

Biennial report of the State Board of Fish Commissioners of the State of
California

California.

Sacramento : J.D. Young, supt. State printing

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FIFTEENTH BIENNIAL REPORT

OF THE

State Board of Fish Commissioners

OF THE

STATE OF CALIFORNIA,

FOR THE YEARS 1897-1898.

COMMISSIONERS:

ALEXANDER T. VOGELSANG, <i>President</i>	- - - - -	SAN FRANCISCO.
C. E. GOULD	- - - - -	OAKLAND.
J. M. MORRISON	- - - - -	SACRAMENTO.

