore even then might be undergoing depletion on account of too intensive fishing. The demand for canned tuna was so great that the canneries were being enlarged at a reckless rate, the number of albacore fishing boats was being rapidly increased mainly on capital furnished by the canners. There was a growing belief that the schools of albacore were not so extensive as a few years before and there was a tendency to increase the price to the fishermen for the fish. The paper voiced the sentiment of the packers at the time in a plea for a scientific investigation of the albacore fishery for the purpose of determining its limitations and to give the packers some idea of the permanency of the industry and as to whether the expansion had reached the limit to which it could be safely extended, or if it had already passed that limit. These were practical and extremely important questions being asked of the scientific investigator by an important industry, and the interest created by the discussion which followed hastened the activity of the state in its fisheries work, which until that time had not been taken up by it in a serious manner.

It takes time and accurate data extending over a period of years to determine if depletion of a fishery is taking place. The total yearly catch does not give an indication unless we also know the number of boats and the kind of fishing gear used in making the catches. This data has to be obtained. Fish are also subject to fluctuations in abundance due to natural causes and not to fishing, so it is necessary in such an investigation to get the data which will enable us, by methods known to the science of fisheries conservation, to determine if periods of scarcity are due to overfishing or to natural causes.

Extensive data has now been gathered and will continue to be gathered an analysis of which will show these very things which we wish so much to know. While the data does not extend over a sufficient number of seasons to enable us to be absolutely certain that depletion of albacore in California waters has not taken place, it is sufficiently extensive to enable us to say, with enough assurance to answer the

requirements of those in the industry, that the present fishing is not causing depletion and that the fluctuations in abundance from season to season are due to natural causes. The analysis of the relative abundance of albacore during past years, as made by this commission and published in the Pacific Fisherman Year Book 1919, showed a steady fall in the catch of the same unit of gear from year to year. Based on that evidence alone this would indicate depletion, but from other facts, mainly that the proportion of older fish caught at the latter end of the season, held up, we are led to believe that the fall in relative abundance of albacore during these years was not due to depletion but to natural causes. This conclusion is borne out by the fact that the catch for 1920 has shown a decided increase, which coupled with the reappearance of younger classes of albacore are encouraging signs.

A necessary part of such a fisheries investigation is to work out a method of determining the age and rate of growth of the fish. It is of great importance to be able to determine the relative abundance of the age classes of the fish under investigation, in order that depletion may be distinguished from natural fluctuations in abundance and to furnish information upon which to predict the abundance in the future seasons.

The work on the age and rate of growth of the albacore has progressed to where it is now ready for publication. The usual method of determining age is by means of the marks or winter checks on the scales. These marks proved to be extremely difficult to decipher by the simple method of viewing them through the microscope. A special technique was used to decipher them which entailed a great amount of painstaking labor. The method is a distinct contribution to the science of fisheries conservation for it proves by a strictly mechanical method which is entirely free from the influence of the workers personal judgment that the marks on the scales correspond absolutely with the age of the fish. The importance of this contribution will be seen when it is known that well known biologists have expressed their doubt if the marks on scales do actually show age. This is the first direct knowledge we have of the age of any of the fish belonging to the mackerel family.

The work on the age of albacore shows that it is a fast growing fish, which is encouraging, for on that account the fishery can stand heavier fishing than if it were a slow growing fish. The study of age has also thrown light on the migration of these fish. These matters are thoroughly discussed in Mr. Thompson's paper.

Much work has been done on the migrations and fluctuations in the run of albacore. A relationship between the catch and temperature, or some factor allied with temperature, has been shown. A couple of papers by Mr. Thompson have already pointed out this relationship.

But since their appearance a great deal of additional work has been done and the whole subject of migrations and fluctuation of the catch will be treated in a subsequent paper which is now being prepared for publication. It is sufficient to say that the results show that there are no sudden and long migrations made within a season as has been believed by many of the fishermen and caused them to make long trips up and down the coast in the belief the schools had made an extensive migration.

There is evidently a migration to the northward through a period of years but the migration of any one year class is comparatively limited. During the short periods when they do not take the hook they are undoubtedly near at hand, probably deep in the water, but the conditions which are allied with the temperature, are such that they do not feed at the surface and therefore do not come within the range of the hooks of the fishermen. This knowledge should prove of economic importance to the industry.

Sardine Investigation.

Although there is probably no immediate danger of depleting the supply of sardines in this state, the time to begin an investigation is while this industry is yet young and before depletion takes place. The rapid growth together with the magnitude and importance of this fishery has caused us to concentrate our efforts upon it. A considerable amount of preliminary work was done by Mr. W. F. Thompson, assisted by Mr. Elmer Higgins, Mr. A. W. Warnock and others. In this work, begun two years ago, the breeding season was observed, a series of scales and other data were collected for the study of age and rate of growth. A set of careful observations were made on the difference between sardines from San Diego, San Pedro and Monterey to determine the interdependence of the fish in the different regions. This point is of importance for it is vital to know if the sardines of each fishing center constitute a local problem or if there is an interdependence between the different regions. A report on this part of the work will soon be out. Very good supplies of very young sardines were collected during the investigations carried on by the patrol boat "Albacore," which throw much light on the spawning habits of the sardine.

About a year ago the sardine work was taken up in a thoroughgoing manner and a well defined program laid down designed to meet the needs of the fishery. This program was published in Vol. 6, No. 1, pp. 10–12 of our quarterly magazine California Fish and Game. It also follows the general plan as set forth in Fish Bulletin No. 2. The program although scientific is extremely practical and meets well the

needs of the fishery. To quote California Fish and Game, Vol. 6. No. 4:

> The program under which the work has been done contemplates (1) the discovery of depletion if it should occur, (2) the discovery of 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 migrations, and (5) 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 interdependence of the sardines in different regions. That the fore-telling of fluctuations is not necessary 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.

The most valuable results to be expected from these investigations will be the ability to detect the earliest evidence of depletion so that we can permit the industry to expand without fear of greatly overrunning the limit of safety for the future of the industry, to detect natural fluctuations in abundance from depletion and to be able to foretell the abundance of the different canning sizes in the next or subsequent years.

Clam Investigation.

Since April, 1919, F. W. Weymouth has been devoting a portion of his time to the completion of a survey of the shellfish of the California coast commenced several years previously by Will F. Thompson. A report is now in the hands of the printer (Fish Bulletin No. 4) embodying all the collected data. The primary purpose of the survey has been to put on record the number and abundance of the species of commercial importance and the location and condition of the beds at present being utilized. The scope of the report has been extended by the inclusion of descriptions and figures together with a key for ready identification of some forty species of present or possible commercial value. Heretofore no such key has been available, and it is hoped that by this publication campers and amateur clam diggers can be made acquainted with the edible bivalves of the coast. Beside the description and range of each species an account of its habits has been included. Though many collections of attractive and interesting "shells" have been made there are few observations on the varied habits of these mollusks and it is hoped that those recorded in this report may lead to more study of the remarkable ways in which the bivalves are adapted to the diverse conditions of life under which they are found.

In connection with this survey certain important points have developed. One is the need for a more detailed study of the life history of at least some of the more representative and important species. At

present, though several of the eastern species have been carefully investigated, no facts concerning the age or rate of growth of a single native Pacific species are known.

In an attempt to remedy this lack, data have been collected throughout the year on the Pismo clam, one of the most important California species, and these are now being carefully studied. The preliminary work indicates the main features of the age and as soon as it can be completed it will be put in form for publication. It appears that the growth is less rapid than has been supposed and that a considerable age is reached by the larger specimens met with.

A careful survey of the coast has forced the conclusion that few of the native species can be materially increased by artificial means, but that in certain suitable bays the "farming" of the introduced soft shell or long clam might be made very profitable. Its culture has passed the experimental state on the eastern coast and profiting by this experience many acres of otherwise barren tide flats might be made to yield as sure and valuable a crop as a wheat field. It is hoped that in the future the question of the control of suitable tide lands may be put on as secure a basis as is the management of existing oyster lands, thus making such clam farming a practical possibility.

Oyster Investigations.

During the past year Dr. Harold Heath has been employed on investigations relative to the propagation of our native California oyster. The larger Eastern oyster has never yielded to efforts to propagate it in this state for the principal reason that our waters during its spawning season are entirely too cold. It has been necessary, therefore, for the growers of Eastern oysters to keep their beds stocked by bringing out the spat or seed oysters from the Atlantic coast. After the oysters have reached the size known as "spat" they will thrive in our waters but the younger larval stage can live only within a narrow range of temperature which is above that reached by the water in any of our bays where oyster raising has been tried. Our smaller native oyster on the other hand, propagates within a comparatively wide range of temperature and breeds naturally from San Diego Bay to Alaska. It is known in the far North as the "Canadian oyster," in Washington as the "Olympia oyster" and in this state as the "California oyster."

In Washington much progress has been made in raising this Pacific Coast oyster and by means of expert advice the industry has been made quite profitable. Choice oyster bottoms on Puget Sound are valued as high as $4,000 per acre.

The only place in this state where it has been at all profitable to gather the native oyster is on Tomales Bay, Marin County. Although

these oysters are said by oyster men to be the equal of the better known Olympia oyster, no very intelligent effort has been made to increase the yield. Occasional trials have been made to obtain a better set by placing out shells or other objects as collectors to which the young may attach themselves. In these trials the collectors have mostly been put out at the wrong time or in the wrong place. In response to requests for aid, Dr. Heath was employed to conduct the present investigation. The work was mainly done on Tomales Bay for the reason that assistance and co-operation could be had from the local oyster companies. The knowledge gained, however, can be applied to any locality where the conditions for oyster growing are favorable. Although the work was in the nature of a preliminary investigation, and only a comparatively small amount of time was consumed, the work was done with the immediate needs of the industry in view and resulted in clearing up several points vital to the success of the industry. The knowledge thus gained should result in the growing of California oysters on a large commercial scale, not only on Tomales Bay but in several of the other bays of the state.

A preliminary report will soon be published giving the progress of this work so that we will give here only very briefly some of the results. It was found that in the immediate vicinity of the natural oyster beds remarkable "sets" can be obtained on oyster shell collectors if these collectors are put out at the right time. Collectors placed in the water too soon accumulate a coat of slime and sediment which permits only a very few of the embryo oysters to become attached. It is necessary, therefore, to put out experimental collectors at intervals or to observe the relative abundance of free swimming oyster larvae, in order to determine the proper time for putting out the collectors. This work must be done by an experienced person for it is necessary by means of the microscope to distinguish the oyster larvae from the larvae of clams and other mollusks. If this information is supplied each spatting season, it will be possible for the industry to expand greatly. It is now quite certain that the young oysters can be collected on oyster shells or other collectors and later transplanted to prepared beds in places where no oysters grow naturally, just as has been done in Puget Sound. In this way large areas which are now unproductive can be made to maintain beds of oysters.

Work was carried on to determine the distribution of the free swimming larvae in relation to water salinity, temperature and currents. The rate of growth and character of food supply were also subjects of study. Experiments were made in transplanting both young and adults to different parts of the bay to determine how much of a change in salinity or temperature they can withstand.

A STATE FISHERIES LABORATORY.

As stated toward the beginning of this report, the fisheries conservation work of any state or government, to be adequate must be based upon detailed and accurate data of the catch. These data gain in value as the years progress and in order that they may be properly preserved and kept available for the investigators, they should be kept in a permanent depository where they will be safe from fire or other destructive agencies. This depository should be in the building where the fisheries work is being carried on. It is also necessary that the investigators have suitable quarters in which to carry on the work upon the biology of the species upon which the principal fisheries depend.

Within these quarters there should be space for a working library dealing with fisheries subjects. Space should also be provided for the collection of specimens and biological material. Storage room is needed for nets and other apparatus used in connection with the investigations and finally it is very desirable that space be had to exhibit to those interested the extent and methods of the fisheries and more especially to show in graphic form the progress and achievements of the investigation work.

So far we have rented quarters wherever we could find them and this has proven to be very unsatisfactory. In fact, it has been impossible to rent anything that even approaches our needs in the locality where such a laboratory should be located. The laboratory quarters have had to be moved frequently and the workers are now scattered so that it is difficult to systematize or to supervise the work.

In order that the records of the fisheries may be safe from destruction by fire we have had to store them where they can be referred to only with great difficulty. There has been no room for the library which is being accumulated nor is there space for the collections.

To meet this need for adequate and permanent quarters plans have been made to build a state fisheries laboratory. We have secured from the City of Los Angeles free of charge, a long term permit to occupy a site at Fish Harbor, San Pedro, situated at the intersection of Seaside avenue and Tuna street. This location is central to the canneries, markets and docks of the most important fisheries center in the state. Tentative plans for a fire proof building have been approved and placed in the hands of the State Architect for the final draft and specifications. The estimated cost of the building is $20,000. We quote in the following from a statement of the aims of this institution by W. F. Thompson and published in California Fish and Game for October, 1920:

"It will be well to state now as clearly as possible those ideals to which the Commission is planning to dedicate a unique institution. Such a statement may save misunderstanding and opposition, and should give to those interested an appreciation of the underlying purposes such as will enable them to comprehend the reasons for the choice of site and for the plans adopted. The site was chosen because of its

proximity to the canneries and the fish wharves, making it possible to follow easily the progress of the fishery. The plans adopted are intended to give good working room for a statistical and biological study of the fisheries for the purpose of conservation and adequate utilization and at the same time to allow an exhibit to those interested in the purposes of the work and its relation to the fisheries.

That the primary purposes of the investigations of the California Fish and Game Commission are conservation and adequate utilization has been stated many times. But such purposes have been repeatedly avowed by investigators, whose programs when adopted have betrayed a primary interest in general natural history, and have shown little relationship to the problems to be solved. The scientific program of the Commission has, however, been planned very specifically to meet the problems which are involved in governmental control of the fisheries, and are adapted to meet the responsibilities of the state as legal guardian of those natural resources. The machinery for the execution of this program is, in fact, already operating in part, and its purposes are stated very clearly in the laws of the state as duties of the Commission.

The law then goes on to make provisions for the statistical system now in use as one of the bases for the scientific work. This system is to the best of our knowledge one without parallel in any country, and it has already proved itself superior to any statistical system we are acquainted with. It registers the catch of every boat, leaving its record for subsequent study by scientists in conjunction with other records by which changes in apparatus and economic conditions may be discounted, in order that there may be obtained a measure of the fluctuations in abundance of fish from year to year. It will be inevitable, in the future, that any scientific program carried on by the possessors of such complete records as, by this law, we shall eventually have, will be a program designed to discover the meaning of such records in terms of abundance and scarcity of fish. That there are faults in the system must be granted, but the faults are infinitesimal compared to those of statistical systems depending upon estimates and hearsay. The laboratory will provide for the filing and the study of these records.

But this statistical work is only a part of the program, and in formulating both this and the biological, which is in a way the more important, the Commission has had before it the several programs adopted during the last two decades in other countries, notably in those bordering the North Sea and our North Pacific, and from these programs and their results it has been possible to decide within somewhat narrow limits what knowledge is necessary to competently legislate for our fisheries. The failures and successes of others during the recent great advances in fishery science have profited us. And in this fact is seen the reason why the program for the proposed laboratory will be a really vital one, *dealing with questions which actually face the legislator and the men interested commercially.* It will lack the vagueness of random natural history investigations, and it will avoid the limitation in value of technological research. In the future we may justifiably hope that the investigations carried on in the new laboratory will further define and clarify the many problems to be met with.

And in thus reviewing the work in other fields perhaps the most obvious fact has been the absolute necessity of access to the vast store of specimens and data to be furnished by the commercial fisheries. No agency could afford to duplicate this store, despite its vital importance to any investigations. And this has, in fact, determined the location of the laboratory and dominated in the construction of its plans. Another obivous conclusion to be drawn from the work of others has been the necessity of obtaining popular support by exhibiting to those interested the purposes of the work, and its achievements, as well as by showing graphically the necessity for it. Because of this there has been planned an exhibit room.

The great scientific value of this work may not be immediately obvious to the scientist who is interested in some of the more basic laws of biology. It may appear too practical. Yet this definition of aim, and practical trend actually heightens the value of the work from the standpoint of general science. The problems faced by the legislator are, in striking degree, the same as those in which the student of geographical distribution, and of evolution is or should be interested, and the material offered by the commercial fisheries far exceeds in extent that which can be obtained through other sources. The degree of isolation of different races and the extent to which it leaves its traces on the morphology or habits of the species is of great importance to one pondering the value of protection to a species overfished in a particular locality, just as it is to the man interested in the formation of races and

species. The rapidity of growth, the distribution of pelagic ova or larvæ by currents, the response of the species to changes in surrounding conditions, all affect both the conclusions of the naturalist and those to whom the apparent abundance of fish is vitally important. Above all, however, our program will be most vital to the progress of hydrographical science in its relation to the food supply of man, through what is in reality the most essential purpose of our work—the measurement of the actual abundance of fish in the ocean. The effect of hydrographical conditions on fish can not be measured without a knowledge of the real abundance of fish, of the rate of growth, and the habits. So, in addition to being dedicated to the service of competent legislation for conservation and utilization, the laboratory will be in a very real way an essential part in the progress of more general scientific knowledge."

FISHERIES PATROL.

Most of the fisheries conservation laws of the state apply to the Sacramento and San Joaquin rivers and to the San Francisco Bay region where intensive fishing has been longest carried on and where more species of fish are in need of protection. For the enforcement of these laws we have five patrol boats. San Francisco Bay and the near outside waters are covered by the boats "Quinnat" and "Steelhead", the river fishing districts by the boats "Rainbow," "Barracuda" and "Shad." The first two boats are directly in charge of this department. The other three come under the head of general patrol as they

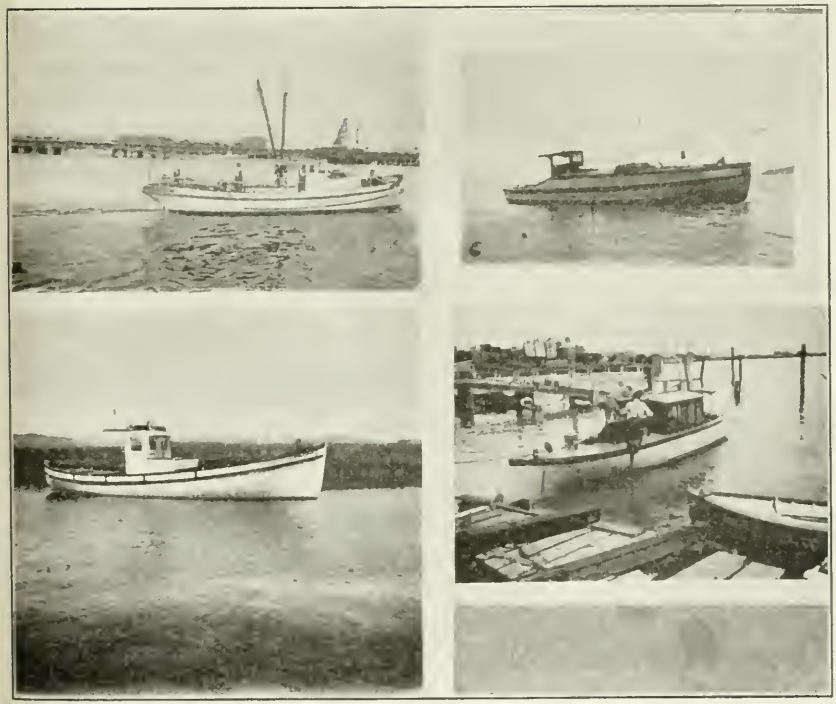


Fig. 17. Commercial Fisheries patrol boats. a. The "Albacore," June 3, 1918. Photograph by E. M. Nielsen. b. The "Steelhead" patrolling the lower Sacramento c. The "Quinnat." Photograph by N. B. Scofield. d. The "Rainbow" at time of launching in 1919. Photograph by A. M. Fairfield.

have much game patrol work as well, and are directed by the chiefs of patrol of the San Francisco and Sacramento districts.

Patrol Boat "Quinnat."

The patrol boat "Quinnat" is a cruiser or raised deck type of boat, forty-six feet in length with a beam of eight feet and nine inches, and draws three feet two inches of water. She is a well equipped boat with a cabin which furnishes sleeping accommodations for four persons, a fully equipped galley, wardrobe, lockers and lavatory. She is finished in Philippine mahogany and is electric lighted throughout. When built in 1910 at a cost of $6,500 she was equipped with a forty horsepower gasoline engine which enabled her to attain a speed of about twelve miles per hour. In 1919 it was found necessary to replace this old engine and a ninety horsepower Wisconsin engine was installed in its place. With this new engine she can make a speed of thirteen miles per hour. The boat has a fuel capacity of 240 gallons which gives it a fairly large cruising radius. A small house has been recently built at the forward end of the cockpit to protect the operator from the weather. This boat's regular crew consists of a captain and engineer but can accommodate two extra men when the emergency requires. Although in constant service since being built this boat has been given good care and is in an excellent state of preservation. She was designed for use on San Francisco Bay and for trips to the crab, rock cod and trawl fishing grounds outside, and to the fishing grounds in Monterey Bay. While she is an excellent boat and is doing the work for which she was built she is not as seaworthy in bad weather outside the heads as had been expected. With the growing importance of the outside fishing, more especially that at Monterey and Fort Bragg, it may be necessary at some time to replace her with a larger and more seaworthy boat.

Patrol Boat "Steelhead."

In 1920 the boat "Steelhead" was built to assist in the patrol work of San Francisco Bay. The "Barracuda" which had been doing this work was transferred to the river work to take the place of a boat which was being rented for the purpose.

The "Steelhead" is the type of boat used in salmon trolling at Monterey and Fort Bragg. She is thirty-one feet long, nine foot beam and draws thirty-two inches of water. She has a twelve horsepower Hicks two cylinder heavy duty engine and has a speed of nine miles per hour. She is decked in and has a house shelter over the engine and cockpit. The forward deck is slightly raised to give sleeping quarters for three men. There are fuel tanks for 100 gallons and a 20 gallon water tank. Her contract price was $2,545. She can be operated by one man but can carry more when necessary.

In addition to work on San Francisco Bay it is intended to use the "Steelhead" at Monterey and Fort Bragg during the fishing seasons at those places and to engage in experimental fishing to develop methods of catching fish now little used.

Patrol Launch "Albacore."

For the patrol of southern California waters we have the boat "Albacore," built in 1918 and described in the last Biennial Report. She is sixty feet long, twelve foot beam and has a draft of five feet. She is equipped with a sixty-five horsepower Acme engine and has a speed of eleven miles per hour. An ample cabin is provided with sleeping accommodations for six persons, a fully equipped galley, a lavatory and lockers. She is built plainly on the model of a tuna fishing boat and is a good substantial seaworthy boat, well adapted to patrol and investigation work. With a crew of three, captain, engineer and deckhand, she covers the coast from Santa Barbara to San Diego.

The "Albacore" has been used a great deal in experimental "long line" fishing for albacore and has assisted in the fisheries investigation work. For more than a year, however, practically all of her time has been occupied with patrol work. With constant demands made upon her by the patrol work and with long distances to cover she has been put through a lot of hard work. We doubt if the log of any boat of its size on the coast will show as much work done.

Other Patrol Work.

Besides the fisheries patrol carried on by boat we employ a patrolman in the vicinity of San Pedro who works about the piers, fishing docks and part of the time on the patrol boat. As occasion has demanded extra men have been secured from the Los Angeles County sheriff's office.

At San Diego we have a patrolman who devotes about all of his time to the fisheries patrol work. At San Francisco one man gives this branch of the work all of his time. As already stated the three boats, "Rainbow," "Barracuda" and "Shad," while doing some game patrol work are largely employed on fisheries work. Game deputies wherever stationed in commercial fishing localities devote part of their time to fisheries work and during fishing seasons may give all their time under the direction of this department. In this way the fisheries patrol is well cared for.

SALMON INVESTIGATIONS.

In the salmon investigations this department is cooperating with the Department of Fisheulture for each is equally concerned with the conservation of these fish. Investigations of California salmon which have been made in the past have in a large degree been superficial, but to

work out the important problems remaining unsolved requires well organized and sustained effort.

The chief object here is to acquaint ourselves as much as possible with the life and habits of the salmon, for intelligent attempts at conservation must depend largely on our knowledge of the natural history of the species. The fact that rapid depletion and almost total destruction of the supply of salmon has occurred in certain localities to the northward, is sufficient warning that the question of conservation must be considered by us even more seriously than in the past. In addition to a constantly increased effort to supply a growing demand for fish food, we are faced with the rapid development of irrigation and power construction, which in some instances completely closes or threatens to close large tributaries of our rivers which have served as natural breeding grounds for salmon. The recent growth of sea fishing for salmon also furnishes a problem for careful investigation. The main hope of being able to combat these destructive agencies lies in intellgently administered conservation and propagation.

Artificial propagation seems to have reached a high state of perfection, but there are many questions relating to methods of liberation, distribution and breeding of young salmon that need immediate attention. It is quite possible that some of our smaller coastal streams might be made through artificial propagation to contribute largely to the demands of sea fishing, and that with a little aid more or less permanent migrations might be established in some of them.

The salmon investigation work has been placed in charge of Dr. J. O. Snyder of Stanford University, who is exceptionally well qualified to carry on this line of work.

During the past two seasons assistants, under his direction, have been engaged in making observations at Monterey Bay, Fort Bragg, Klamath, Trinity, Smith and Sacramento rivers, and elsewhere. There have been assembled considerable data relating to sea fishing and river migration, collections of scales from which something of the life history of the fish may be obtained, collections of young salmon from different localities, etc. Laboratory studies of this material is now in progress. Attention has been directed principally toward king salmon, but observations of value have been made on silver salmon, steelheads, sturgeon, and other river fishes as well.

What is most urgently demanded now is some knowledge of the composition or source of origin of the schools of salmon upon which the sea fishing draws, of the movements, source of food, and other facts relating to the ocean life of salmon, of the location and extent of spawning grounds, the migrations of adults and young, and methods of introduc-

tion and distribution which will bring the best results to artificial propagation. Facts relating to these questions can only be gained through patient observation and carefully planned experimentation.

FISH REDUCTION.

Wherever fisheries are carried on extensive waste usually results. Many unmarketable fishes are unavoidably caught and frequently even the desirable varieties are caught in such quantities they cannot be absorbed by the markets before spoiling. As an illustration, the mackerel boats fishing out of a port in England recently brought in so many mackerel in one day that the fresh markets and salteries would not take all of them and 500,000 perfectly good mackerel were taken to sea and dumped. Besides such losses resulting from occasional overcatches there is a loss of at least fifty per cent in the cleaning of fish which go to the markets, salteries or canneries. In many places this waste is dumped at sea and no effort is made to convert it into useful products such as fish meal and oil. It is evident that even in England where fishing has been carried on for centuries fish waste and offal is not being utilized as it should. In the salmon fisheries of the north Pacific, many millions of pounds of fish offal are annually dumped into the sea. The Council of Scientific and Industrial Research of Canada estimates that in that country $12,000,000 worth of fish offal is wasted each year.

In California the demand for fish meal for poultry or stock food or as a fertilizer for fruit trees, and the demand for fish oil to be used in the manufacture of fruits and other products has resulted in almost every pound of fish waste being utilized. California easily surpasses all other states in the utilization of its fish waste. A few years ago when our fisheries began to expand, reduction plants were established at the principal fishing centers and the fish offal and waste was hauled to them by barge or truck. There was a demand for small, compact and sanitary reduction plants which could be run in connection with the cannery. After considerable experimenting these were finally perfected and several different makes were placed on the market by manufacturers in this state. Most of our fish canneries are now equipped with these plants and in them the fish offal is handled quickly before putrification sets in and the fish meal thus manufactured is an excellent poultry or stock food.

The independent reduction plants which depended on fish offal for their supply of raw material have lost by this and some have had to close. Fish meal and oil have sold at such good prices and sardines can be caught so cheaply that there have been times when it was as profitable to convert the fish into meal and oil as into canned food. This resulted in large quantities of sardines being used in the reduction

plants in the spring of 1919 during the time when the fish were not quite up to the standard of fatness to can. Although it is considered proper to use the menhaden in vast quantities on our Atlantic coast for obtaining fish oil and the herring to a less extent in Norway for oil and meal, it was believed that the unrestricted use of sardines for this purpose should not be permitted in California. Our canners themselves as well as the public were opposed to the practice and the legislature, then in session, enacted a law which placed the regulation of the use of fish in reduction plants in the hands of the Fish and Game Commission. The first idea of the legislative committee which passed upon the bill was that the use of any edible fish in reduction plants should be prohibited, but adopted the plan of placing the control of the matter in the hands of the Fish and Game Commission when it was shown that frequently over-catches cannot be avoided, that fish hoisting apparatus or canning machinery will break and that consequently if the fish could not be used in reduction plants there would be a useless waste.

The handling of this problem has not been an easy one. Sardine canneries having reduction plants are making a profit out of their waste and this gives them an advantage over the other canneries. Further than this, they are able with profit to divert sardines for reduction purposes which have become soft underneath the load in the boat, or fish which are broken or do not otherwise come up to standard and by so doing they make use only of the fine fish for canning. The tendency, however, is for them to use more fish than they should for reduction purposes. The canneries which are not equipped for converting fish and offal into fish meal and oil have paid the fishermen more for their fish than they can get from the reduction plant which buys their offal. As a consequence, they are inclined to can some fish which might better be discarded and with only a few exceptions they pack more cases from a ton of fish than the canneries with reduction plants and they accuse their opponents with using good fish for fish meal and of using that profit to underbid them in the sale of the canned product.

It has been extremely difficult to regulate the percentage of fish that is discarded in this way, even when an inspector is placed in the cannery. Consequently a plan of checking a cannery's daily pack with the amount of fish it receives has been adopted. Their receipts are obtained accurately from the copies of the receipts issued to the fishermen and the daily pack is secured from the memoranda of retort or comptometer records from which the cannery makes up the record of its daily pack. By this means we are able to hold their waste in discarded fish and excess catches within definite limits.

In the matter of controlling excess catches of sardines our task has also been difficult for fishing conditions vary in one locality through a season and the fishing conditions in southern California are very

different from those at Monterey. At Monterey sardines are found in great numbers most of the season and are usually caught close to the canneries and within a comparatively small area. The boats most of the time are able to get their allotted limits and there is little incentive to make an over-catch with the expectation that other boats will not get their limit and on that account they will be able to sell the excess amount. Further than that, the boats are usually near enough together so that each knows what the catch of the other boats is. In southern California the boats fish mostly far from the canneries and scattered over a wide area so that they are not able to regulate the total catch. To insure the canneries running at capacity it is necessary that the limits which the canneries place on their boats be slightly in excess of the capacity of the cannery. We have found by experience that the excess allowed must, on account of the difference in fishing conditions, be greater in southern California than at Monterey. The percentage of leeway which is allowed therefore, is greater in southern California than at Monterey. The canners, almost without exception, are cooperating with us and are willingly permitting us to inspect their plants and the records of their pack.

The regulation of the use of fish in reduction plants we believe is working out quite satisfactorily and in accordance with the wishes of the legislature. Some of the canners without reduction plants and some of the plants not connected with canneries have not been wholly satisfied. But, from force of circumstances they are at a slight disadvantage and it is not natural that they should be entirely satisfied. On the other hand, some of the canners with reduction plants feel that we have been too severe with our regulations. The direct fishing for reduction purposes which caused the passage of the law has been entirely stopped and over-catches and waste has been reduced to a low percentage.

PURSE SEINE FISHING.

About the most important development in the fisheries during the past biennial period is the introduction of purse seine fishing in southern California and the capture by this means of large quantities of blue-fin tuna. The tuna canning industry has been supported by the fish known as the long-finned tuna or albacore which is caught only with hook and line. As already stated in discussing the tuna investigations, the catch of this species of fish until this year had been decreasing due, most likely, to a natural fluctuation in abundance and not to over-fishing. A few purse seines introduced in 1918, demonstrated that the other varieties of tuna may be caught with nets. In 1919 the number of purse seine boats increased, in the San Pedro district where

this manner of fishing is chiefly done, from nine to forty-one. These boats had a very profitable season, catching nearly eight million pounds of blue-fin tuna, thus making up the partial failure of the albacore catch. This resulted in a large tuna pack which the canners of the district sorely needed. In 1920 the number of purse seine boats was increased to 103. The purse seine fishermens' association demanded a higher price than the canners believed they could pay. The canners maintained that $125 per ton was the limit they could pay, and subsequent market conditions have shown that figure to be too high. When the fishermen finally decided to accept this price they were unable to find the blue-fin tuna in sufficient numbers to make their operations profitable. The result of the season was that some of the boats did not operate and scarcely a half dozen of them made their expenses. The albacore catch by the hook and line method, however, was very good and the canners on that account did fairly well.

The presence of these purse seine boats, many of which have come from the Puget Sound salmon fisheries, is a source of worry to us. They have insisted on fishing within the prohibited area at Catalina Island when tuna were to be found there and have had little respect for the law which forbids their presence within that district with nets on their boats. Our southern patrol boat has had to make numerous arrests. A more serious result of the growth of purse seine fishing, however, is the ill effect it may have on such varieties of fish as the barracuda and white sea bass. These boats are engaged in fishing for tuna for only about three months, the rest of the year many of them fish for the markets. One of these boats is able in one haul of their net to take more barracuda or mackerel than they can carry on their boat. The markets which are not prepared to freeze and hold over large catches until the time when fish are not plentiful, are easily swamped, and it often happens that large quantities of these fish, caught in good faith for the markets, have to go to reduction plants. The fishermen have shown a willingness to cooperate with the Commission and at our request have at times put limits on the amount any boat shall bring in. The losses come, however, on days when, instead of only a few boats making catches, a large number of boats fishing over a wide area make good catches simultaneously. Provision should be made by the markets to freeze and hold these over-catches for there are times in the winter when the markets are practically bare of fish.

The worst feature of purse seine fishing, which cannot very well be remedied under existing laws, is the catching and killing of undersized and young barracuda and white sea bass. It is possible the catching of these two varieties of fish by means of purse nets should be prohibited.

KELP POTASH INDUSTRY.

At the time of our last Biennial Report the kelp beds of California were being taxed to their utmost to furnish potash, the supply of which was cut off from Europe by the war. When this source of supply was cut off potash manufactured from kelp sold readily for four times the pre-war price. About 400,000 tons of kelp were being cut annually and the government plant at Summerland and some of the larger companies were making every effort to develop and obtain a market for the by-products in order that the business might be carried on profitably even if the price of potash should fall to what it was before the war. We ventured the opinion at that time that some of the companies would be able to continue operations through the sale of the by-products which they were developing. But the end of the war came sooner than expected and was accompanied by a decided drop in the price of potash. Soon after the signing of the armistice nearly all kelp harvesting ceased for as yet a sufficient market had not been found for the by-products. At the immense, three million dollar plant of the Hercules Powder Company on San Diego Bay, where the fermentation process was used to break down the physical and chemical structure of the kelp, many by-products were developed, several of them being chemicals which had never before been produced in commercial quantities. It was hoped that use for these materials would be found in the industrial arts, but so far no good market has been found for them. The only plant which has continued to operate is the government experimental plant located at Summerland. Here they have continued to work on a small commercial scale and researches have been continued to discover more economical ways of extracting the potash and the different by-products. Here besides the potash salts such by-products as kelp-oils, creosote, pitch, ammonia, bleaching carbons, salt, and iodine have been obtained in commercial quantities. To quote from their last report: "The results obtained to date indicate that it will be possible to establish on kelp as a basic raw material a new American chemical industry of considerable size and of importance and usefulness to the nation." From the work which has been done we now know that the kelp beds of California are capable of yielding 500,000 tons of raw kelp annually without injury to the present stand. It is possible that this great industry may soon be partially revived, but at the present time it is at a standstill.

Respectfully submitted.

(Signed) N. B. Scofield,
In Charge, Department of Commercial Fisheries.

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 Bureau of Education, Publicity and Research, covering the period from July 1, 1918, to June 30, 1920, this being the third report since the inception of this department. Although war conditions prevented an enlargement of the work, yet we believe meritorious accomplishments in the field of education and publicity have been achieved.

EDUCATION AND PUBLICITY.

LECTURES.

The Bureau has continued to emphasize work in the schools, consequently a large proportion of the lectures given during the past biennium have been delivered to high school and grammar school students. High school principals have been particularly sympathetic with the work, and in many instances return lectures have been requested. In some instances all the schools in a city have been concentrated for the purpose of hearing a lecture and seeing wild life films. It has been surprising to find how little definite information regarding the life history and habits of game birds and mammals is had by the average high school student. Furthermore, there is evident lack of information as to the present status of fish and game and the need for its conservation. As the lectures are often followed by a quiz, or the demand for a written paper, by the biology teacher, the results should prove very much worth while.

Early in 1920, the California Academy of Sciences was furnished with a series of four popular science lectures by employees of the Commission.

Another fruitful field which has been entered is that of the Boy Scouts of America. Many lectures have been given to groups of scoutmasters and also to the boys themselves. In the summer of 1918 several boy scout summer camp groups were visited and instruction given by means of field trips and camp-fire talks.

The usual series of nine lectures on fish and game were given to a large class in general forestry at the University of California, in the spring of 1919 and again in 1920. Short field trips designed to give students a first hand acquaintance with the common birds on the campus, and to stimulate their interest in natural history were also given. The response of this group of students has been particularly gratifying. A series of lectures and field trips were also given to a group of prospective teachers in a course in advanced vertebrate zoology,

in the spring of 1919. We believe that we have been fortunate in having this opportunity to give a course of instruction to University students, for in such instruction, we are reaching many prospective teachers and many who will hold responsible positions in the state.

The lecture schedule would have been expanded had there not been the need for curtailing traveling expenses. Lectures have been distributed as follows:

High schools	20
Grammar schools	17
Normal schools	3
Universities and colleges	21
Parents' and teachers' associations	5
Civic clubs and public	59
Boy scouts	21
Churches	4
Miscellaneous	12
Total	162

There is still a considerable demand for a collection of study skins of common birds to be used as a loan collection for schools. Although such a collection has slowly been accumulating, it is not sufficiently complete to be available for this use. When completed this collection could be kept on the move with no expense to the Commission, each school paying the expressage. There is a continuous demand from teachers for helpful conservation literature and new material needs to be prepared.

Nature study libraries furnished by the California Nature Study League have been loaned to winter resorts and augmented libraries of reference books have been used in connection with the summer resort work.

MOTION PICTURES.

The set of Salisbury wild life films owned by the Commission have been in almost constant use. The films formed the basis of many lectures, and in addition have been displayed in many cities of the state. Not only do these films depicit the home life of game birds and mammals but they also emphasize the need for fish and game conservation. Of particular use has been the reel showing the hatchery operations. The films have been furnished free of charge to schools or other organizations making application, providing that they furnished a lantern and operator. All of the high schools have recently been circularized, with the result that the films are being shown systematically in all of the high schools possessing the proper projecting apparatus. Three worn duplicate films have been given wide distribution through the state by the University Extension Division.

One reel has been added to the six Salisbury films. This one was secured by the Commission itself and shows the albacore and tuna fisheries of southern California. The reel shows the fishing grounds, the catching of the fish, shipment, and the processes of canning. Another reel showing the sardine industry is to be added in the near future. Two hundred feet of film showing sea lions on Anno Nuevo Island has also been secured.

A small collection of lantern slides of common birds and mammals has been loaned to the schools on several occasions.

FIG. 18. Sacramento school children arriving from a nearby school to hear a lecture on wild life conservation and to see motion pictures. Photograph by H. C. Bryant.

PUBLICATIONS.

The continually increasing mailing list and the many letters received, lead us to believe that our quarterly CALIFORNIA FISH AND GAME is proving an educational force in the state. The magazine is now in its sixth volume. A glance at its editorials and the type of articles which appear should convince anyone that its aim is "conservation through education." On many occasions CALIFORNIA FISH AND GAME has been mentioned as the best publication of its kind in the United States. Outstanding among the numbers issued is that for July, 1919, which appeared as a "Trout Number." An article on "California trout" gave a description of the life history and habits of all the different varieties of trout found in the state, and this was illustrated with four beautifully colored plates. As was expected the demand far exceeded the supply. Volume Five (1919) contained 222 pages and 70 illustrations including 18 general articles and more than 220 shorter items.

Increased activity in the field of commercial fisheries is evidenced by the publication of two new fish bulletins which have been given wide circulation. A department in California Fish and Game entitled "Notes from the State Fisheries Laboratory" has furnished published results of the activities of this laboratory.

A large part of the material appearing in the "Bird and Arbor Day Manual" issued by the State Superintendent of Public Instruction was furnished by this Bureau. This manual reaches all of the teachers of the state.

The 1916-1918 Biennial Report of the Commission, edited by this Bureau, although reduced in size and attractiveness for economy, nevertheless, furnished a complete record of the activities and accomplishments during the biennial period.

Mention should also be made of a work on the "Game Birds of California" published by the University of California Press, in December 1918, in which this Bureau had a distinct part, your director being a joint author. The book contains 642 pages, 16 colored plates and 94 line drawings and according to reviewers is the best work of its kind. Each of the 108 game birds of the state is described and introductory chapters are devoted to such subjects as: Decrease of Game and Its Causes; Natural Enemies of Game Birds; The Gun Club in California; History of Attempts to Introduce Nonnative Game Birds; The Propagation of Game Birds; Legislation Relating to Game Birds in California.

Our office is now equipped with a mimeograph and an addressograph and as a result a long series of newspaper items have been sent to all the prominent newspapers of the state. At the top of the paper utilized is a heading which points out that the item is part of the free news service furnished by the California Fish and Game Commission, with a note addressed to the editor suggesting the purpose and value of the news service. It has been gratifying to note how regularly the newspapers print these items. A particularly well conducted campaign regarding the summer work was made possible by the California Nature Study League. It was estimated that 40,000,000 people were reached by this publicity.

EXHIBITS.

In the fall of 1918 and again in 1919 in connection with exhibits at the State Fair at Sacramento, the different publications of the Commission were exhibited, additions to the mailing list taken and a display of films made. In connection with the summer resort work, a wall rack displaying colored pictures of fish and game proved very useful. This Bureau also cooperated in a bird display shown in connection with the annual flower show given at the St. Francis Hotel, in San Francisco.

SUMMER RESORT WORK.

The statement in our last report suggesting that the summer vacationist finds himself in close touch with nature, and is in a particularly susceptible mood to receive information on wild life, and that the vacation camps and mountain resorts of the state constitute a neglected opportunity for additional work, has been clearly demonstrated during the past two years. During the summer of 1919, the Tahoe resorts were chosen as a field for the work. Each resort around the Lake was invited to institute educational work relating to wild life. Five of the larger resorts having accepted our proposition, a campaign plan was outlined and extensive newspaper publicity given the project.

In order to avoid the appearance of a cut and dried education propaganda it seemed best to first of all stimulate people's interest in the out-of-doors and the wild things encountered on trips afield, and secondly, to furnish information on the status and needs of fish and game by means of illustrated lectures. There was offered, therefore, at each resort a series of field excursions designed to bring to each participant the ability to recognize and name birds, mammals, trees and insects encountered on the summer vacation. The classes were limited to twenty and the instructor led them along the mountain trails, pointing out the different kinds of plants and animals, and adding some item of interest regarding their life history, status and the need for conserving them. Special excursions were offered for children.

Great interest was shown in these trips afield. At Fallen Leaf the interest was so great that it was almost impossible to care for the crowds. In many instances duplicate excursions had to be made in order to limit the number of students. In all 42 separate field trips were conducted. The total attendance of adults was 362 and that in the children's classes, 157. The fact that many school teachers attended these trips emphasized the value of the work; for invariably these teachers will carry to their pupils the conservation messages given.

In the evenings a series of illustrated lectures was offered. The lectures were designed not only to be entertaining, but to carry facts valuable in developing public sentiment favorable to fish and game conservation. Among the subjects used were: The Fish and Fisheries of California; Game and Fur-Bearing Mammals of California; The Economic Value of Birds; Bird Migration; Methods of Wild Life Conservation; Wild Animal Life in California. Twenty-two lectures in all were given and the total attendance was 2,240. It can be seen, therefore, that the average attendance was more than 100. This is the more encouraging in that a series of lectures was advertised and the attendance continued good throughout each series.

The California Nature Study League became so much interested in this new work that they furnished a compact nature study library to be placed in each of the summer resorts where the work was instituted. This library was supplemented by colored pictures of fish and game and other illustrative material.

The work at Tahoe attracted the attention of the Superintendent of National Parks, Mr. Stephen T. Mather, and in 1920 he suggested that the Commission cooperate in similar work for Yosemite National Park. As a consequence, there was installed in the summer of 1920 in

FIG. 19. A Yosemite audience listening to a conservation lecture. Summer vacationists are in an unusually receptive mood for information on fish and game. Photograph by Curry Camping Company.

Yosemite National Park what was called a "Free Nature Guide Service." Illustrated lectures dealing with wild life and wild life conservation were given in the evenings at the different resorts, and trips afield were scheduled for morning and afternoon. Small nature study libraries were made available at two different places in the Valley, and an office hour gave visitors a chance to have questions relating to natural history properly answered. Considering that the effort was practically new and untried, the results were remarkable. During the month of June alone, the only part of the season covered in this report, 10,815 persons were reached through the medium of lectures, eighteen being given; and the attendance on the thirty-five scheduled trips afield was 483. Further

information on wild life was furnished by some "nature notes" which were run regularly on the back of the menus at Yosemite Lodge and the Sentinel Hotel.

On the field excursions it was not uncommon to come upon deer, bandtailed pigeons and mountain quail, thus giving a splendid opportunity to furnish information on the status of the game and the means whereby it may be conserved. Furthermore, it was possible to convince everyone of the efficacy of a game refuge, for the park itself clearly demonstrates the value of such a reserve.

It hardly seems necessary to emphasize that a larger number of persons were reached, and at a time when they were most ready to learn,

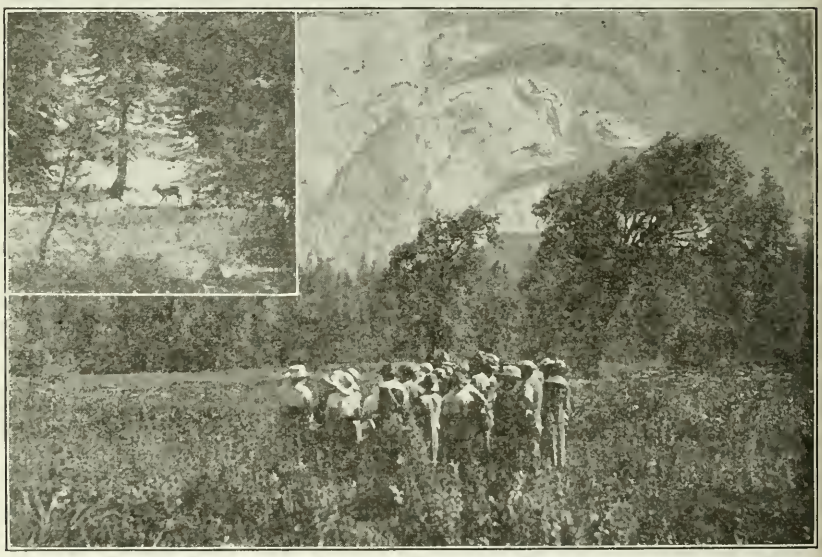


FIG. 20. Under the instruction of a nature guide in Yosemite Valley. Typical of the Fish and Game Commission's summer resort work. Although this particular group were not studying the deer shown in the upper left-hand corner, many opportunities for such a study were offered to similar groups. Photograph by H. C. Bryant.

than could have been reached in any other way. We are convinced that this work has been the most profitable of any educational work outlined by the Commission, which has been undertaken up to the present time. If we may judge by the enthusiasm of those who came in contact with the Nature Guide work in the Yosemite, there is every reason to believe that it will not only be continued in the Yosemite National Park, but that it will spread to the other national parks of our country. If this proves to be true, it will be to the everlasting credit of the Commission that it was largely responsible for the beginning of so important a project connected with the recreation and education of the people.

RESEARCH.

Ducks versus Rice.

There has been no more important problem confronting the Commission during the past biennium than that relating to ducks and the rice grower. In the fall of 1918 misleading news items led farmers to believe the rice industry was threatened due to the depredations of ducks, and the sportsmen to believe that ducks were being slaughtered by rice growers in the Sacramento Valley in order to save the crops. In cooperation with the United States Biological Survey, an investigation was made to determine the real damage caused by the ducks and to determine also, some solution for the problem which had become an intense one. Investigation showed:

(1) The consensus of opinion of rice growers obtained through interviews was that owners should legally be allowed to protect crops but the unrestricted hunting would cause more damage to the rice than the ducks. Much of the agitation was started by townspeople who wanted a chance to hunt before the season opened.

(2) Damage to rice caused by ducks is limited in extent, hundreds of growers never having sustained loss. The greatest damage in 1918 was found between Maxwell and Colusa, in Colusa County.

(3) Thin rice or rice with open water is most often attacked by ducks.

(4) The total acreage of growing rice destroyed in 1918 amounted to not more than 300 acres out of 145,000 planted in the Sacramento Valley.

(5) The pintail duck is the only duck causing appreciable damage.

(6) Such suggested methods as an earlier open season and market hunting must be branded as impractical methods of solving the problem.

(7) Such control measures as herding and bombing have been proved feasible and should be depended upon. Intelligent growers can outwit the ducks if they make the attempt.

The misuse of permits which were first granted led to a rescinding of all permits and to concentration on the use of bombs and fireworks for frightening birds from the fields.

As a consequence of the attitude taken by the government, agitation has practically ceased, for those largely responsible for the disturbance have become discouraged because they are unable to shoot before the season is open, while those few rice growers in need of protection have been able to successfully frighten the ducks from the fields by use of bombs and more recently by use of a carbide automatic gun.

OTHER INVESTIGATIONS.

In December, 1919, an investigation was made of the fisheries and bird life of Salton Sea, in Imperial County. Some valuable data on the history and status of the mullet fishery, which has recently become important, was obtained as well as data on wintering wild fowl and damage to winter grain crops by ducks.

Considerable progress has been made in the examination of duck stomachs with the idea of publishing an article on the food habits of ducks in California. Most of the material now on hand has been gone over, and a full report is now in preparation.

A cursory study of the fur-bearing mammals of the state and estimates of the annual take have been prepared. This data has now been turned over to the Museum of Vertebrate Zoology, of the University of California, where Mr. Joseph Dixon is undertaking the preparation of a

Fig. 21. Wild pintail ducks being fed on the lawns surrounding Lake Merritt, Oakland, California's first game refuge. Photograph by H. C. Bryant, January 6, 1919.

full report illustrated with colored plates by America's foremost artists. It is expected that at least three years work will be required before the results of the investigation will be ready for publication.

A list of all of the publications of the Commission together with a finding index has been prepared and is now ready for publication. A history of the Fish and Game Commission is also being compiled.

In addition to the work outlined above there has been the routine work of estimating the annual deer kill, and the study and filing of the reports made to the Commission by forest officers. The latter contain much valuable data relative to the status of fish and game.

The holders of scientific collectors' permits now number about 140, nearly a third of whom are collecting for museums and schools. Each is required to make a full report to the Commission of their activities for the year. Permits are issued only to those competent to exercise the

privilege for the advancement of knowledge. Accordingly, much valuable ornithological and mammalogical work is being accomplished by the scientific collector in this state.

CONCLUSION.

That this Bureau is reaching the public with increasing success is evident from the fact that the persons reached through the medium of lectures total 36,555, through trips afield, 1,308 and through motion picture displays 11,945, making a total of 49,808, in addition to the thousands reached through the medium of the printed word.

Respectfully submitted.

(Signed) HAROLD C. BRYANT,
In Charge, Education, Publicity and Research.

REPORT OF THE LEGAL DEPARTMENT.

The Honorable Board of Fish and Game Commissioners 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, 1920. Most of the work of this department is in conjunction with the other departments with the exception of the prosecution of violators; therefore, much detail is eliminated for the reason that it would simply be a repetition of the statements found in the reports of the various departments.

During this biennial period 1891 arrests were made of which number 1707 were convicted, 150 dismissed or acquitted and 34 cases still pending.

The amount collected in fines was $46,373 and the number of days imprisonment imposed on violators was 324.

The number of arrests for this biennial period shows a slight increase over the former report but the aggregate in fines imposed and collected has increased almost 50 per cent, while the jail sentences imposed show a marked decrease over the same period. This decrease in jail sentences is no doubt due to the fact that probation law has had much to do with the reluctance with which judges impose jail sentences on almost all malefactors.

The district attorneys throughout the state, with but few exceptions, have cooperated with the Commission and have rendered valuable assistance in the prosecution of violators, and the justices of the peace, as shown by the amount of fines collected, are imposing heavier sentences for violations of the fish and game laws.

The past two years has shown a marked increase in the number of convictions had where jury trials were demanded by defendants, particularly in the few counties where formerly a conviction could scarcely, if ever, be had against a game violator.

In these sparsely settled counties the residents felt the game belonged to them and they could kill it at all seasons of the year, but the work of the Commission along educational lines and the vigorous prosecution of violators has been the means of teaching the people the value of the game as a natural resource, as well as that all violators will be vigorously prosecuted irrespective of the result of a trial; as a consequence there is scarcely a county in which a conviction cannot be had by jury where the evidence warrants.

Much work has been done in the enforcement of the screen and ladder law, and many of these devices have been installed. Surveys are being made and hearings held where demanded. But the greatest difficulty is in compelling ditch owners to maintain the screens after they are once installed, for in many instances the ditch owners take the screens out to clean the ditches and fail to return them until prosecution is threatened or begun.

The appropriation of the river waters of the State of California for irrigation and power purposes and the erection of large dams for impounding purposes has become a serious menace to the run of fish unless laws are enacted or means can be adopted whereby the corporations taking the water from these rivers can be compelled to permit sufficient water to pass down the natural channel of the rivers, in question, at all times sufficient to sustain fish life, the run of fish will be ultimately exterminated and that shortly.

The Anderson-Cottonwood Irrigation District has constructed a dam on the Sacramento River above Redding that prevents the free passage of fish and is interfering with the salmon run. A notice was served on the district to construct a fishway on the dam, but so far the order has been ignored and proceedings are about to be begun to compel the district to install the fishway. The District Attorney of Shasta County has been requested by this Commission and the United States Bureau of Fisheries to begin an action against the district to compel an installation of the fishway, for under the law as it now stands the District Attorney is the officer whose duty it is to bring an action to abate this nuisance and prevent the destruction of one of the most valuable run of salmon in California.

A case was prosecuted against the Red River Lumber Company at Westwood, Lassen County, for the pollution by sawdust of Robbers Creek, a tributary of the Feather River, and a conviction had in the Superior Court of Lassen County. The creek ran through the mill

grounds. After the conviction, the company diverted the entire stream around the mill and away from the source of pollution.

In the month of December 1919 the Engels Copper Mining Company in Plumas County was tried and an information filed against it for the pollution of Hights Creek by depositing the refuse from its mill into the creek. The case was tried before J. O. Moneur without a jury, the evidence showed that the stream for a distance of over five miles from the plant was polluted to the extent that practically all fish life had been destroyed, yet notwithstanding the testimony the case was dismissed. This was one of the worst cases of pollution of public waters of the state with which this Commission has had to deal.

The most important decisions rendered on the subject of fish and game during this biennial period was in the case of Suttori vs. Peckham et al. by the District Court of Appeal. Suttori was arrested for using a net in Fish and Game District No. 20 in violation of Section 636, Penal Code, and brought an action in conversion against Justice of the Peace Peckham et al. for the fish seized by the officer in making the arrest. The plaintiff contended that the law was unconstitutional in that the state had no jurisdiction over the waters surrounding Santa Catalina Island and the court in deciding the case held that the "state has jurisdiction a marine league at sea in all directions from the shore of the island in question." This decision determines the right of the legislature to pass laws for the protection of fish not only within the three mile limit of the state but also within the three mile limit of all islands adjacent thereto.

Working under a written agreement, the United States Forest Service has cooperated with the Fish and Game Commission in the enforcement of fish and game laws in the forest reserves.

Since the last biennial report the Government of the United States under a treaty with Great Britain for the protection of migratory birds of United States and Canada has taken over the protection of migratory birds and placed them under the Department of Agriculture. By an act of congress, the Secretary of Agriculture is authorized to make regulations for seasons when such birds may be lawfully killed, taken and possessed, and has conferred upon the several states the right to pass laws not inconsistent with the regulations of the Department of Agriculture and to enforce the same. Under the regulations of the Department of Agriculture the sale of migratory birds is prohibited. This regulation has done much to prevent the unlawful traffic in game and has practically eliminated the market hunter who knew neither bag limit nor season.

Respectfully submitted.

(Signed) Robert D. Duke,
Attorney.

REPORT OF THE DEPARTMENT OF WATER POLLUTION.

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

SIRS: There has been much less pollution of state waters during the last two years than in like periods in the past. This is probably due to the following reasons:

First—The larger firms and corporations have been convinced that much, if not most, of the (so called) "waste" is of value either in its original state or, at small cost, turned into a by-product. Thus the Standard Oil Company of California recovers both acid and asphaltum from the "sludge" from the lubricating stills (which was formerly discarded as worthless), and makes a fair profit on the investment and labor.

The Mason By-Products Company, (formerly the Mason Malt Whiskey and Distilling Company), has found a greater profit in its "waste" than in its alcohol.

The gas companies, realizing the immense value of lampblack and tar as a fuel, would gladly recover the amount, which in past years was dumped into the bay, if it were possible and thus effect a still more material saving in their oil bill. It may be well to state, in this connection, that the "Jones" generators (used in nearly all of the Pacific Gas and Electric gas plants and in most of the other plants manufacturing more than a million feet per day), produce the required quality of gas with about one-third of the amount of lampblack formerly resulting.

Second—The enormously increased cost of petroleum, both in crude and refined forms, has forced both manufacturers and consumers to utilize every possible means to prevent leakage and recover all oil which has escaped as the result of unavoidable accidents. Thus, firms which installed separating boxes, filters and other means of retaining oil "waste" at our request or to avoid prosecution, now find that these improvements have more than paid for themselves in saving of oil.

Examples of the foregoing are the Doheney Pacific and Associated Oil Companies at Casmalia, Santa Barbara County, against whom complaints were filed charging pollution. They have expended about thirty thousand dollars in the purchase and improvement of a tract of land adjoining their property and it is now an enormous settling basin with its own pumping plant, pipes, ditches and tanks. The pollution has ceased and the saving will soon pay for the work. The Southern Pacific Company has constructed a concrete wall, or dike, in the Sacramento River at Dunsmuir, at a cost in excess of twenty thousand dollars, which retains and permits the recovery of the oil which has

been seeping out of the yards for several years past. I have been unable to get figures on the actual amount of oil thus recovered but it must be considerable.

There is still some complaint about "tankers" pumping ballast outside the entrance of San Luis Bay but this practice has evidently ceased in the vicinity of the Farallones and San Francisco lightship.

A concrete separator has been constructed by the Union Oil Company at Avila to recover the oil leakage from the "topping" plant and the Pacific Gas and Electric Company have done likewise at Vallejo to retain lampblack.

Prohibition has, temporarily at least, aided the cause by eliminating the winery and distillery, both of which were sources of pollution particularly deadly to fish.

There are treble the number of small concerns using fuel oil than existed prior to 1918, all of which require frequent inspection. Small leaks may amount to nothing individually but the aggregate may run into barrels.

Respectfully submitted.

(Signed) A. M. Fairfield,
In Charge, Department of Water Pollution.

REPORT OF SAN FRANCISCO DISTRICT.

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

Sirs: We herewith submit a report for the San Francisco District covering the period from July 1, 1918 to June 30, 1920.

PERSONNEL.

The Fish and Game Commission has been particularly fortunate in retaining practically all of its employees during the strenuous times of the past several years. Although many employees obeyed the call to arms, they all returned safely at the close of the war. The higher wages paid in other lines of work proved attractive to only a few. For the most part their interest and loyalty held them even though it meant financial loss.

GAME CONDITIONS.

On account of the dry season the duck and goose shooting has not been as good as usual. The only part of the state where waterfowl were found in normal numbers was the Sacramento Valley. In the San Joaquin Valley there was practically no loafing water and for the most

part birds were scarce. In the Suisun district shooting held up very well on certain grounds, but was indifferent on others. In the Bay region shooting was good in the 1918-19 season, but in the 1919-20 season there were far less birds.

It is probable that the early flights of birds on account of the scarcity of open water went on through the state without stopping. With the return of normal winters good hunting should be had in all the duck districts.

While the dry seasons have not been favorable for waterfowl they have been excellent for quail. This with the late opening of the season, the middle of November, has given the birds an opportunity to keep ahead of the hunters and throughout the Coast district there has been a notable increase. It is apparent that with favorable breeding seasons and the continuance of the present law it will not be necessary to put further restrictions in force in order to maintain a constant supply of quail.

Doves have increased in all parts of the state on account of the fact that the law protects them during the greater part of the nesting season. In certain sections nesting birds are found even later than the first of September, but in most parts of the state the young are out of the nest and very well able to take care of themselves by that date. With the present open season doves should increase as they are rather prolific breeders and can stand a considerable drain.

Mountain quail have increased very well both in the coast and the Sierra regions. The mountain quail is one of the most interesting birds in our state. Its cousin, the valley quail, will breed from sea level to an elevation of over 7,000 feet, but the mountain quail in most of the state practically never breeds below 2,000 feet except in the north coast district. Just why this is so is one of the mysteries of nature. From the human point of view there is no reason why congenial conditions could not be found at a lower elevation. Food is abundant and the temperature is not altogether different.

The abundance of mountain quail depends more upon the mildness of the winters than on hunting. A cold winter, with heavy snowfall, sometimes wipes out entire coveys. The season for hunting mountain quail in the Sierra districts, opens somewhat early. The young birds have not fully developed by September 1st and should not be killed.

Grouse are still commonly found in the pine belt but are not abundant. The chief factor in preventing them from becoming more common is the grazing of sheep in their breeding range. Many nests are destroyed by the sheep.

Three species of game make California most attractive to the sportsman—ducks, quail and deer. It is difficult to estimate the number of

hunters that go after deer during the open season, but it is safe to say there are not less than 50,000. That there are deer for these men to hunt is due to the fact that California is a natural deer state. There is an abundance of wild brush-covered lands and we also have had laws that gave protection and were enforced. In 1905, the present law allowing the killing of two bucks per season was passed. Previous to that time the limit had been three. Since 1905, the population of the state has increased by approximately one million. Naturally the hunters have increased and the facilities for getting into the deer country have increased more than 100 per cent, with the development of the automobile. During this time the deer cover has been greatly reduced and the deer are having more and more difficulty in keeping out of the way of the hunters. It is extremely probable that within a very short time a one-buck law will have to be put in force.

There is still an impression among sportsmen that it would be well to allow the killing of deer of both sexes. The old story of too many barren does is the excuse. There are men who claim that they can tell a barren doe by the color of the hair, and from other characteristics. We have never met a man who on sight could tell a barren domestic animal, animals with which we are most familiar. How anyone can claim ability to tell from the fleeting glimpse that they may have of the deer that the animal is barren, is beyond understanding. It is certain that any law allowing the killing of does would be the one big step toward extermination. New York state recently had an experience from which every state in the Union can take lesson. Under extreme pressure the legislature was induced to change the law so as to allow the killing of one deer of either sex. This law remained in effect for one season and it has been shown that out of an estimated number of 50,000 deer in that state, more than 20,000 were killed, and 13,000 of these were does. Fully one-half of the breeding stock wiped out in a single season. Think what would happen in California during two seasons. It is certain that no quicker way could be devised to exterminate the deer than by legalizing the killing of does.

ANGLING CONDITIONS.

The several dry seasons have raised havoc with trout fishing throughout the State. In the Coast region many streams that ordinarily carry a heavy flow of water were reduced to a mere trickle. In others there was no flow at all. The scant rainfall has also made it exceedingly difficult to obtain the usual number of eggs. This has greatly reduced the output of our hatcheries. With the return to normal rainfall it will be necessary for the hatchery department to work overtime in order

FIG. 22. Mr. Jay Bruce, state lion hunter, and his dogs, Ely and Ranger, with a male mountain lion killed six miles east of Zaca Lake, San Rafael Mountains, Santa Barbara County, January, 1920. Photograph by Wm. A. Magee.

to make up the loss. The public can rest assured that every effort will be made to bring back the streams to normal conditions.

On account of the greater number of fishermen it will be necessary to shorten the open season on trout so that the fry will have a better chance to develop. The season at present, when the great number of fishermen is considered, is entirely too long. The young fish that are planted from year to year are caught out almost as fast as they are put in. Under such conditions it is impossible to build up a stream. The only remedy is to shorten the season so that the young fish will have some chance to get by the first season at least.

Many years ago black bass were brought from the East by the Commission and planted in various parts of the State. Nearly 30 years ago one of these plants was made in Clear Lake, in Lake County. Bass have increased so that we now have good fishing practically throughout the State. Nowhere, however, is fishing better than in Clear Lake. As yet it is not commonly known to the fishing fraternity that fish weighing nearly ten pounds are frequently taken. Bass fishing in Clear Lake is better in the spring and early fall than at other seasons of the year when the fish are in deeper water.

During the past two years trappers of fur-bearing animals have secured excellent prices for their furs. The good prices have stimulated trapping so that many more trappers have been working. This heavy trapping has of course reduced the number of fur-bearing animals and it is more essential than ever that those that are left be protected at the season of the year when the fur is of small value. A statement made in Bulletin No. 1165 of the United States Department of Agriculture is very pertinent:

"American trappers receive yearly in the aggregate many millions of dollars for their fur harvest which up to the moment they set out to gather it, does not cost them a single effort. Recently, the supply of peltries has been decreasing at an alarming rate. Raw-fur buyers representing all parts of the country place the decrease at from 25 to 50 per cent during the last 10 years. There are no longer any virgin trapping grounds. Even in Alaska the two most important fur-bearing animals, the beaver and the marten, have become so nearly exterminated that they are now being protected by a closed period.

"Laws protecting fur-bearing animals are designed to keep a steady flow of peltries coming to market year after year, thereby bringing trappers a reliable income and giving regular employment to thousands of people engaged in dressing skins, manufacturing garments, and distributing them through the various avenues of trade.

"A general protest comes from raw-fur buyers against traffic in unprime skins. The losses caused by killing fur animals when their pelts are not prime are enormous. An educational campaign is greatly needed to prevent this waste and to perpetuate our fur-producing resources."

It is commonly believed by hunters and others that the fur-bearing animals feed primarily upon game and that these animals are responsible for the scarcity of game. Such, however, is not the case. Years ago, when game was more abundant than today, all fur bearers were also more abundant. The quail and other game knew how to hide their nests and to protect their young and themselves from those animals with which they were familiar. As soon as the human equation came in, then the game began to lose out. At first the muzzle loading gun was used, then as game became scarcer and more difficult to secure, the breech-loading gun, and at present the automatic, first with five shells and now in the duck regions with nine. Why not put the blame for the scarcity of game where it belongs and not hold the fur-bearing animals responsible? The natural food of the fur animals consists of small rodents, rats, mice, gophers, ground squirrels, etc. Of these we have more than an abundance in California. Of native species and subspecies there are 7 moles, 17 shrews, 73 mice, 39 rats, 16 ground squirrels, 19 gophers, besides the common domesticated rats and mice, a total of 175 species. Mice and rats are most prolific breeders. Seaton, in "Life History of Northern Animals", in referring to the breeding capacity of the meadow mice, says:

"To breed like rabbits is an old measure of fecundity, but those who established the standard were not fully acquainted with the Microtinae. These mice can marry, multiply and raise to independent age a whole family before the rabbits get much beyond the period of gestation. They begin in the early spring or even late winter, and seldom stop before snowfall. Meanwhile the young of the first breeds are at work in assisting the noble work of multiplying the race, supplying further toilers for the task of converting a world of vegetable matter into a world of sublimate flesh and blood, for the service and subsistence of the vast tribe of mouse-parasites known as birds and beasts of prey * * * "An animal which multiplies itself by six every six weeks would in six years possess the earth and more than fill its possession if something were not done about it. The voles (meadow mice) are very near such rate of increase. Fortunately there are numberless able reducers of the vole population eager to do their very excellent best but these do not any more than strike a balance. If they relax their efforts or fail in the least, the mouse millions break forth in devastating hordes."

The fact that destructive rodents are held in control by the fur bearers should not be lost sight of, as without doubt if mice and other rodents should be allowed to multiply without check, California as an agricultural and horticultural state would be a thing of the past.

Respectfully submitted.

(Signed) J. S. HUNTER,
Assistant Executive Officer.

REPORT OF THE SACRAMENTO DISTRICT.

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

SIRS: We submit herewith a brief report of the work and accomplishments of the Northern or Sacramento District which has supervision over a land area of approximately 39,107 square miles, or only 1378 square miles less than the area of the combined states of Massachusetts, Delaware, New Jersey, Vermont and Maine. Fifteen of the state's deputies work out of this office.

As much of the best shooting grounds for waterfowl and the best deer country is found within this district, the enforcement of law occupies an important place in our duties.

MARKET HUNTING STOPPED.

Market hunting in the Sacramento Valley has been reduced to a minimum. No doubt there is some traffic in ducks and other game, and while there is game, always will be more or less. Several convictions in the Federal Court for violations of the Migratory Bird Treaty Act broke the back of the "Colusa ground sluicers" with their double automatics. These guns carry ten loads that can be shot in six seconds. It is the

FIG. 23. Ducks (310 in all) confiscated from two market hunters near Colusa, Colusa County, in 1919. Market hunting in California is now a thing of the past.

custom for three or four of these hunters to sneak along on the ground in approaching ducks and geese and then turn loose the bombardment.

The difficulty of detecting sale transactions is evidenced by the following facts: One of the most notorious hunters maintained a joint in Colusa where ducks were disposed after the password had been given. So notorious had the place become for the distribution of ducks that traveling men had no difficulty in purchasing them at any time. It was the custom of these men to keep a supply of ducks on hand in order that they might guarantee the limit to so-called city "sportsmen" whom these hunters took out at so much per day. The surplus ducks were shipped to San Francisco and Sacramento under fictitious names to be distributed by agents.

The proprietor of this joint, with three other well-known market hunters, was detected on October 15, 1918, the day previous to the opening of the season, with 226 ducks and one snipe in his possession. Information was filed against these four defendants, Charles Guernsey, J. T. Maley, Frank Chambers, and Joe P. Meyers. They were indicted by the Federal Grand Jury and were tried by jury on February 4, 1919, at Sacramento, Judge Van Fleet presiding. The jury returned a verdict of guilty in eleven minutes, and the defendants were sentenced to pay $100 each or in default serve 60 days in jail.

Much credit is due state and federal wardens Carpenter and Ludlum, Deputy United States Game Warden E. S. Cattron and Assistant United States Attorney Johnson for the manner in which the case was handled. As this was the first case in California under the Migratory Bird Treaty Act, Judge Van Fleet did not impose a maximum fine, but warned all future offenders to beware.

The conviction of these men had a very beneficial effect. Should the legislature put the ban on the possession of this murderous weapon it will eradicate this class of market hunter, who is the twin of the "bull hunter" and will not take a sporting chance with other weapons.

DUCKS VERSUS RICE.

The difficult problem confronting the Fish and Game Commission regarding the alleged necessity of killing ducks in the rice fields, where it was claimed they were destroying rice, is about solved. United States Biological Survey has now assumed control and custody of the migratory waterfowl, and in order to cooperate with the rice growers in affording protection to their crops has appointed a resident United States Game Warden, Mr. C. F. Heuser. Stationed at Sacramento, Mr. Heuser is in a position to investigate all complaints. When damage by ducks is found efforts are made to frighten them from the fields by means of the automatic flash gun or lantern, the use of bombs, and black

powder without shot. All of these protective methods are proving very satisfactory if used intelligently and with the full purpose of obtaining relief. Because of the success attained the warden is receiving the cooperation of many rice growers in protecting both the rice and the waterfowl until the open season established by the government.

California could most effectively rid herself of the rice and duck problem by asking the United States Department of Agriculture, and the California State Legislature to fix an open season to conform with both Oregon and Nevada, where the season is October 1 to January 15. This would permit the rice growers to legally protect their crops where it might be found necessary. It would also allow the residents of the extreme Northern California counties to kill some waterfowl before these birds leave on their southern migrations. These residents claim, and justly so, that they are discriminated against, as by the time of our existing open season the waterfowl have nearly all left for the lower valleys.

RIVER PATROL.

The launch patrol on the Sacramento and San Joaquin rivers and tributaries is most efficient. With the addition of the fast cruiser "Rainbow," whose speed is twenty-six miles an hour, the patrol is able to more than double its cruising radius. The phenomenal run of striped bass in the Sacramento and San Joaquin rivers during the closed season for nets demonstrated that few, if any, nets have been used during the closed season.

STATE FAIR EXHIBIT.

The Fish and Game Commission's exhibit at the State Fair at Sacramento, August 30 to September 9, 1919, was the most pretentious yet attempted and proved to be the biggest attraction at the fair. A capable engineer was retained to draw the plans and Mr. Wm. F. Dabelstein, an artist of San Francisco, executed them. The whole north end of the new Agricultural Building was given over to the exhibit. The main feature of the exhibit was a cyclorama of the Sierra with Mounts Shasta, Lassen and Whitney looming up in the background and in the foreground the south end of Lake Tahoe at one end and a miniature of the Mount Whitney Hatchery at the other. Several miniature waterfalls tumbled down the rocks into an artificial lake filled with trout. The whole scene was made still more attractive by a system of lighting which successively showed the gray light of dawn, the rosy tints of sunrise and the light of full day.

Arranged in front of the panorama were four large aquaria. Two of them showed common introduced fish such as black and striped bass, bluegilled sunfish, crappie and catfish, a third showed different varieties

of trout and a fourth was filled with the famous golden trout of the Mount Whitney region. Great interest was shown in the golden trout, and no wonder, for their bright colors would attract anyone. The hardiness of this variety of trout was evidenced by their vigorous good health while in the aquarium. Not a fish was lost in transit, nor did one die during the ten days duration of the fair.

The publications of the Commission were on display and wild life films were shown in the motion picture theater twice daily.

The exhibit was remodeled and improved for the 1920 fair. The observation platform was moved farther away, additional foothills were added and a miniature electric train, with bridges and tunnels, was installed and better lighting effects supplied. Of particular interest this year were the added cloud effects. While changing colors which lighted the mountains showed the change from day to night, clouds swept across the sky and later the stars appeared. This was followed by the rosy tints of morning.

Visitors to the fair unhesitatingly stated that this exhibit was not only the finest exhibit on the fair grounds but the finest ever shown in the West, even exceeding any of those shown at the Panama-Pacific Exposition.

As in previous years there was a splendid aquarium display of food and game fishes, including a splendid exhibit of introduced fishes of valley streams and the famous golden trout.

TAHOE FREE CAMP GROUND.

The Legislature at its last session set aside the old hatchery grounds at Tahoe City, which were to be abandoned for a better site, as a public camp for vacationists. Under the direction of the Fish and Game Commission the State Engineering Department installed a water supply, sewer system and other sanitary conveniences. The camp was opened to the public on July 4, 1919, with Mr. Arnold D. Patterson as superintendent. On the first day over a hundred campers were cared for. The camp remained open until September 5. During the season 1239 persons registered, but this number does not represent the total number accommodated.

In the summer of 1920 the attendance was not as large as the previous season, considering the length of time the camp was open, which was no doubt due to the shortage of gasoline.

Among the added attractions this season was a profusion of beautiful flowers bordering the drive and walks. Camp closets, or cupboards, were also installed in each camping spot, where campers could keep their supplies.

There were visitors from every state in the United States, and every county in California. Every one of the 1396 guests voted that it was

the best equipped and managed free camp in the state and many letters of commendation of the management have been received. The expenses of operation of the camp are maintained by the hunting and angling license fund.

SUMMARY OF GAME CONDITIONS.

Game Fishes.

The drought has had a most detrimental effect on game fishes, especially trout. Many of the mountain streams went entirely dry in early July and August, streams that in the history of the state were never known to be absolutely dry. We believe the open season is entirely too long. If the present demand upon our streams continues to expand and no provision is made to meet that demand either by reducing the length of the open season or the bag limit, it will be but a few years until our smaller streams are entirely depleted except by the small fry annually planted. A large amount of fish reclamation will be necessary this fall, both in the valley and mountains.

The fishes introduced by our Commission from other states, such as striped and black bass, crappie and sunfishes, are now widely distributed and furnish an abundance of sport and food for the population of the valleys and interior. The striped bass have penetrated into the upper Sacramento and San Joaquin rivers and their tributaries, and in their seasonal runs furnish sport and food for many anglers on week-end outings, who otherwise cannot take annual vacations elsewhere.

Deer.

Every county in the district contains deer in some numbers. Many are killed within a few miles of the Capital City. There has been a most phenomenal increase in the last years of this splendid game animal. The Hayfork Valley lookout from his ranger station counted 170 deer on July 31. The Bally Mountain lookout reported having counted 1170 deer during the month of July. The relentless war waged by our Commission on the mountain lion, and the increase in the warden service, which has reduced the winter killing, is no doubt partly responsible for this wonderful increase. Especially is this true in connection with the Lava Bed country of Modoc County, where mule deer abound.

Mountain Quail.

Mountain quail have also shown a wonderful increase since our last report, probably due to the very limited fall of snow in the last few years in the areas in which these birds winter, and the vigilance of the district wardens. In 1915 and 1916, this species was all but destroyed by freezing and starvation in the counties of Shasta, Tehama, Lassen,

Modoc and Plumas. The remnant which survived were fed by our wardens. Happily they have now increased in their former numbers.

Valley Quail.

Reclamation is diminishing the area where quail find food and shelter and consequently they are perhaps decreasing, except in localities where they are protected at all times by the vineyardist or orchardist, or where they are not subjected to intensive hunting. However, this grand bird is reported by our district wardens as being fairly numerous.

Doves.

After the United States Department of Agriculture assumed control of migratory birds and established an open season for shooting doves commencing September 1, dove shooters predicted it would practically bar them from shooting this bird. However, this has not proven true. Doves were noticeably plentiful in the Northern District on September 1. Many limit bags were made on fully grown, strong flying birds. If this season prevails for a few years, allowing doves to rear their full quota of young, they will be as abundant in September and October as they are in July and August.

Grouse, Sage hens.

These birds likewise have benefitted by the minimum of snowfall for the last few years, and are reported fairly numerous in some districts. In Lassen and Modoc Counties, sage hens are notably abundant. It is to be regretted that the California law on these birds does not conform with the Oregon and Nevada laws, which place the open season from July 15 to August 15. By this date the birds become so strong with sage, which renders them not fit for table use, that California residents feel they are discriminated against and consequently blame the Commission.

Ducks, Geese.

The last three or four years of drought in California have been of inestimable benefit to wild waterfowl, inasmuch as the lack of water in the usually overflowed areas of the great San Joaquin and Sacramento valleys has driven these birds to the extreme southern portion of the United States and Mexico, where water conditions were more favorable and where these birds are immune from the great army of California hunters.

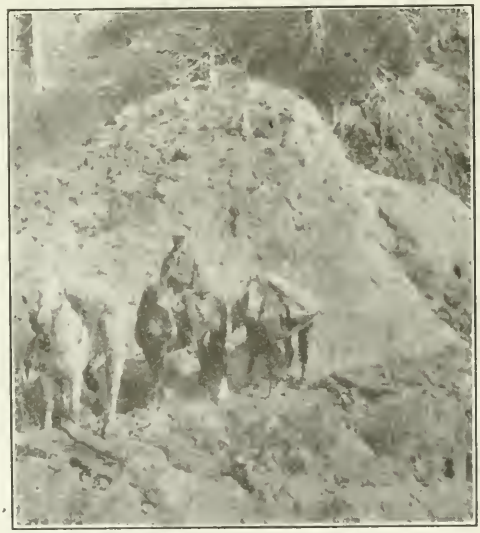
Fur-bearing Mammals.

The business of trapping fur-bearing mammals has grown by leaps and bounds in this district. The law protecting them until the furs are

FIG. 24. Alex Reichel, a trapper, with his take of furs caught in Trinity County, in February, 1920. These furs sold for $178. From left to right the furs are ringtailed cat, raccoon, fisher, raccoon, river otter, raccoon, fisher, raccoon, ringtailed cat.

at their best is most strictly observed and is very popular with the man who traps for profit.

The Sacramento Division makes grateful acknowledgment of the splendid service rendered by officers of the several National Forests in this district. They have capably and efficiently assisted our wardens and cooperated in enforcing the fish and game laws. Grateful acknowledgment is also made of services of the deputies of the Sacramento Division and of their loyalty, efficiency and hearty cooperation so readily given to their office and to their fellow wardens. No hardship is avoided, no day or night is too long, and no dangerous detail is shirked in the performance of duty.



[illegible] on patrol work in the mountains. Game laws are enforced in the hidden fastnesses of the mountains as well as in the more populated districts. Photograph by Euell Gray.

Respectfully submitted.

(Signed) GEO. NEALE,
Assistant in Charge.

REPORT OF THE LOS ANGELES DISTRICT.

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

SIRS: We are pleased to present the following report of Southern Division activities in the cause of fish and game conservation during the biennial period closing June 30, 1920.

Our policy during the last two years has been one of steadily increasing and ever more detailed frankness with our masters, the public. It has been dictated with particular reference to the sportsmen and commercial fisheries interests, which jointly finance our work through their contribution of licenses and other special forms of taxation. Never have we lost sight of the peculiarly direct responsibility devolving upon us for a frequent and frank accounting to the general public, as well as to these earlier, but no less certain, beneficiaries of this great trust that has been placed under our charge.

PUBLICITY.

We have consistently sought through the ever charitable medium of our generous southern California press, to advise the people, by means of a continuous and systematic newspaper campaign, using widely circulated articles of live news value, written from the viewpoint of those specially interested, and distributed with all possible consideration of newspaper ethics. We have sought to make this service timely, by seeking to diversify it among competing journals and by investing it with an individual flavor, giving due regard to style requirements where known. Such a course has unavoidably involved a very considerable increase in the purely physical part of the work; but we believe the general appreciation shown has more than justified it.

Today, we believe it can truly be said that the public of southern California is not only virtually unanimously behind the conservation of fish and game, but also that it has a better working idea of operating problems and difficulties, and is in closer sympathy with our efforts than ever heretofore.

LAW ENFORCEMENT.

In a work the success of which must be measured by the degree of cooperation attained on the part of the people who first must be awakened from their normal apathetic view to the realization of the value of conservation, the importance of such results is easier to underestimate or to ignore than to embody in cold figures. However, the statistical proof is not lacking. It is to be found in the steadily increasing percentage of convictions to prosecutions, and in the materially mounting average penalty per conviction.

When, from a percentage of 90.8, the convictions in one year jump to 96.4; and the average fine ascends from $33.53 to $36.51; with the number of convictions rising from 109 in 1919 to 136 in 1920, supported by fines of $3,252.50 in 1919 swelling in one year to $4,966, there appears considerable tabulated food for thought. If these figures do not reflect a stiffening of public sentiment in favor of strict enforcement of the conservation laws, what then shall be said at the almost doubled totals of days of jail sentence imposed last year as compared with the twelvemonth preceding? The figures were 245 days against 480 up to June 30, 1920. Likewise, the total number of prosecutions increased from 120, in 1919, to 141, in 1920, despite very satisfactory evidence that the laws are being respected more generally than ever before.

Had statistics been founded sufficiently early to show the increase in popular cooperation as expressed in information written, telephoned or given by personal call, the figures would undoubtedly have shown an even more sensational gain. Establishing the rule that no such call should ever fail to receive the promptest and most painstaking attention, it has become possible to build up a very considerable volunteer intelligence service which is steadily extending over the country, and proving of the very greatest value in putting a practical point to patrol work by focussing attention upon centers of violation. In a territory so comprehensive as southern California, and one whose fishing waters and game-fields are so widely separated, something of this sort is an essential preliminary to effective accomplishment. With an area larger than many states, yet containing seldom more than one regular appointee in any one county, nevertheless, the law-abiding sportsman insists upon seeing the fish and game laws enforced far more extensively—and intensively—than the ordinances of his own city where a hundred times as many specially trained patrolmen are inadequate to prevent nearly every law on the statute books being broken repeatedly every day. Nevertheless, there is but one course open, and that is to bring up the service to the utmost efficiency possible under the controlling conditions. This is being done, and nothing is overlooked that may tend toward further enlisting that public confidence which manifests itself most practically in the form of whole-souled volunteer cooperation.

There was a time when deserving volunteers, desirous of aiding directly the enforcement of fish and game conservation laws, could be specially deputized; but all such unsalaried help has now become impossible owing to the Employers' Liability acts, which are construed as placing a fair charge against the conservation funds for any injury that might befall even an unsalaried officer, if operating under authority conferred by this Commission. Since no man can waive the rights of his heirs in him, the numerous applicants for special badges have been

enlisted, so far as possible, as informants and cooperators in such other lines as were possible, although a considerable part cannot understand just why the state cannot take a sporting chance upon their services toward the conservation of sport.

Likewise, were it possible to keep an accurate record of requests for information coming along the various avenues of inquiry—mails, telephones, calls at the office—the percentage of increase would be found to have approximately doubled each year. While in great measure such increases may be due to the establishment of a comprehensive and accurate "Sportsman's Information Bureau" as an adjunct of its general work, the explanation is in part found in the steady widening out of the Fish and Game Commission's activities; and to a natural following up of the very great annual increases in the numbers of hunters and anglers licensed.

LICENSE SALES.

Most public service bodies are charged with the expenditure of moneys turned over to them from the general tax funds on a prearranged basis which admits of budgeting expenditures, and arranging outlays in advance. The Fish and Game Commission happens to be numbered among those which must support their own efforts by a direct taxation of the more immediately benefited class; and for many years past, conservation has in no sense been a charge upon the general tax funds of the state. Surely, in a state whose phenomenal growth stands as a monument to the pulling power of her manifold attractions, no extended elaboration of the argument is necessary; and it is needless, for the sportsmen of southern California have most nobly proved, not only that they can, but that they most heartily will, pay the costs of propagating and protecting fish and game. Nor do they ask more than that their moneys shall be expended as intelligently and as effectively as a board of business men, backed by the ablest experts in their several lines obtainable, shall direct. With the collection of those moneys, the average sportsman has little concern; but since the financing of conservation work is its very foundation, the Fish and Game Commission must needs give the utmost consideration to increasing its revenues by greater placing of licenses, since each brings in the single dollar income that was established when a dollar did double duty as compared with today.

To the end that the public might more easily procure licenses, and revenues be increased by a larger volume of sales, Commissioner M. J. Connell, who has charge of this Southern Division, recommended, and after considerable effort, secured a law which permits the Commission to issue—not to sell—any number of licenses to any selected agent, to exact a bond, or cash-deposit equal in value to the amount of the licenses

so issued, and to allow agents so selling licenses, the legal commission of ten per cent.

In conformity with this law, innumerable such agencies have been created, sporting-goods stores, hardware and general merchandise houses and post offices among others. In addition to this already comprehensive distribution, the Automobile Club of Southern California has now placed our licenses on sale to its 50,000 members through its main office in Los Angeles, and its twenty branches in all the leading cities of southern California. The Automobile club not only has cooperated most cheerfully in every way through dissemination of information through the wide and highly specialized sporting circulation of its "Touring Topics" magazine; but has with most commendable public spirit, waived its lawful commission of ten per cent on the large volume of licenses sold, thereby establishing a laudable precedent.

Today, the hunting and angling licenses are so easily obtainable in southern California that nobody has the least excuse to be without. The requirements of the law are so universally known, and so conveniently complied with that convictions for lack of licenses are now negligible.

It is particularly gratifying that the gain in our revenues through thus convenienceing the public, has been attained without the loss of a dollar, or any dereliction in accounting, notwithstanding the broadcast nature of the distribution. The system is now so organized that a loss is virtually impossible, the Fish and Game Commission being entirely safe-guarded in advance, placing the entire responsibility right where it belongs—namely, upon those who are being paid ten per cent for their services to the state. Nor can the very large number of firms thus financially interested, be overlooked as a contributing factor in stimulating the sale of sporting licenses. These merchants are not overpaid for their time and trouble; but their profit comes in the very considerable advertising value incidental to the issuance of licenses, which bring people into their places of business to leave many a dollar in trade that otherwise would go elsewhere. Today, a more loyal or conscientious organization than these sales agents would be difficult to discover.

The story of conservation in southern California reads like a romance; nor has the last biennial period proved its least interesting chapter. Rather, the reverse is true.

Confronted by a combination of conditions seemingly prohibitive fifteen years ago—with a population increasing beyond any known precedent and agriculture ever reaching out for all arable lands, as intensive machine farming methods increased human capacity for cultivation—there seemed but a dismal future for the gentleman's field sports of angling and shooting.

Handicapped by a scanty legislative appropriation that was hopelessly inadequate, no one dared hope to ever finance conservation work upon a scale adequate to handle the magnitude of the job, that even then had made itself manifest to those whose lives are devoted to this public service.

The hunting license was then a new, untried thing; its possibilities problematical, so much so that Senator H. M. Willis, himself a southern Californian, sensing something of the local need proposed and indeed did, for a time, succeed in limiting the use of revenues thereunder arising to the introduction and propagation of alien species of game. From that early day to this, when conservation no longer asks support from the general public, is indeed a far cry. But now that the sportsmen have, through an enlightened popular sentiment, come to consider their hunting and angling license investments as virtually a contribution to the general good of game and fish, there has been a steady increase year by year, not only from immigration, but internally as well.

GAME CONDITIONS.

Some years after the establishment of the hunting license the Fish and Game Commission concluded, somewhat hastily, that propagation of game birds and introduction of alien species did not pay. It was then felt that careful conservation of indigenous species was more productive than experimenting with exotics. Whether that conclusion was entirely sound has for some time appeared debatable. Increasing cultivation involved changing conditions for game, development of water, and different crops. But of all developments questioning that conclusion, nothing could have a more unsettling effect than the phenomenal success attendant upon the artificial propagation and introduction of Chinese pheasants in the Owens Valley of Inyo County. This alone is unquestionably worth every penny this state ever spent upon the propagation of game. To such extended range and in such considerable numbers have these traditional game birds of royalty increased that a short open season with low bag limits is only a matter of time, meaning thus the actual addition of these magnificent fowl to the already long list of California's game. Today, a hundred of them may be seen in driving through the extent of their range in Owens Valley from the salt lake to the foot of Long Valley, delighting the motor tourist with their gorgeous display of coloring as they strut about the stubble fields and run or fly across the road, quite tame, usually in pairs, but often in considerable family parties.

At present, a plan made eight years ago by Commissioner Connell for sending a well equipped expedition into southern and southeastern Mexico in quest of the Grayson bob-white is held in abeyance await-

ing sufficient settlement of internal troubles in that revolution-rent republic. It is proposed to make the final arrangements as soon as such order is restored that such a mission will not imperil those delegated to so important a service. In the meantime, investigation of the living conditions and habits of these quail has progressed far enough to give every reasonable assurance that they are desirable from the sportsman's point of view, as well as promising to succeed in southern California because of the similarity in climatic conditions with their present habitat. No less an authority than Edward W. Nelson, Chief of the Biological Survey, has advised the California Fish and Game Commission to that effect, which brings probably the ablest judgment in the world to this question.

Among the problems of those who seek to protect and increase game, in southern California particularly, one of the foremost is the maintenance of suitable natural conditions that will encourage the residence, and particularly the breeding of our indigenous game. Without this, there is no foundation upon which to build in its behalf. Settling up of the country unavoidably means turning tillable land beneath the plow; and the subdivision of the large land-holdings of but yesterday is bound to bring a continuing menace to the maintenance of the game. Smaller owners are almost certain to cultivate more intensively, where the big proprietors left large ranges for stock, crops nowadays are going in, often but not always to the deprivation of the sportsman of his most desirable upland "happy hunting grounds." There is some comfort in the knowledge that many crops add something to the food supply of game; but none can deny the curtailment in breeding grounds, notably of quail, in the more thickly settled areas.

In various ways the conservation authorities have sought to meet this issue in the south following the general state plan. Previous legislatures provided the necessary enabling acts preliminary to the setting aside of suitable areas for the natural propagation of game. In the aggregate, millions of acres in the national forests have thus been reserved in the form of game refuges. These, under the Districting Act, must each be created separately and in a definite numerical rotation even as the larger Fish and Game Districts, which were dictated by the desire to harmonize open seasons with the wide variance in breeding habits incidental to California's continental climatic range.

The game refuges of southern California were altered somewhat both as to boundaries and as to regulations by the last legislature, the aim being to render them as efficient as possible. Anti-vermin campaigns were conducted in some of them, with very material results, not only directly in the decrease of predatory vermin but to the very evident benefit of the game therein. While the area of the Angeles

Forest refuges in particular is so great as to be unwieldy and virtually impossible to patrol efficiently, the forest rangers have cooperated toward this end more generally during the biennial period than ever before. As a result of a number of rather unusually favorable conditions, it may now be said that the withdrawal of these vast areas from the sportsmen appears to have gained them more game than it has cost. Deer hunting has been more productive around the borders of these refuges than elsewhere, due to increased game overflowing into the adjacent country. The very material stimulus given to trapping by the unprecedentedly high prices of furs cannot be overlooked as a contributing factor. For years, sportsmen have urged energetic anti-vermin campaigns upon the part of the state conservation forces. Prior to the last legislature, the Fish and Game Commission entered upon an experiment to determine what could be expected from putting expert hunters into the refuges to thin out species predatory upon game. While the experiment was entirely successful, and gave good reason to believe that substantial results could be attained in that way, the "war prices" on furs relieved the conservation authorities of any greater responsibility along this line than that involved in licensing trappers and keeping a certain surveillance upon them. There are always a few who need watching, but in this matter, so far as the south is concerned, the exception appears to have proved the rule. One gang of trappers in the southern Sierra of Tulare County, after a systematic campaign wherein the southern patrol force united to collect and link up the evidence necessary to prove up the offense, paid some of the biggest fines ever collected in fish and game annals, for winter slaughter of deer. The job was successful in securing pleas of guilty, and a thoroughly outraged public sentiment still awaits the chief offender for further punishment, despite the large fine he paid.

No bounties within the state's power could possibly have so stimulated warfare upon predatory animals as the high prices of furs. Since virtually all the fur-bearing species are predaceous upon game, several being in fact so classed, the aggregate benefit to the mountain game supply of the state is enormous. Good figures for skunks and other small pelts have caused many a farmer's boy to turn his spare time into good service for the sportsman as well. While fur prices are on the decline now they are still high, and so many have formed the "trapping habit," so to speak, that there is good reason to hope for a continuance of this general campaign against the so-called "varmints" of the old time Nimrod. Remembering that these vermin work day and night the year through, without respect for season or bag limit, one cannot but feel considerably encouraged over the game outlook. Obviously, the logical way to meet the situation is to substitute man for the vermin-

ous factor in the natural equation. Nature strikes her balances inexorably, but by reduction of animal enemies more remains for the hunter.

COMMERCIAL FISHERIES.

Development of the Commercial Fisheries of southern California has enforced paying of particular attention to problems of the industry in this end of the state, the Fish and Game Commission being forced to establish two branch offices in the great centers of the fishing and packing business at San Pedro and San Diego. Meanwhile, a steadily widening scale of scientific investigation has been carried on, financed by collections of class-taxes levied upon various phases of the fisheries. While always the major part of the revenue will come from licensing of market-fishermen at $10 each, the privilege and poundage taxes upon preserving of fish add considerably; and the extensive patrol activities of the state's patrol launch suffice in considerable degree to finance themselves through fines collected. The inclusion of Santa Catalina Island in two districts one of which is rather narrowly limited to certain classes of net fishing, and the other and nearer entirely closed to commercial exploitation, has of course proved a most fruitful field for the state's patrol activities at sea. Unavoidably, during the busy summer canning season, when high prices for tuna and albacore place every possible premium upon getting the fish wherever they are to be found, the courts have been kept congested with the over-ambitious netmen. Encouraging prices have stimulated a large migration of purse seiners from the virtually depleted waters of the northern salmon ranges to southern California; and a long association with the uncertainties of the International Boundary in the Straits of Juan de Fuca appeared to have inspired a considerable percentage of these newcomers with a general contempt for all fish and game law.

Due to the carefully programmed methods devised for handling the always serious problem of regulating alien fishermen upon the sea, it has been possible during the last summer to inculcate a due and proper respect for the written law among these visitants, and whether they remain or return, the conservation authorities feel that there will be very much less trouble with them in the future. While some stiff fines were imposed, and a few verbal clashes were unavoidable, the ends of justice have been served without any violence upon either side. A policy of dignified firmness was outlined by the Commissioners in the attempt to do no one any injustice. On the one hand were the large packing interests clamoring for fish and ever more fish to pack who are backed by the enormously increased fleet of largest sized fishing boats equipped with the most extensive gear known. On the other

side stood the law bitterly attacked by able counsel as essentially "class legislation" in favor of wealthy sportsmen. With these differences of opinion, the conservation authorities steadfastly refused to have anything to do. Once a fish and game law is enacted in California, that removes the Fish and Game Commission from any duty or responsibility other than its enforcement. Bitterly criticised by both parties to this conflict piscatorial, blamed by the fishermen for its zeal, criticised by anglers for its alleged apathy, the fact remains that persistent prosecutions have been met by suspended sentences of late in the very strongholds of this latter criticism so the only logical conclusion must be that on the whole the situation has been fairly well met. Today, with the constitutionality of the disputed law upheld, its enforcement must rest with those justices whose sworn duty it is to properly penalize violators whom the state's patrolmen bring before them.

It has required no small amount of consideration to enable the conservation authorities to keep in touch with so rapidly changing a situation as the regulation of fisheries on the southern California coast alone during the past biennial period. Without discretionary power there has been no adequate manner of meeting emergencies of supply and demand, so the only possible course has been a policy of enforcement until necessary alterations in the laws could be made by the forthcoming legislature. Many measures initiated two years ago have completely vindicated themselves, others in the nature of things have unavoidably proved inadequate. So long as no arrangement exists to adjust regulation to immediate requirements, even in matters so transient and ever-changing as fish and game conditions, the conservation authorities will be compelled to attempt to fortell the developments of many months ahead.

This uncertainty has encouraged the Fish and Game Commission to enter upon what probably is the most extensive program of scientific research along fishery lines ever undertaken by any of the states. While the need is state-wide and the work has not been limited sectionally the phenomenal growth of the fish-packing industry has naturally focussed attention first upon southern problems, although these in a great measure have a relation and bearing upon the situation elsewhere.

The time already has arrived when the one boat charged with patrol and scientific research is hopelessly inadequate, there being enough demand in either line to occupy her entire available time. It is probable that eventually the excellent and seaworthy patrol-cruiser "Albacore" will be detailed to scientific work, and replaced with a faster, bigger craft for the regulation of fishermen. When built, the "Albacore" was superior to any, but the growth of the fisheries industry has been

by such leaps and bounds that today she is no more than abreast of the demands made upon her and within another biennial period, when swift refrigerating carriers are operating between the local distributing points and the source of probable future fresh fish supply in far southern waters, obviously something more will be essential. In seaworthiness, comfort, economy, endurance, the "Albacore" has done all that was expected of her, and could not be duplicated today at her original cost.

Numerous complications are injected into the regulation of California fisheries by the proximity of the virtually virgin west Mexican banks off the coast of Lower California. Political uncertainties below the line have rendered the fishing business in southern waters a species of "get there first" game, rather preventing the effective and intelligent exploitation of these enormous, perhaps inexhaustible fishery resources, which so well might be employed to allow certain of the locally depleted species to recuperate. Until something definite evolves out of the southern situation, Mexican fish will merely continue to be an indefinite, unsettling factor in the fresh fish business, occasionally glutting the market, again falling into monopolistic control, yielding but a small part of their potential possibilities. Competent observers consider the southern supply of fish as far in excess of what California's colder waters ever could show and general observations by the state's research experts go far to confirm that conjecture. Eventually this supply will certainly become available to California under modern and efficient refrigeration.

No section of the state has been so clamorous and exacting in its demands upon our fishcultural facilities as southern California. With her population mounting by unprecedented figures, it seems as if an abnormal proportion of the increase were anglers. While in measure such a condition might be construed as a testimonial to the efficacy of the Fish and Game Commission's consistent campaigns in advertising the south's sporting attractions, which find a ready ear with the large leisure class attracted here by climatic opportunities for year-round enjoyment of outdoor sports. Certainly the fact remains that fishing never was more popular anywhere than here.

ANGLING CONDITIONS.

Favored none too bountifully by Nature in the way of natural waters, the very scarcity of streams and lakes has brought by artificial means its own remedy. Growth of population and cultivation has enforced the conservation of water and its development wherever possible. The situation was appreciated in advance by those whose thoughts are shaped along the line of providing the people with healthful sport afield. From the very first, fish were planted in the reservoir lakes generally

with encouraging success. As a result, the angling attraction proves potent enough to finance further efforts.

The scanty streams of southern, steep gorge watersheds do not lend themselves to the natural maintenance of trout. Too much water, or too little, is the ever present menace. Many a stream is planted annually in the certainty that there can be but little natural propagation therein. The best trout lake in the extreme south, Big Bear, in the San Bernardino watershed, is now, and for some years past has been on an essentially artificially maintained basis. The natural spawning facilities in its short, steep creeks are under ordinary conditions virtually nil. At considerable expense, the Fishcultural Department has installed two hatcheries, with spawn-taking racks and has sent a crew of its most skilled men into Bear Valley every spring to gather such eggs as Nature offered, these were hatched in the local plants for distribution in the lake and streams of the range. Last spring, although facilities had been almost doubled the fall before, the egg-take followed the general rule in the state and fell off until not enough eggs were available to operate to full capacity, even though the turnoff was about that of the year before.

In measure, Big Bear Lake's great popularity as the "Tahoe of the south," so-called, has proved its undoing for mid-summer sport at the height of the season and the concentration of the water through several dry seasons has played a part. The number of adult fish seen every spring at the spawn-taking stations and out in the bays at the creek months has indicated an abundant supply. Fishing is always good enough to satisfy the most ardent fishermen both early and late in the season. The state's students of such conditions are of the opinion that a normal winter will restore the fishing to its former sustained excellence, its consistency being one of the most remarkable things about it in past years.

Realizing several years ago that southern California's demands could no longer be met by long shipments from the mother hatchery under Mount Shasta, Fish and Game Commissioner Connell set about searching for a site combining the necessary conditions of cold, pure water in certainty of supply, with accessibility to transportation and after long consideration, the eastern Sierra was selected as a site for the splendid Mount Whitney Hatchery, which today supplies the lower end of the state, as well as the enormous aggregate area of fishing waters within motor-truck and pack-train reach of its troughs.

Had it accomplished nothing remarkable beyond the successful rearing of the rare and delicate golden trout, the Mount Whitney Hatchery would have successfully established itself among the great fishcultural institutions of the world. But in addition to this hitherto

unprecedented accomplishment, the remarkably favorable waters of Oak Creek upon which this latest of trout hatcheries is situated, have set new records for the growing of all kinds of fry. Its site was chosen with the same realization of increasing future demands that has actuated the Fish and Game Commission in all its recent enterprises. With not a minute's prematurity in its forethought, the Commission set about building up the barren lakes of the Sierra as soon as the Mount Whitney Hatchery began to operate. Consequently, sportsmen have found fish teeming in many a lake that three years ago was barren. They have enjoyed the keenest of the fly-caster's sensations in battling with the wonderful golden trout in those high, crystal-clear lakes. To such an extent did the needs of the situation impress Commissioner M. J. Connell that he personally took charge of the distribution of the 600,000 odd golden trout reared in the Mount Whitney Hatchery from the "take" of eggs at Cottonwood Lakes this year, limiting the planting to specially selected and barren waters which henceforth are to be golden trout lakes and streams, thus providing an infinitely pleasing variety to the summer Sierran camper. Large federal motor-trucks lend a most businesslike air to the distribution of trout from the Mount Whitney Hatchery, but of course the actual planting is a laborious pack-train proposition, tedious and expensive at best.

FIG. 26. Mount Whitney Hatchery, showing newly improved grounds. Photograph by J. L. Von Blon.

Extensive improvements in the grounds at the Mount Whitney Hatchery have made it such a show-place that many visit it every week, making the short drive from the main Eastern Sierra Highway, and feel well repaid for the trip. Thanks to the cooperation of Park Superintendent John MacLaren of San Francisco, a particularly harmonious bit of landscaping has been consummated. The general effect is a natural park, the typical trees and plants of the region having been used. As one approaches through the great rough-stone gate, the view is entirely commensurate with the nobility and dignity of California,

Fig. 27. Fish pond and gardens at the Mount Whitney Hatchery. Photograph by J. L. Von Blon.

and in perfect keeping with the enduring character of the primeval Sierran surroundings. To have neglected this "finishing touch" upon a work so eminently successful in all its practical features would have been to stop short of attaining an accessible ideal. The sportsmen of southern California can well take a lasting pride in this, their most substantial and most tangible accomplishment.

A most encouraging measure of cooperation in all lines of conservation work has not failed to extend its influence to the actual physical work of planting the fish reared in the southern hatcheries, particularly over the past biennial period. Without such public interest and assistance, it would be impossible to distribute the output of the hatcheries

under existing financial conditions. Gradually, the Fishcultural Department has built up an elaborate system of employing and organizing this popular enthusiasm by turning it to a definite service. Many men are planting fish now who have been doing it in the same waters for many years. In San Bernardino County, the board of supervisors undertake the entire distribution, the resident deputy is in charge, and the work occupies the better part of two months, being done in an intensive manner. It has maintained sport at an attractive level despite what doubtless are the greatest demands which have ever been made by anglers upon any similar lakes and streams.

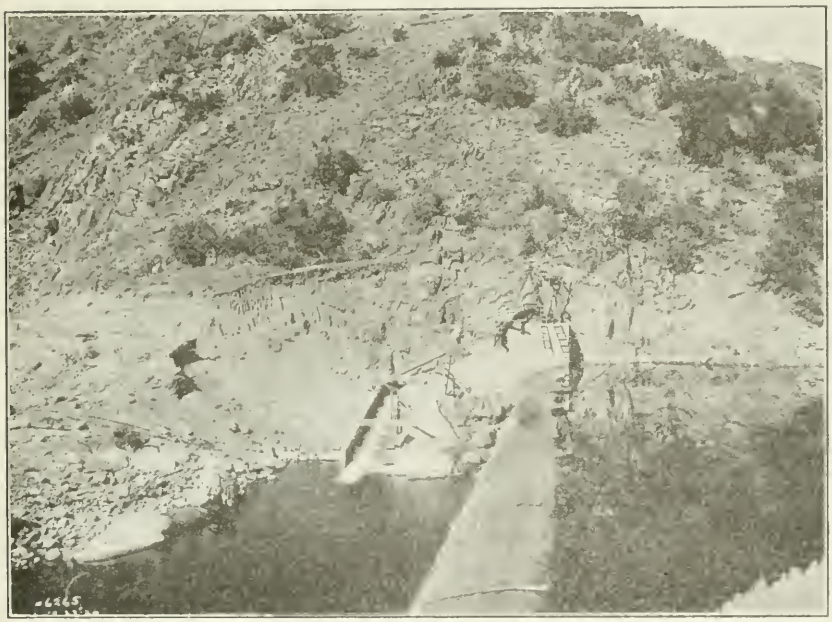


FIG. 28. Newly finished fishway built by Southern California Edison Company at Kern River plant No. 3. Built according to plans furnished by the Fish and Game Commission.

No consideration of fishcultural work in the south would be complete without a reference to the "people's fish"—the large-mouthed black-bass. Introduced into the north years ago, the lusty "bronze-back" thrived amazingly in the warm waters and congenial environment of the artificially established southern reservoirs. Today, business men can, and do, take nice catches of good sized bass right in the city limits of Los Angeles, enjoying sport in all the celebrated methods, casting the fly, using the short "plug-bait" rod or various natural baits. When it is considered that only a few years ago there were no bass in the south, and no prospect of any, their introduction identifies itself as something of an achievement in behalf of the sportsman-angler

Such ready accessibility is by no means the least of its charms and it holds a bright future as further flood control and reservoir projects materialize.

Such success has attended the introduction of bass in certain of the San Diego city water service reservoirs that a well warranted plea for an entire removal of the winter closed season upon these fish is being made to the present legislature by those who argue correctly that the fish are best for the table in winter and have so increased that in the present open season the anglers cannot hold their numbers within the limits of desirability.

The efforts with game have not been relaxed during the biennial period. By stricter legislation and by steadily increasing the measures toward enforcement of law, the state has been building its best against the certainty of increases in demand each year. Propagation of game is to be reinforced by wholesale importation as soon as the experimental work has demonstrated the right species with which to win.

Nor have the activities of the California conservation commissioners been comprised entirely by limitations of sportsmen. Rather, the aim has been to stimulate field-sports, to encourage a wider use of our wild life resources by a greater number of outdoor exploiters every succeeding season. In every practical way, this object has been advanced. Information has been distributed broadcast through all available channels, and always hand in hand with the most direct aims of conservation that there may be more fish for which to angle and more game to hunt.

Last summer, after several conferences with leading sportsmen and business men of the Owens Valley, where the attraction value of fish and game are appreciated at par, Commissioner Connell succeeded in organizing a movement for the building of a trail into the now virtually inaccessible "Sixty Lake Basin" above Mount Whitney Hatchery, in which wonderful wealth of previously barren waters, the Fish and Game Commission has planted and built up such a stock of trout, two miles above the sea, that until additional feed was introduced, the fish had increased beyond the capacity of those high lakes to fatten them. This last year, exploration parties found them in prime condition awaiting the flies of the sportsman. As a result—partly of the successful acclimatization of the fish, partly of the organization of local sentiment in favor of making this entirely new vacation ground easy of access another summer—an excellent trail is being surveyed. Thus, the present top-heavy demand of southern California sportsmen upon the Mono Sierra will be diversified by this virtually virgin counter attraction one hundred miles nearer the center of population.

Such linking up of all the otherwise diverging lines in behalf of a direct, straight-from-the-shoulder policy of encouraging, regulating and

controlling sporting enthusiasm along the course of greatest general benefit to the entire public, never losing sight of the main uses of fish and game as inducements toward the healthful, recreative outdoors is characteristic of the California policy of conservation, nowhere better or more earnestly exemplified or appreciated than in this Southern Division. It remains our hope, as it certainly is our object, that these efforts shall never be curtailed or narrowed in their striving for that goal. Always the idea of undeviating public service along the lines of the greatest general good to the people must remain the aim.

Respectfully submitted,

(Signed) EDWIN L. HEDDERLY,
Assistant.

FISH DISTRIBUTION BY COUNTIES, SEASON 1918.

Mount Shasta Hatchery.

County	Rainbow	Eastern brook	Loch Leven	Black-spotted	Steelhead	Salmon
Alpine	12,000				4,000	
Amador	85,000	94,500	75,000			
Butte	127,000	43,000	92,000		46,000	
Calaveras	180,000		146,000			
Colusa	80,000	10,000			40,000	
Contra Costa	4,000				4,000	
Del Norte						100,000
El Dorado	166,000	108,000	110,000		150,000	
Fresno	133,000	95,000	117,000			
Lake	15,000				40,000	
Madera	20,000				30,000	
Mariposa	136,000	37,000	34,000		84,000	
Modoc	22,000					
Monterey	123,500			1,000*		
Napa	10,000				120,000	
Nevada	248,000	48,000	154,000	24,000	110,000	
Placer	112,000	91,000	48,000		34,000	
Plumas	110,000	62,000	150,000	6,000	40,000	
San Benito					18,000	
San Luis Obispo	3,500	6,000	15,000		314,000	
Santa Barbara		6,000	10,000		125,000	25,000
Shasta	248,500	139,500	190,000		70,000	
Sierra	60,000	30,000	9,000		30,000	
Siskiyou	165,000	136,000	169,000	50,000	100,000	13,195,000
Sonoma	20,000				20,000	
Tehama	144,000	6,000	38,000	60,000		
Trinity	85,000	42,000	50,000	10,000		
Tuolumne	150,000	63,000	108,000	80,000	12,000	
Ventura	42,000				100,000	25,000
Yuba	25,000		16,000		3,000	
Ponds Mount Shasta Hatchery		16,000	28,000			
Totals	2,528,500	1,033,000	1,559,000	231,000	1,494,000	13,345,000

*Cutthroat.

Mount Whitney Hatchery.

County	Rainbow	Eastern brook	Loch Leven	Black-spotted	Steelhead	trout Golden
Fresno	28,000			10,000	20,000	
Inyo	136,000	52,500	24,000	17,000	12,000	35,000
Kern	186,000	50,000		50,000	30,000	
Los Angeles	172,000	9,000				
Madera	4,000	20,000	14,000	44,000	10,000	
Mono	56,000		8,000	23,000	18,000	100,000
Placer		8,000		32,500	5,000	165,000
Riverside	32,000			8,000		
San Bernardino	10,000					24,000
San Diego	72,000	4,000			36,000	
San Mateo	45,000	2,500		20,000		
Sierra		2,000				
Tulare	328,000	20,000	20,000	110,000	4,000	
Ventura	50,000		8,000		110,000	
Ponds Mount Whitney Hatchery						60,000
Totals	1,073,000	128,500	74,000	314,500	245,000	384,000

Fort Seward Hatchery.

County	Rainbow	Steelhead	Salmon
Humboldt	89,000	760,000	1,094,000
Mendocino		50,000	
Trinity	58,000	20,000	
Totals	147,000	830,000	1,094,000

Tahoe Hatchery.

County	Rainbow	Black-spotted
El Dorado		75,000
Nevada		45,000
Placer	15,000	205,000
Sierra		75,000
Totals	15,000	595,000

Mount Tallac Hatchery.

County	Rainbow	Eastern brook	Steelhead
Alpine	50,000		10,000
El Dorado	89,000	1,133,000	245,000
Placer	10,000		100,000
Totals	149,000	1,133,000	355,000

Almanor Hatchery.

County	Rainbow
Lassen	61,000
Plumas	85,000
Total	146,000

Ukiah Hatchery.

County	Steelhead
Mendocino	305,000
Sonoma	125,000
Total	430,000

Bear Lake Hatchery.

County	Rainbow
San Bernardino	783,000

Domingo Springs Hatchery.

County	Rainbow	Steelhead
Lassen	120,000	4,000
Plumas	193,000	94,000
Tehama	4,000	
Totals	317,000	98,000

Wawona Hatchery.

County	Rainbow	Steelhead
Mariposa	98,000	196,000

Snow Mountain Station.

County	Steelhead
Mendocino	125,000

Brookdale Hatchery.

County	Steelhead
Santa Clara	210,000
Santa Cruz	500,000
Total	710,000

Feather River Hatchery.

County	Rainbow	Black-spotted
Plumas	124,000	119,000

North Creek Hatchery.

County	Rainbow
San Bernardino	300,000

Fish Transplantation.

Counties	Herring	Pike	Carp	Black Bass	Cat-fish	Blue-gills	Perch
Kings				1,005	53,787		57
San Francisco	12	12	15	229	140	2	
San Mateo				16			
Tulare							5,000
Totals	12	12	15	1,250	53,927	2	5,057

Summary of Fish Distribution, Season 1918.

Hatcheries	Rainbow	Eastern brook	Loch Leven	Black-spotted	Steel-head	Golden trout	Salmon
Almanor	146,000						
Bear Lake	783,000						
Brookdale					710,000		
Domingo Springs	317,000				98,000		
Feather River	124,000			119,000			
Ft. Seward	147,000				830,000		1,094,000
Mt. Shasta	2,528,500	1,033,000	1,559,000	231,000	1,494,000	348,000	13,345,000
Mt. Whitney	1,073,000	128,500	74,000	314,500	245,000		
North Creek	300,000						
Snow Mountain					125,000		
Tahoe	15,000			395,000			
Tallac	149,000	1,133,000			355,000		
Ukiah					430,000		
Wawona	98,000				196,000		
Totals	5,680,500	2,294,500	1,633,000	1,059,500	4,483,000	348,000	14,439,000
Total trout							15,534,500
Total salmon							14,439,000
Grand total							29,973,500

Mount Shasta Hatchery Fish Distribution, by Counties, Season 1919.

Counties	Rainbow	Eastern brook	Loch Leven	Black-spotted	Steel-head	Brown trout	Salmon
Alameda	73,000	15,000	43,000		122,000		
Alpine	22,500		22,500				
Amador	85,000	70,000	100,000			50,000	
Butte	130,000	44,000	191,000	30,000	9,000	75,000	
Calaveras	137,500		132,500		60,000	80,000	
Colusa	60,000				20,000		
Contra Costa	9,000				9,000		
El Dorado	150,000	68,000	264,000		250,000		
Fresno	144,000	80,000	208,000			15,000	
Lake					20,000		
Lassen	12,000		4,000		4,000		
Marin					200,000		
Mariposa		15,000	15,000				
Modoc	83,500	20,000	2,000				
Mono		28,000					
Monterey	100,000						
Napa	25,000				197,500		
Nevada	147,000	94,000	220,000	30,000	50,000	50,000	
Placer	187,000	52,000	220,500		4,000		
Plumas	145,000	64,000	114,000		26,000	10,000	
San Luis Obispo	51,000		31,000	12,000	250,000		2,500
Santa Barbara		6,000	20,000				22,500
Santa Clara	5,000						
Shasta	251,000	60,000	210,000		20,000	40,000	
Sierra	68,500	74,000	199,500		40,000		
Siskiyou	160,000	226,000	488,000	15,000			
Siskiyou							*178,000
Siskiyou							†10,018,000
Sonoma	30,000		10,000		30,000		
Tehama	56,000	10,000	20,000				
Trinity	61,000	32,000	76,000				
Tuolumne	225,000	108,000	147,000				
Ventura	25,000	4,000			100,000		25,000
Yuba	23,000		48,000				
Totals	2,468,500	1,070,000	2,746,000	87,000	1,411,500	320,000	50,000

*Silver salmon.
†Quinnat salmon.

Mount Whitney Hatchery.

Counties	Rainbow	Eastern brook	Loch Leven	Steel-head	Black-spotted	Golden trout
Fresno				8,000	71,000	31,000
Inyo	200,000	20,000	70,000	30,000	121,000	180,000
Kern	180,000	20,000	30,000	90,000	90,000	
Los Angeles	120,000	10,000	10,000			
Madera	40,000	10,000	10,000	10,000	52,000	
Mariposa	18,000					
Mono	14,000	8,000	8,000			239,000
Riverside	56,000	4,000			4,000	
San Diego	56,000			49,000		
San Luis Obispo	8,000					
Santa Barbara	21,000			121,000		
Tulare	178,000	11,000	8,000	62,000	64,000	
Ventura	132,000	10,000		104,000		
Totals	1,023,000	93,000	136,000	474,000	402,000	450,000

Tahoe Hatchery.

Counties	Rainbow	Black-spotted	Golden trout
El Dorado	6,000	45,000	
Mariposa			24,650
Nevada	25,000	70,000	
Placer	40,000	176,000	210,000
Sierra	25,000	60,000	
Totals	96,000	351,000	234,650

Mount Tallac Hatchery.

Counties	Rainbow	Black-spotted	Steel-head
El Dorado	26,000	630,000	143,000
Placer			17,000
Totals	51,000	685,000	185,000
Alpine	25,000	25,000	25,000

Fort Seward Hatchery.

Counties	Rainbow	Eastern brook	Steel-head	Salmon
Humboldt	186,000	8,500	538,000	932,000
Mendocino	8,000			
Trinity	40,000			
Totals	234,000	8,500	538,000	932,000

Ukiah Hatchery.

Counties	Steel-head
Mendocino	270,000
Sonoma	330,000
Total	600,000

Snow Mountain Station.

Counties	Steel-head
Lake	27,000
Mendocino	223,000
Total	250,000

Brookdale Hatchery.

Counties	Steel-head
Monterey	6,000
San Mateo	100,000
Santa Clara	208,000
Santa Cruz	535,000
Total	849,000

Clear Creek Hatchery.

Counties	Rainbow
Lassen	152,000
Plumas	5,000
Total	157,000

Domingo Springs Hatchery.

Counties	Rainbow	Steelhead
Lassen	28,000	30,000
Plumas	112,000	40,000
Tehama	80,000	46,000
Totals	220,000	116,000

Bear Lake Hatchery.

County	Rainbow
San Bernardino	748,000

Wawona Hatchery.

Counties	Rainbow	Steelhead
Madera	9,000	9,000
Mariposa	146,000	91,000
Totals	155,000	100,000

North Creek Hatchery.

County	Rainbow
San Bernardino	810,000

Yosemite Hatchery.

Counties	Rainbow	Blackspotted	Steelhead
Mariposa	186,500	89,200	81,600
Tuolumne	5,000	10,500	15,000
Totals	191,500	99,700	96,600

Fall Creek Hatchery.

County	Rainbow	Quinnat salmon
Siskiyou	670,000	1,148,200

Kaweah Hatchery.

Counties	Rainbow	Black-spotted	Steel-head
Fresno	9,500	1,000	3,000
Tulare	230,000	45,000	95,000
Totals	239,500	46,000	98,000

Fish Transplantation.

Counties	Black bass	Sun-fish	Crappie	Calico bass	Striped bass	Cat-fish	Blue-gill
Alameda	22	60	12				
Fresno		180	135				
Marin	9		14				
Napa	16						
Placer	18			75			
San Benito	13			32			
San Luis Obispo					3,500	38	
San Mateo	32		24	32			
Santa Clara	6						30
Shasta	50		25				50
Sonoma				550			
Yuba	17			44			
Totals	183	240	210	733	3,500	38	80

Summary Fish Distribution, Season 1919.

Hatcheries	Rainbow	Eastern brook	Loch Leven	Black-spotted	Steel-head	Golden trout	Brown trout
Bear Lake	748,000						
Brookdale					849,000		
Clear Creek	157,000						
Domingo Springs	220,000				116,000		
Fall Creek	670,000						
Fort Seward	234,000	8,500			538,000		
Kaweah	239,000			46,000	98,000		
Mount Shasta	2,468,500	1,070,000	2,746,000	87,000	1,411,500		320,000
Mount Tallac	51,000			685,000	185,000		
Mount Whitney	1,023,000	93,000	136,000	402,000	474,000	450,000	
North Creek	810,000						
Snow Mountain Station					250,000		
Tahoe	96,000			351,000		234,650	
Ukiah					690,000		
Wawona	155,000				100,000		
Yosemite	191,500			99,700	96,600		
Totals	7,063,500	1,171,500	2,882,700	1,670,700	4,718,100	684,650	320,000

Grand total trout	18,510,450
Grand total salmon	12,326,200
Fish transplantation	4,984
Total of grand totals	30,841,634

CALIFORNIA FISHERY PRODUCTS FOR YEAR 1918.*

Compiled by Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Sutter, Tehama, Glenn, Colusa	Alameda, Contra Costa	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Imperial	Totals	Mexico
Albacore									39	5,084	918	6,434,770	230	822,854		7,263,895	1,527
Anchovy	100		11,300					257,170		540,323		49,392		9,563		867,851	310
Barracuda								17,160	63,899	37,572	41,185	1,988,598	9,343	1,724,934		3,885,691	951,593
Bonito									33,541	6,007	13,646	978,120	363	1,233,087		2,264,164	176,637
Bocaccio		1,603	2,061					49,351	105,081	1,083,074						1,242,170	
Blufish									558	69,340		185				70,083	
Chilipepper								209,172	89,537	54,622						353,331	
Carp		14,834	8,250	23,296	60,294	3,303	86,865	36,073				79,859				312,774	
Catfish		90,210		14,571	52,745	4,488	42,150	712								204,876	
Croakers												56,031		11,095		67,126	
Coalfish			19					478,844	3,593	11,530		4,221	730			498,937	
Cultus cod	1,848	32,413	8,424					446,793	123,853	300,432		1,613	457			915,836	
Dolphin												741				741	
Dogfish			78,070				8	274,099	500	11,359		14,731		21,711		400,478	2,615
Flounder	14,793		732	1,522			3,677	716,080	47,178	27,243		6,679	240	1,291		818,835	
Hardhead					10,848	7,309	9,704									27,861	
Halibut	30,346	61,096	1,140					40,990	8,619	25,544	309,378	1,145,734	13,974	1,201,163		2,837,987	1,915,704
Hake			8					143,68	47,313	2,019	64	17,094		8,496		218,672	5,360
Herring	7,311		3,190,686				1,500	4,732,883	5,900							7,938,280	
Kingfish			10					62,726	83,342	154,128	734	650,281	349	23,525		975,095	
Mackerel									973	1,489,163	4,497	2,346,048	6,242	158,983		4,005,906	70,178
Marlin												2,275				2,275	
Mullet												30,267			59,390	89,677	1,745
Pike			1,285	494	1,894	730	8,790	172								13,365	
Pompano			3					1,786	2,752	6,609	44	12,876		100		24,260	
Perch	32,039	258	66,183				105	52,810	10,180	6,551	1,616	26,771	374	1,280		198,167	365
Rock bass											6,393	535,375	3,644	231,233		776,645	7,219
Rockfish	57,408	6,500	716					1,340,103	644,450	1,109,737	123,305	1,575,558	25,512	1,398,043		6,281,425	12,912
Sole	171		78					4,696,905	1,893,705	293,529	85,749	53,110	166	4,353		7,027,767	
Salmon	1,234,653	1,097,771	172,630	2,305,800	565,834	41,791	2,957,492	1,756,134	209,923	2,682,953		1,065				13,026,076	
Smelt	13,209		24,012				316	263,900	32,550	161,388	30,747	196,869	76,910	46,082		788,923	8,031
Shad (roe)				194,549	35,108		673,237									902,894	
Sea bass (white)			10,921					40,413	171,885	59,137	64,618	1,015,478	1,054	88,942		1,452,478	154,853
Shad (buck)				159,921	13,990		241,615									414,926	
Sea bass (black)										248	6,184	97,432	2,969	103,599		210,432	38,363
Sanddab								1,380,057	308,403	41,154		21,970	25			1,751,609	
Suckers					6,719	190	358									7,267	
Striped bass			22,773	353,100	113,578	5,035	751,830	161,353	47	94						1,407,841	
Shad			1,639	224,773	104,813	2,059	671,804	60,717								1,065,815	
Surf fish												4,888				4,888	

Stingaree			151,500								300			151,800		
Sturgeon																
Sardine	908	240	451				892,026	559,265	61,915,002	42	78 077,612		13,207,265	157,652,811		
Skipjack								728	155		3 019 683	133	3,145	3,023 847		
Skate							232,801	2,090	4,078	425	6 809	28		246,231		
Sheepshead										45	8,605		13,838	22,488	450	
Sculpin							165		2		28,156		81	28,404		
Splittail				3,139	3,726	1,115								7,980		
Sea trout											4,902	941	346	6,189		
Swordfish											17,862		580	18,442		
Tom cod							8,756	55			39 563	159		48,536		
Trout (farm)							1,677	1,781					392	3,830		
Trout (steelhead)	21,819													21,819		
Tuna								315	1,580	1,174	5,807,951		429,941	6,240,971		
Turbot			3,087							525	52			3,634		
Whitebait		100	9,297				108,053		81	18,326				137,857		
Yellowtail							21,520	124,052	137,261	20,782	5,926,021	1,069	5,427,563	11,658,259	139,916	
Miscellaneous	2,000			3,640	3,251	41	93,366	1,001	36,863	14,928	139,409	3,175	31,940	329,614	261,163	
Total fish	1,416 605	1,305,925	3,765,305	3,278,026	972,602	71,923	5,449,407	18,518,432	4,581,108	73,276,952	744,845	110 421,912	148,078	26,205,431	59,390	250,218,041	3,752,071	
Crustaceans—																
Crab (dozen)	4,128					13	62,079	707	531					67,458		
Spiny lobster										29,979	120,796	2,611	42,364	195,750	735,077	
Shrimp							722,178							722,178		
Ecrevisse																
Mollusks—																
Squid			85				1,970	850	301,007		48,376		14,426	361,714		
Cuttlefish		100	10				11,583	4,406	13,268		372			32,739		
Clam (Pismo)								517		665,167				665,684		
Clam (cockle)			23,652							160	21,121			44,933		
Clam (softshell)	1,085	13,105	125,575			173,278								313,043		
Clam (mixed)	20,211	1,867	72,842			10,780	344	252	310	1,359	21,089			129,084		
Oyster (shell), Eastern, No.			885,811				5,302,210							6,188,021		
Oyster (native)			39,279											39,279		
Abalones	1,935	405							365,986	183,863	50,730			602,919		
Sea snails											1,461			1,461		
Mussels	760		673			4,297	5,334	4,270	600	9,954	21,251	690	580	48 319	835	
Reptiles—																
Terrapin (doz.)			25											25		
Sea turtles													18,135	18,135		

All amounts shown in pounds unless otherwise specified.

*During 1918, 8,888,455 pounds of mollusks and crustaceans were taken. This added to 250,218,041 pounds of fish gives a grand total of 259,106,496 pounds of fish. Mollusks and crustaceans taken in California during the year 1918.

CALIFORNIA FRESH FISHERY PRODUCTS FOR THE YEAR 1919.*

Compiled by Department of Commercial Fisheries.

Species of fish	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	Imperial	Totals	Mexican
Albacore										81		11,225,857	126	2,326,961		13,553,025	77,871
Anchovy			264,000					41,895		705,045		576,837		21,770		1,609,548	
Barracuda	150							814	31,321	67,512	137,752	2,533,258	51,795	1,216,249		4,038,852	1,786,105
Bluefish									9,750	55,046						64,796	
Bocaccio		80						61,863	104,630	1,153,078						1,319,651	
Bonito									1,169	2,303	23,714	2,534,433	1,042	341,024		2,903,688	600,353
Carp		7,115		14,154	165,722	80	57,342	14,426				50	1,875	624		261,388	
Catfish		38,625		17,323	71,878		36,322	708								164,856	
Chilipepper								207,159	7,145	17,524						231,828	
Coalfish								319,613	6,926	8,208	18	132				334,950	
Cultus cod	8,468	59,945						773,712	67,236	151,753		2,022				1,063,136	
Dogfish			355	11			885	143,554	1,239	5,177	3,005	62,416		396,031		612,683	
Dolphin																	
Eels								10								10	
Flounder	11,498		1,218	1,453			2,540	368,613	27,504	4,184	3,621	14,630	490			435,731	
Greenfish												2,405				2,405	
Hake								122,913	9,320	948						133,181	755
Halibut	19,844	106,717	808					37,784	4,576	18,584	316,861	1,465,490	67,832	492,387		2,523,895	2,335,63
Hardhead					47,631		1,627									49,291	
Herring	7,146		3,740,518				62,712	478,673	750					100		4,289,899	
Kingfish			44					41,481	35,369	71,355	1,492	449,598	104	9,127		608,561	614
Mackerel	180		14						3,518	450,717	20,294	2,037,581	15,544	126,748		2,654,593	48,086
Marlin																	
Mullet												270	485	356	6,428	7,539	1,630
Perch	27,057		55,901				273	22,495	16,491	9,033		49,869	221	9,101		191,341	1,140
Pike				519	2,840	10	3,141									6,510	
Pompano			2					4,015	1,113	867		54,924	32	471		61,424	
Rock bass											2,484	190,315	5,952	243,794		442,555	7,674
Rockfish	13,503	1,492						1,127,029	305,439	459,426	85,447	1,148,074	4,885	568,890		3,714,185	67,610
Salmon	1,458,162	2,899,603	15,571	1,732,028	314,202	226,309	2,262,509	1,427,137	499,168	2,316,854		10				13,145,553	
Sanddab								628,206	67,885	2,602	1,394	7,830		1,821		709,738	
Sardine			141,700					1,352,518	5,141,869	81,447,280	54	51,640,194	25	11,183,539		153,877,179	
Sculpin												24,217	1,111	104		25,432	
Sea bass (black)											3,183	67,464	1,825	54,525		125,997	58,273
Sea bass (white)	124		27,904					23,045	317,432	18,934	29,563	1,836,454	2,631	103,650		2,359,737	74,217
Sea trout	47											15,385	15	5,576		21,623	377
Shad				56,363	89,127		23,853	9,251				25				181,632	
Shad (buck)				144,430	14,050		289,821									448,301	
Shad (roe)				176,821	16,752		750,232									943,805	
Sheepshead												7,334	842	9,796		17,972	
Skate								241,811	1,408		543	8,535	179			252,776	

Skipjack										3,173	1,884		4,089,287		2,791,025		6,885,369	12,115
Smelt	46,933		69,633				4,701	138,095		51,641	109,759	9,597	145,693	128,262	47,523		751,870	5,110
Sole	1,178	15						4,914,533		398,245	44,543	71,451	87,899		5,821		5,528,685	
Splittail					12,862		11,420										24,282	
Striped bass			1,581	203,828	72,775		371,863	108,261			1,031						762,345	
Stingaree			38,200					4,000							824		43,024	
Suckers					5,730		43										5,833	
Surf fish																		
Swordfish													17,960		352		18,252	
Tom cod								31,310									31,310	
Trout (farm)																		
Trout (steelhead)	17,217																17,217	
Tuna										25	24	17	1,993,486	854	200,178		2,194,584	233,727
Tuna (blue fin)													14,952,462		38,398		14,990,860	
Tuna (yellow fin)													348,023		58		348,081	
Turbot			1,672					433									2,105	
Whitebait			403					5,512									5,915	
White fish												1,305	18,034		7,852		27,191	70
Yellowtail												191	2,531,973	4,505	2,335,093		4,871,763	133,502
Miscellaneous	356		4	106	599		31	45,320		6,012	8,342	54,450	423,249	2,997	13,413		554,879	15,907
Total fish	1,611,863	3,113,592	4,359,541	2,350,036	814,261	220,399	3,882,331	12,706,286		7,120,345	87,137,997	765,439	103,523,694	286,941	22,553,181	6,428	250,453,244	5,493,871
Crustaceans—																		
Crab (dozen)	1,882							51,935		428	128	3					54,376	
Ecrevisse																		
Shrimp								747,023					107				747,130	
Spiny lobster												19,465	167,680	29,852	39,897		256,894	832,571
Mollusks—																		
Abalones	450	225								740	248,056	509,732					759,203	65,905
Clam (cockle)	786		15,857									1,020	5,768	1,328	18		24,777	
Clam (mixed)	27,669	1,688	34,695					251				2,228	273				63,744	
Clam (Pismo)										175		417,340					417,515	
Clam (soft shell)	210	8,728	27,945				265,268	425									302,576	
Cuttlefish			36					6,294		1,378	9,633	137	3,984				21,432	
Limpets														8,350			8,350	
Mussels	830		207				4,947	1,155		940	925	11,677	5,424	8,888	100		35,095	
Oyster (shell), Eastern, No.			1,342,828					5,545,468									6,888,296	
Oyster (native)			91,950														91,950	
Snails													653				653	
Squid										92	3,689,299		8,406		445		3,698,242	
Miscellaneous—																		
Frogs (dozen)								328									328	
Terrapin (dozen)	2	61						84				10					160	
Turtle																		255,239

All amounts shown in pounds, unless otherwise specified.

*The mollusks and crustaceans represent additional weight of 11,796,475 pounds added to 250,453,244 pounds of fish, making a grand total of 262,249,719 pounds of fish. Mollusks and crustaceans taken in California during the year 1919.

CANNED, CURED AND MANUFACTURED FISHERY PRODUCTS OF CALIFORNIA FOR THE YEAR 1918.

Compiled by Department of Commercial Fisheries.

Canned.

	San Diego, cases	San Pedro, cases	Northern California, cases	Total cases
Abalone—				
1-pound		300	1,425	1,725
Albacore—				
1-pound		17,392		17,392
½-pound		56,214		56 214
¼-pound		9,195		9,195
Anchovy—				
5-pound			1,522	1,522
4-pound			227	227
¾-pound			450	450
Barracuda—				
½-pound	24			24
Bonito and skipjack—				
1-pound	765	2,012		2,777
½-pound	9,527	48,342		57,869
¼-pound	12,310	5,395		17,705
Herring—				
1-pound (oval)			58,330	58,330
½-pound			5,817	5,817
Mackerel—				
1-pound		3,450		3,450
½-pound		4,068		4,068
Sablefish—				
1-pound			25	25
Salmon—			8,395	8,395
1-pound (tall)			3,304	3,304
1-pound (flat)			197	197
1-pound (oval)			22,540	22,540
½-pound (flat)				
Sardines—				
1-pound (oval)	17,796	136,632	593,315	747,737
½-pound (oval)	174	3,788	13,244	17,205
1-pound (round)		138,879		138,879
½-pound (round)	1,101	228,139	945	230,185
¼-pound (round)		51,841		51,841
1-pound (square)		50,076		50 076
½-pound (square), tomato	19,568	70,850	3,716	94,134
½-pound (square), oil			4,249	4 249
⅝-pound (square)			133	133
¼-pound (square)	67,785	78,756	3,997	150,538
Shad—				
1-pound			5,056	5,056
Shad roe—				
½-pound			2,213	2,213
Skipjack—				
½-pound	42			42
Tuna*—				
1-pound	5,788	33,825		39 613
½-pound	41,652	161.744		205 396
¼-pound	2,617	29,404		32,051
4½-pound		268		268
Turtle—				
1-pound	300	199		499
½-pound	100	29		129
Yellowtail—				
1-pound	8,328	2,824		11.152
½-pound	31,737	28,537		60,274
¼-pound	405			405

*Includes some albacore.

CANNED, CURED AND MANUFACTURED FISHERY PRODUCTS OF CALIFORNIA FOR THE YEAR 1918—Continued.

Compiled by Department of Commercial Fisheries.

Salted Fish.

	San Diego	San Pedro	Northern California	Totals
Anchovy—				
Barrels		20	310	330
25-pound cans			2,600	2,600
5-pounds cans			1,000	1,000
Barracuda—				
Barrels	450	5		455
Black sea bass—				
Barrels	53			53
Bonito—				
Barrels	12	17		29
Mackerel—				
Barrels	110	380	1,521	2,011
18-pound kits			6	6
Rock bass—				
Barrels	9	42		51
Rock cod—				
Barrels	9	2		11
Sablefish—				
Barrels			72	72
Salachini—				
100-pound tubs			5,955	5,955
65-pound tubs			10,899	10,899
50-pound tubs			12,329	12,329
Salmon—				
Casks (mild cured)			2,796	2,796
Sardines—				
Barrels	2	852	107	961
40-pound barrels			1,252	1,252
25-pound cans			1,200	1,200
18-pound kits			6	6
Sea bass—				
Barrels	29			29
Shad—				
Casks (mild cured)			287	287
Yellowfin—				
Barrels		35		35
Yellowtail—				
Barrels	425	76		501

NOTE.—Casks contain 800 pounds net; barrels, 200 pounds net.

CANNED, CURED AND MANUFACTURED FISHERY PRODUCTS OF CALIFORNIA FOR THE YEAR 1918—Continued.

Compiled by Department of Commercial Fisheries.

Miscellaneous Pack and General Information.

	San Diego	San Pedro	Northern California	Totals
Albacore—				
Smoked, pounds		31,420		31,420
Kingfish—				
Dried, pounds		19,000		19,000
Sardines—				
Dried, pounds		37,000		37,000
Scotch, cured, pounds		4,620		4,620
Yellowtail—				
Smoked, pounds		1,000		1,000
Fertilizer, tons		1,521		1,521
Fish meal, tons	1,123	3,216	2,874	7,213
Fish oil, gallons	17,400	67,858	261,466	346,724
Number of plants	13	34	40	87
Number of employees	1,427	2,783	3,829	8,039
Value of plants	$1,316,000	$2,773,660	$1,569,330	$5,658,990

CANNED, CURED AND MANUFACTURED FISHERY PRODUCTS OF CALIFORNIA FOR THE YEAR 1919.

Compiled by Department of Commercial Fisheries.

Fish Canned.

Species of fish	Size of cans	San Diego district, cases	San Pedro district, cases	Monterey Bay district, cases	Northern California district, cases	Total cases
Abalone	1-lb.		105		2,873	2,978
Albacore	1-lb.	5,862	21,236			27,098
	½-lb.	37,855	107,822			145,677
	¼-lb.	4,152	15,325			19,477
Anchovy	¼-lb.	184	32			216
Barracuda	1-lb.		8			8
Bonito	1-lb.	12	2,177			2,189
	½-lb.	4,935	34,631			30,599
	¼-lb.	287	17,108			17,395
Caviar	½-lb.		395			395
	3-oz.		374			374
Herring	1-lb. oval				28,236	28,236
	½-lb. oval				1,589	1,589
Mackerel	1-lb.	65	1,995			2,061
	½-lb.	17	6,344			6,361
	¼-lb.		988			988
Rock bass	½-lb.		10			10
Salmon	1-lb. oval			102	725	827
	1-lb. tall				1,941	1,941
	1-lb. flat				9,086	9,086
	½-lb. flat				18,657	18,657
Sardines	1-lb. oval	33,594	113,909	760,724	7,842	946,069
	1-lb. round		11,875			11,875
	1-lb. tall				7,318	7,318
	½-lb. oval	3,878	27,713	11,960		43,551
	½-lb. square	9,513	17,510	7,267		34,260
	½-lb. round	405	25,742	128		26,275
	¼-lb. round	10	3,213			3,223
	¼-lb. square	39,603	31,553	7,789		78,945
Shad	1-lb.				4,350	4,350
Shad roe	½-lb. oval				1,131	1,131
Skipjack (striped tuna)	1-lb.	3,199	750			3,889
	½-lb.	38,229	28,849			67,078
	¼-lb.	2,460	11,351			13,811
Squid	½-lb.			3,538		3,538
Tuna	4-lb.		1,905			1,905
	1-lb.	1,170	33,524			34,694
	½-lb.	14,555	291,453			306,008
	¼-lb.	2,785	119,980			122,765
Turtle		7,407				7,407
Yellowtail	1-lb.	12	350			362
	½-lb.	19,291	8,739			28,030
	¼-lb.	5				5
Total cases canned		229,463	933,939	821,443	83,758	2,071,641

Dried, Salted, Smoked and Miscellaneous.

Species of fish, size or quantity	San Diego district	San Pedro district	Monterey district	Northern California district	Total
Albacore bellies, smoked, lbs.		4,368			4,368
Anchovy, salted, lbs.		63,150	242,576	24,448	330,174
Anchovy, salted, 5-lb. cans, 24 cans to case			243		243
Anchovy, salted, 5-lb. cans, 12 cans to case			367		367
Anchovy, salted, 24-lb. cans, 6 cans to case			119		119
Anchovy, salted, 12-lb. cans, 8 cans to case			216		216
Anchovy, salted, 1½-lb. cans, 24 cans to case			200		200
Anchovy, salted, 2½-lb. cans, 12 cans to case		1,800			1,800
Barracuda, dried, lbs.	67,102				67,102
Barracuda, smoked, lbs.		2,000			2,000
Bonito, salted, lbs.		68,760			68,760
Bonito, smoked, lbs.		31,003			31,003
Cuttle fish, pickled, lbs.		3,800			3,800
Herring, smoked, lbs.				1,000	1,000
Herring, sugar cured, lbs.				1,450	1,450
Mackerel, salted, lbs.		24,842			24,842
Miscellaneous fish, dried, lbs.	51,037	46,479	15,000		112,516
Miscellaneous fish, salted, lbs.	20,000	59,079			79,079
Rollmops, 10-lb. pails				1,142	1,142
Sablefish, salted, lbs.				7,519	7,519
Sablefish, smoked, lbs.				5,400	5,400
Salachini, 100-lb. tubs			100		100
Salachini, 65-lb. tubs		740	14,370	1,362	16,472
Salachini, 45-lb. tubs			987	358	1,345
Salachini, 30-lb. tubs			4,020		4,020
Salmon, mild cured, casks*			1,044	4,153	5,197
Salmon, hard salted, casks*				30	30
Sardines, dried, lbs.			15,000		15,000
Sardines, salted, lbs.		43,982	260,500		304,482
Sardines, smoked lbs.				2,200	2,200
Sardines, salted, 2½-lb. cans, 12 cans to case		4,000			4,000
Sardines, salted, 3-lb. cans, 24 cans to case		6,067	200		6,267
Sardines, salted, 5-lb. cans, 24 cans to case			573		573
Sardines, salted, 12-lb. cans, 8 cans to case			739		739
Sardines, salted, 24-lb. cans, 4 cans to case			450		450
Sardines, salted, 34-lb. kegs			1,600		1,600
Sea bass (black), dried, lbs.	26,830				26,830
Skipjack, smoked, lbs.		2,601			2,601
Squid, dried, lbs.			686,159		686,159
Tuna, smoked, lbs.		10,180			10,180
Yellowtail, smoked, lbs.		45,933			45,933
Fish meal, tons	1,674	5,697	3,331	451	11,153
Fish, oil, gallons	26,791	146,298	300,833	40,340	514,262
Number of plants	15	35	28	21	99
Number of employees	1,191	3,928	2,218	905	8,242
Estimated value of pack	$2,599,852	$9,694,482	$6,990,563	$2,132,843	$21,417,743
Value of plants	1,100,700	4,335,657	1,366,189	906,325	7,708,871

*Casks contain 800 pounds net.

SEIZURES OF FISH, GAME AND ILLEGALLY USED FISHING APPARATUS.

July 1, 1918, to June 30, 1920.

Rabbits (cottontail and brush)	149	
Quail	194	
Doves	37	
Wild pigeon	12	
Ducks	2,856	
Gray geese	17	
Sage hens	14	
Pheasants	2	
Shore birds	71	
Non-game birds	15	
Miscellaneous game	157	
Deer meat	4,059½	pounds
Deer hides and heads	39	
Beaver skins	4	
Mink skins	3	
Aigrettes	59	
*Illegally used fishing apparatus, nets, lines, etc.	73	
Salmon	17,338½	pounds
Trout	2,208	pounds
Striped bass	9,008	pounds
Black bass	56½	pounds
Halibut	22,812½	pounds
Barracuda	8,136	pounds
Catfish	278	pounds
Yellow fin croaker	23,600	pounds
Sturgeon	249½	pounds
Miscellaneous fish	63	pounds
Abalones	2,727	
Abalones (dried)	1,157	pounds
Abalones (canned)	150	cases
Crabs	4,884	
Lobsters	7,153	
Lobsters (dried)	131	pounds
Clams (Pismo)	4,811	
Clams (cockle)	3,692	pounds
Dried shrimps and shells	5,700	pounds

*73 nets, lines, etc., represent about 3,697 fathoms or 22,182 feet.

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 acknowledgment have been received.

During the period from July 1, 1918, to June 30, 1920, 67 searches for illegal fish and game were made by deputies.

LION BOUNTIES.

Statement of Lion Bounties paid by the Fish and Game Commission from January 1, 1918, to December 1, 1919.

County	1918	1919	Total from Oct. 1907.
Alameda			1
Alpine			1
Amador			9
Butte		2	33
Calaveras		2	13
Colusa	3		17
Del Norte	2	5	97
El Dorado	1	8	48
Fresno	3	4	22
Glenn	3	3	43
Humboldt	22	8	564
Imperial			1
Inyo		1	7
Kern	10	15	134
King			1
Lake	11	9	166
Lassen		1	7
Los Angeles	8	9	49
Madera	5	1	39
Mariposa	12	5	77
Mendocino	18	22	219
Merced			1
Modoc	1		4
Monterey	12	19	105
Mono			7
Napa			3
Nevada	2		7
Orange	2	1	9
Placer	2	3	37
Plumas			9
Riverside	4	5	29
Sacramento		1	1
San Benito	2	1	33
San Bernardino	5	3	23
San Diego	4	5	41
San Joaquin			2
San Luis Obispo	3	6	76
San Mateo			1
Santa Barbara	6	19	99
Santa Clara	3	2	19
Santa Cruz		1	2
Shasta	26	30	261
Sierra			6
Siskiyou	1		241
Sonoma	2	1	22
Stanislaus	1	1	9
Sutter		1	2
Tehama	6	3	159
Trinity	12	14	260
Tulare	11	17	95
Tuolumne	9	12	75
Ventura	2	2	40
Yuba		1	4
Totals	214	243	3,176

SUMMARY OF PROSECUTIONS FOR VIOLATIONS OF STATE FISH LAWS.
July 1, 1918, to June 30, 1920.

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	72	72	-----	-----	7	30	$870 00	$860 00
Fishing (angling) without license	102	92	10	-----	7	-----	2,030 00	1,880 00
Illegal fishing apparatus (nets, lines, spears, etc.)	9	6	3	-----	3	-----	300 00	300 00
Salmon—taking and possession; closed season; excess limit, Sat., Sun.—fishing	20	17	2	1	3	100	1,200 00	900 00
Striped bass—closed season, buying and selling; underweight; excess limit	49	43	6	-----	8	-----	1,150 00	1,150 00
Black bass—taking and possession; closed season; undersized; excess limit	12	12	-----	-----	-----	-----	460 00	460 00
Trout—closed season; excess limit; taking other than by hook and line; offering for sale; shipping parcel post	61	50	7	4	4	-----	1,485 00	1,460 00
Catfish—undersized; offering for sale, closed season	4	4	-----	-----	-----	-----	80 00	80 00
Sturgeon—taking or possession	2	2	-----	-----	-----	-----	40 00	40 00
Sunfish—taking or possession, closed season	3	3	-----	-----	3	-----	-----	-----
Perch—Sacramento and Salt Water, possession; sale, shipment; closed season; excess limit	3	3	-----	-----	-----	-----	50 00	50 00
Halibut—underweight, possession and sale	14	13	1	-----	-----	-----	405 00	305 00
Barracuda—underweight, possession and sale	1	-----	1	-----	-----	-----	-----	-----
Salt Water Eels—taking undersized	2	2	-----	-----	-----	-----	120 00	120 00
Taking fish from pond	2	2	-----	-----	-----	-----	40 00	40 00
Using explosives to take fish	4	3	1	-----	2	-----	400 00	92 50
Polluting waters—oil, sawdust, etc.	5	3	2	-----	1	-----	400 00	400 00
Fishing with nets in restricted districts	44	33	5	6	2	2	3,860 00	3,506 00
Selling young fish for bait	1	1	-----	-----	-----	-----	20 00	20 00
Failing to maintain screen	1	1	-----	-----	-----	-----	20 00	20 00
Crabs—closed season, undersized, female	31	27	4	-----	13	-----	245 00	245 00
Clams—excess limit, undersized	45	45	-----	-----	1	52	1,155 00	1,160 00
Abalones—closed season, undersized, excess limit, drying	163	153	9	1	3	15	3,460 00	3,025 00
Crawfish—closed season, under or oversize	43	39	4	-----	2	-----	871 00	661 00
California dried shrimp and shells	20	18	2	-----	-----	-----	280 00	280 00
*Seining within 1 mile of Los Angeles City sewer	3	3	-----	-----	-----	-----	300 00	300 00
Total fish cases	716	647	57	12	59	199	$19,818 00	$17,323 50

*Paid into Los Angeles County treasury.

SUMMARY OF PROSECUTIONS FOR VIOLATIONS OF STATE GAME LAWS.

July 1, 1918, to June 30, 1920.

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	272	255	17	-----	9	-----	$4,497 00	$4,472 00
Deer—killing, pursuing, possession, closed season; excess bag limit. Hides—female; evidence of sex removed; not properly tagged; failure to retain portion of head bearing horns	187	149	30	8	7	78	6,510 00	5,982 00
Female deer and fawns—killing and possession	73	51	20	2	1	5	3,592 00	3,202 00
Spike bucks—killing and possession	42	37	5	-----	2	-----	1,870 00	1,870 00
Ducks—killing and possession, closed season	41	38	2	1	1	20	1,140 00	1,120 00
Ducks—excess; bag limit	8	8	-----	-----	-----	-----	600 00	600 00
Ducks—night shooting; shooting from power boat in motion	101	88	7	6	8	-----	2,330 00	2,305 00
Quail—killing and possession, closed season; excess bag limit	94	93	-----	1	7	-----	2,705 00	2,602 50
Quail—trapping or holding in captivity without permit	4	4	-----	-----	-----	-----	160 00	160 00
Doves—killing or possession, closed season; excess bag limit	44	40	4	-----	8	-----	825 00	805 00
Snipe, curlew, rail, plover and other shore birds—killing and possession	58	57	1	-----	2	-----	1,270 00	1,245 00
Pheasants—killing and possession	7	6	1	-----	-----	-----	220 00	220 00
Grouse, sage-hen—killing and possession, closed season; excess bag limit	9	8	-----	1	-----	-----	215 00	215 00
Wild pigeons—killing and possesion, closed season	13	13	-----	-----	2	-----	295 00	295 00
Non-game birds—killing and possession	107	104	2	1	7	12	1,741 00	1,741 00
Cottontail and brush rabbits—killing and possession, closed season; excess bag limit	49	47	2	-----	3	-----	1,025 00	975 00
Tree squirrels—killing and possession, closed season; excess bag limit	5	5	-----	-----	3	-----	50 00	50 00
Wild geese—killing and possession, closed season; excess bag limit	1	1	-----	-----	-----	-----	25 00	25 00
Mountain sheep—killing and possession	2	1	-----	1	-----	-----	30 00	30 00
Swan—killing and possession	18	17	1	-----	1	-----	510 00	510 00
Beaver—killing and possession	2	2	-----	-----	-----	-----	125 00	125 00
Trapping license law violations	20	18	1	1	4	10	145 00	135 00
Trespassing in game refuge	18	18	-----	-----	4	-----	365 00	365 00
Total game cases	1,175	1,060	93	22	69	125	$30,245 00	$29,049 50

TOTAL ARRESTS FOR A PERIOD OF EIGHTEEN YEARS.

1902-1904	550
1904-1906	774
1906-1908	1,192
1908-1910	1,771
1910-1912	2,033
1912-1914	1,993
1914-1916	2,087
1916-1918	1,797
1918-1920	1,891
Total	14,118

RECAPITULATION.

Arrests:			
Fish cases	716		
Game cases	1,175		
Total			1,891
Convictions:			
Fish cases	647		
Game cases	1,060		
		1,707	
Acquittals and dismissals:			
Fish cases	57		
Game cases	93		
		150	
Pending cases:			
Fish cases	12		
Game cases	22		
		34	
Total			1,891
Fines Imposed:			
Fish cases			$19,181 00
Game cases			30,245 00
Total			$49,426 00
Fines collected:			
Fish cases			$17,323 50
Game cases			29,049 50
Total			$46,373 00
Number of days imprisonment:			
Fish cases			199
Game cases			125
Total			324

HUNTERS' LICENSE SALES.

County	Fiscal year 1919	Fiscal year 1920
Alameda	$8,737 00	$10,588 00
Alpine	69 00	106 00
Amador	1,078 00	1,216 00
Butte	2,847 00	4,343 00
Calaveras	1,220 00	1,308 00
Colusa	1,828 00	2,515 00
Contra Costa	2,147 00	1,288 00
Del Norte	276 00	340 00
El Dorado	698 00	568 00
Fresno	8,856 00	10,188 00
Glenn	788 00	1,023 00
Humboldt	3,994 00	5,023 00
Imperial	570 00	532 00
Inyo	1,062 00	1,300 00
Kern	2,653 00	3,180 00
Kings	1,742 00	1,836 00
Lake	681 00	919 00
Lassen	1,219 00	1,605 00
Los Angeles	2,694 00	37 00
Madera	948 00	1,217 00
Mariposa	209 00	221 00
Mendocino	2,799 00	4,117 00
Merced	2,314 00	2,725 00
Mono	143 00	158 00
Monterey	1 216 00	1,701 00
Napa	2 418 00	2,967 00
Nevada	980 00	1,112 00
Orange	1,854 00	1,639 00
Placer	1,732 0	2,479 00
Plumas	944 0	1,270 00
Riverside	886 00	1,017 00
Sacramento	786 00	829 00
San Benito	933 00	1,145 00
San Bernardino	481 00	450 00
San Diego	4,934 00	4,445 00
San Joaquin	803 00	889 00
San Luis Obispo	1,324 00	1,559 00
San Mateo	1,906 00	120 00
Santa Clara	5,186 00	6,482 00
Santa Cruz	360 00	672 00
Shasta	1,870 00	2,346 00
Sierra	173 00	247 00
Siskiyou	3,856 00	4,934 00
Solano	3,026 00	3 813 00
Sonoma	5,719 00	7,350 00
Stanislaus	3,041 00	3,656 00
Sutter	633 00	808 00
Tehama	1,341 00	546 00
Trinity	649 00	975 00
Tulare	3,808 00	4,962 00
Tuolumne	1,010 00	1,762 00
Ventura	738 00	2,580 00
Yolo	1,973 00	2,350 00
Yuba	1,441 00	1,885 00
	$105,587 00	$123,253 00
Los Angeles office	36,417 00	45,650 00
Sacramento office	5,388 00	7,421 00
San Francisco office	31,545 00	45,099 00
Total sales	$178,937 00	$221,433 00

Fiscal year ends June 30. Residents, $1; nonresidents, $10; aliens, $25.

ANGLERS' LICENSE SALES.

County	Fiscal year 1918	Fiscal year 1919
Alameda	$1,130 00	$5,504 00
Alpine	198 00	211 00
Amador	673 00	770 00
Butte	2,253 00	3,165 00
Calaveras	798 00	875 00
Colusa	493 00	739 00
Contra Costa	831 00	351 00
Del Norte	140 00	185 00
El Dorado	679 00	578 00
Fresno	7,372 00	8,032 00
Glenn	210 00	351 00
Humboldt	4,038 00	4,691 00
Imperial	365 00	313 00
Inyo	1,749 00	1,783 00
Kern	486 00	707 00
Kings	879 00	981 00
Lake	426 00	394 00
Lassen	1,250 00	1,420 00
Los Angeles	2,686 00	
Madera	561 00	791 00
Mariposa	127 00	102 50
Mendocino	2,046 00	2,320 00
Merced	977 00	863 00
Mono	509 00	587 00
Monterey	705 00	698 00
Napa	695 00	1,531 00
Nevada	952 00	1,087 00
Orange	780 00	811 00
Placer	1,180 00	1,739 00
Plumas	1,719 00	2,053 00
Riverside	323 00	400 00
Sacramento	456 00	608 00
San Benito	265 00	297 00
San Bernardino	374 00	515 00
San Diego	1,965 00	2,119 00
San Joaquin	623 00	582 00
San Luis Obispo	1,057 00	869 00
San Mateo	665 00	52 00
Santa Clara	2,226 00	3,722 00
Santa Cruz	329 00	351 00
Shasta	1,831 00	2,119 00
Sierra	283 00	373 00
Siskiyou	3,306 00	3,825 00
Solano	1,653 00	2,329 00
Sonoma	2,985 00	3,477 00
Stanislaus	1,737 00	2,387 00
Sutter	260 00	310 00
Tehama	909 00	303 00
Trinity	313 00	496 00
Tulare	3,321 00	4,050 00
Tuolumne	1,196 00	1,315 00
Ventura	589 00	2,196 00
Yolo	575 00	738 00
Yuba	651 00	784 00
	$67,735 00	$78,209 00
Los Angeles office	26,556 00	30,963 00
Sacramento office	5,263 00	7,171 00
San Francisco office	23,526 00	30,381 00
Total sales	$123,080 00	$146,724 00

Fiscal year ends December 31. Residents, $1; nonresidents and aliens, $3.

COMMERCIAL FISHERIES' LICENSE SALES, BY DISTRICTS.

	1918-1919		1919-1920	
Del Norte and Humboldt	307	$3,070 00	322	$3,220 00
Mendocino, Sonoma, Lake	114	1,140 00	155	1,550 00
Marin	72	720 00	67	670 00
Solano and Yolo	245	2,450 00	269	2,690 00
Sacramento and San Joaquin	229	2,290 00	207	2,070 00
Glenn, Tehama and Colusa			68	680 00
Contra Costa and Alameda	291	2,910 00	381	3,810 00
San Francisco	459	4,590 00	393	3,930 00
Santa Cruz	72	720 00	87	870 00
Monterey	528	5,280 00	607	6,070 00
San Luis Obispo and Santa Barbara	120	1,200 00	113	1,130 00
Los Angeles	1,382	13,820 00	1,659	16,590 00
Orange	46	460 00	44	440 00
San Diego	486	4,860 00	581	5,810 00
Miscellaneous	171	1,710 00	134	1,340 00
Totals	4,522	$45,220 00	5,087	$50,870 00

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

TRAPPERS' LICENSE SALES.

Total sales for fiscal year ending June 30, 1920 ..... $4,971 00

STATEMENT OF EXPENDITURES FOR THE FISCAL YEAR 1918-1919.

General Administration.

Commissioners' traveling and other expenses	$920 85	
Salaries of administrative assistants	16,848 13	
Traveling expenses of administrative assistants	1,471 33	
General expenses and supplies	4,036 42	
Equipment	83 03	
		$23,359 76

Research, Publicity and Education.

Salaries	$2,518 50	
Traveling expenses	298 00	
General expenses and supplies	621 04	
Equipment	21 30	
		3,458 84
Subtotal		$26,818 60

General Fish and Game Patrol.

San Francisco Division.

Salaries	$47,642 80	
Traveling expenses	23,639 29	
General expenses and supplies	2,193 44	
Equipment	146 50	
	$73,622 03	

Sacramento Division.

Salaries	$32,225 05	
Traveling expenses	15,724 30	
General expenses and supplies	1,670 25	
Equipment	86 53	
	49,706 13	

Los Angeles Division.

Salaries	$17,966 64	
Traveling expenses	8,861 39	
General expenses and supplies	2,086 23	
	28,914 26	

Miscellaneous Fish and Game Expenditures.

Printing	$2,821 08	
Accident and death claims	1,711 02	
	4,532 10	
Subtotal		156,774 52
		$183,593 12
Apportionment to game expenditures	$110,155 87	
Apportionment to fish expenditures	73,437 25	
		$183,593 12

Special Fishery Expenditures.

FISHCULTURE.

Administration—Department of Fishculture.

Salaries	$7,847 67	
Traveling expenses	2,674 14	
General expenses and supplies	1,349 10	
Equipment	134 25	
		$12,005 16

Mount Shasta Hatchery.

General operating expenses—trout	$27,657 77	
General operating expenses—salmon	4,056 36	
Upkeep and repairs	1,567 06	
Construction and improvement	19 28	
Equipment	8,617 94	
		41,918 41

Klamath Station.

General operating expenses—trout	$360 21	
General operating expenses—salmon	4,221 36	
Upkeep and repairs		
Construction and improvement	517 30	
Equipment	125 95	
		5,224 82

Fall Creek Station.

General operating expenses—trout	$2,909 72	
General operating expenses—salmon	591 92	
Upkeep and repairs		
Construction and improvement	895 02	
Equipment	94 01	
		4,490 67

Mount Whitney Hatchery.

General operating expenses—trout	$12,244 04	
Upkeep and repairs	74 85	
Construction and improvement	6,824 67	
Equipment	497 22	
		19,640 78

Cottonwood Creek Station.

General operating expenses—trout	$625 88	
Upkeep and repairs		
Construction and improvement		
Equipment		
		625 88

Cottonwood Lakes Station.

General operating expenses—trout	$436 03	
Upkeep and repairs		
Construction and improvement	24 19	
Equipment		
		460 22

Tahoe Hatchery.

General operating expenses—trout	$1,106 19	
Upkeep and repairs		
Construction and improvement		
Equipment		
		1,106 19

Tallac Hatchery.

General operating expenses—trout	$2,370 73	
Upkeep and repairs	54 04	
Construction and improvement	165 81	
Equipment	703 64	
		3,294 22

Chico Experimental Station.

General operating expenses—trout		
Upkeep and repairs		
Construction and improvement	250 00	
Equipment		
		250 00

Fort Seward Hatchery.

General operating expenses—trout	$1,363 73	
General operating expenses—salmon	1,523 81	
Upkeep and repairs	56 55	
Construction and improvement	9 50	
Equipment		
		2,963 59

Eel River Station.

General operating expenses—trout	$30 00	
General operating expenses—salmon	2,012 12	
Upkeep and repairs		
Construction and improvement		
Equipment		
		2,042 12

Ukiah Hatchery.

General operating expenses—trout	$1,445 66	
Upkeep and repairs	23 70	
Construction and improvement		
Equipment		
		1,469 36

Snow Mountain Station.

General operating expenses—trout	$1,481 10	
Upkeep and repairs	38 02	
Construction and improvement		
Equipment		
		1,519 12

Brookdale Hatchery.

General operating expenses—trout	$2,622 71	
Upkeep and repairs	698 53	
Construction and improvement	28 15	
Equipment	5 90	
		3,355 29

Scott Creek Station.

General operating expenses—trout	$783 22	
Upkeep and repairs		
Construction and improvement		
Equipment		
		783 22

Feather River Hatchery.

General operating expenses—trout	$171 24	
Upkeep and repairs	4 85	
Construction and improvement	3 32	
Equipment		
		179 41

Almanor Hatchery.

General operating expenses—trout	$1,548 56	
Upkeep and repairs		
Construction and improvement		
Equipment		
		1,548 56

Domingo Springs Hatchery.

General operating expenses—trout	$1,539 43	
Upkeep and repairs	163 22	
Construction and improvement	266 77	
Equipment	8 00	
		1,977 42

Clear Creek Hatchery.

General operating expenses—trout	$220 32	
Upkeep and repairs		
Construction and improvement	525 45	
Equipment		
		745 77

Bear Lake Hatchery.

General operating expenses—trout	$1,291 75	
Upkeep and repairs	76 15	
Construction and improvement	369 50	
Equipment	214 45	
		1,951 85

North Creek Station.

General operating expenses—trout	$2,206 52	
Upkeep and repairs		
Construction and improvement	960 70	
Equipment	200 00	
		3,367 22

Wawona Hatchery.

General operating expenses—trout	$313 99	
Upkeep and repairs	35 00	
Construction and improvement	40 00	
Equipment	3 76	
		392 75

Yosemite Hatchery.

General operating expenses—trout	$230 99	
Upkeep and repairs		
Construction and improvement	759 89	
Equipment	7 48	
Construction (permanent)	281 31	
Construction (Dept. of Engineering—not included in total)	327 27	
		1,279 67

Kaweah Hatchery.

General operating expenses—trout	$247 81	
Upkeep and repairs	142 38	
Construction and improvement		
Equipment		
		390 19

Fish Transplanting.

Salaries		
Traveling expenses		
General expenses and supplies	$37 56	
Equipment		
		37 56

Screens, Fishways and Water Pollution.

Salaries	$4,305 32	
Traveling expenses	1,813 94	
General expenses and supplies	318 89	
Equipment		
		6,438 15

Special Field Investigation.

Salaries	$150 00	
Traveling expenses	115 50	
General expenses and supplies		
Equipment and repairs		
		265 50
Total expenditures—Department of Fisheulture		$119,723 10

Commercial Fishery Expenditures.

Administration.

Salaries	$11,688 40	
Traveling expenses	2,590 71	
General expenses and supplies	2,868 11	
Equipment	865 71	
		$18,012 93

Northern California District.

Salaries	$211 67	
Traveling expenses	179 72	
General expenses and supplies	5 00	
Equipment		
		396 39

San Francisco District.

Salaries	$2,530 00	
Traveling expenses	179 05	
General expenses and supplies	19 54	
Equipment	291 80	
		3,020 39

Monterey District.

Salaries	$2,021 00	
Traveling expenses	893 17	
General expenses and supplies	514 13	
Equipment	85 75	
		3,514 05

San Pedro District.

Salaries	$4,173 33	
Traveling expenses	888 45	
General expenses and supplies	627 85	
Equipment	541 00	
		6,230 63

San Diego District.

Salaries	$1,520 16	
Traveling expenses	522 62	
General expenses and supplies	340 78	
Equipment	61 00	
		2,444 56
		$33,618 95

Launch Patrol.

Launch "Quinnat."

Salaries	$3,003 00	
Traveling expenses and mess allowance	941 00	
Repairs	2,631 39	
General expenses and supplies	716 13	
Equipment	7 56	
		$7,299 09

Launch "Albacore."

Salaries	$3,235 25	
Traveling expenses and mess allowance	946 41	
Repairs	1,760 99	
General expenses and supplies	3,140 67	
Equipment	425 24	
		9,508 56

Launch "Shad."

Salaries		
Traveling expenses and mess allowance		
Repairs	829 40	
General expenses and supplies	301 91	
Equipment	7 50	
		338 81

Launch "Barracuda."

Salaries		
Traveling expenses and mess allowance		
Repairs	$178 20	
General expenses and supplies	212 59	
Equipment		
		390 79

Launch "Salmo."

Salaries		
Traveling expenses and mess allowance		
Repairs		
General expenses and supplies	$5 15	
Equipment	2,300 00	
		2,305 15

Miscellaneous Launch Patrol.

Salaries		
Traveling expenses and mess allowance	$20 00	
Repairs	86 45	
General expenses and supplies	176 30	
Equipment		
		282 75
		$20,125 14

Miscellaneous Fishery Expenditures.

Printing	$1,090 54
Prosecutions and allowances (fish cases)	690 69
Lithographing fishing licenses	950 00
Angling license commissions and refunds	13,278 99
Market fishing license commissions	815 00
Crawfish inspection	1,706 45
Subtotal fishery expenditures	$191,998 77

Special Game Expenditures.

Hayward Game Farm.

Salaries	$631 19	
Traveling expenses		
Rent	150 00	
General expenses and supplies	124 06	
Food for birds	252 74	
Construction and improvement		
Equipment		
		$1,157 99

Miscellaneous Game Expenditures.

Printing	$476 69
Prosecutions and allowances (game)	504 36
Lithographing hunting licenses	110 48
Hunting license commissions and refunds	17,760 80
Mountain lion bounties	6,100 00
Winter game feeding	
Subtotal game expenditures	$26,110 32

Segregation:	
Total of all fish expenditures	$265,436 02
Total of all game expenditures	136,266 19
Grand total of all expenditures	$401,702 21

FISH AND GAME COMMISSION.

Statement of Expenditures for the Period From July 1, 1919, to June 30, 1920.

Administration:		
Commissioners	$1,672 70	
Executive offices	26,217 67	
Printing	3,824 84	
Research and publicity	5,030 44	
Accident and death claims	2,765 19	
		$39,510 84
Commercial fisheulture and conservation:		
Superintendence	$13,639 99	
Inspection and patrol	29,693 55	
Research	18,122 68	
Statistics	9,662 74	
Market fishing license commissions	765 00	
Propagation and distribution of salmon	22,703 34	
		$94,587 30
Sporting fisheulture and conservation:		
Superintendence	$14,510 34	
Printing	1,909 94	
Prosecutions and allowances	656 05	
Angling license commissions	15,324 20	
Special field investigation	252 35	
Fish exhibits	7,208 91	
General patrol (pro rata share):		
San Francisco District (40 per cent)	34,545 05	
Los Angeles District (40 per cent)	14,148 09	
Sacramento District (40 per cent)	27,303 76	
Propagation and distribution of trout	121,102 29	
		$236,960 89
Game conservation:		
Printing	$2,870 17	
Prosecutions and allowances	1,225 38	
Hunting license commissions	21,131 20	
Mountain lion hunting (and bounties)	6,950 23	
General patrol (pro rata share):		
San Francisco District (60 per cent)	51,789 75	
Los Angeles District (60 per cent)	21,222 05	
Sacramento District (60 per cent)	40,956 68	
		$146,945 46
Tahoe camping ground		3,152 98
Total expenditures		$521,157 47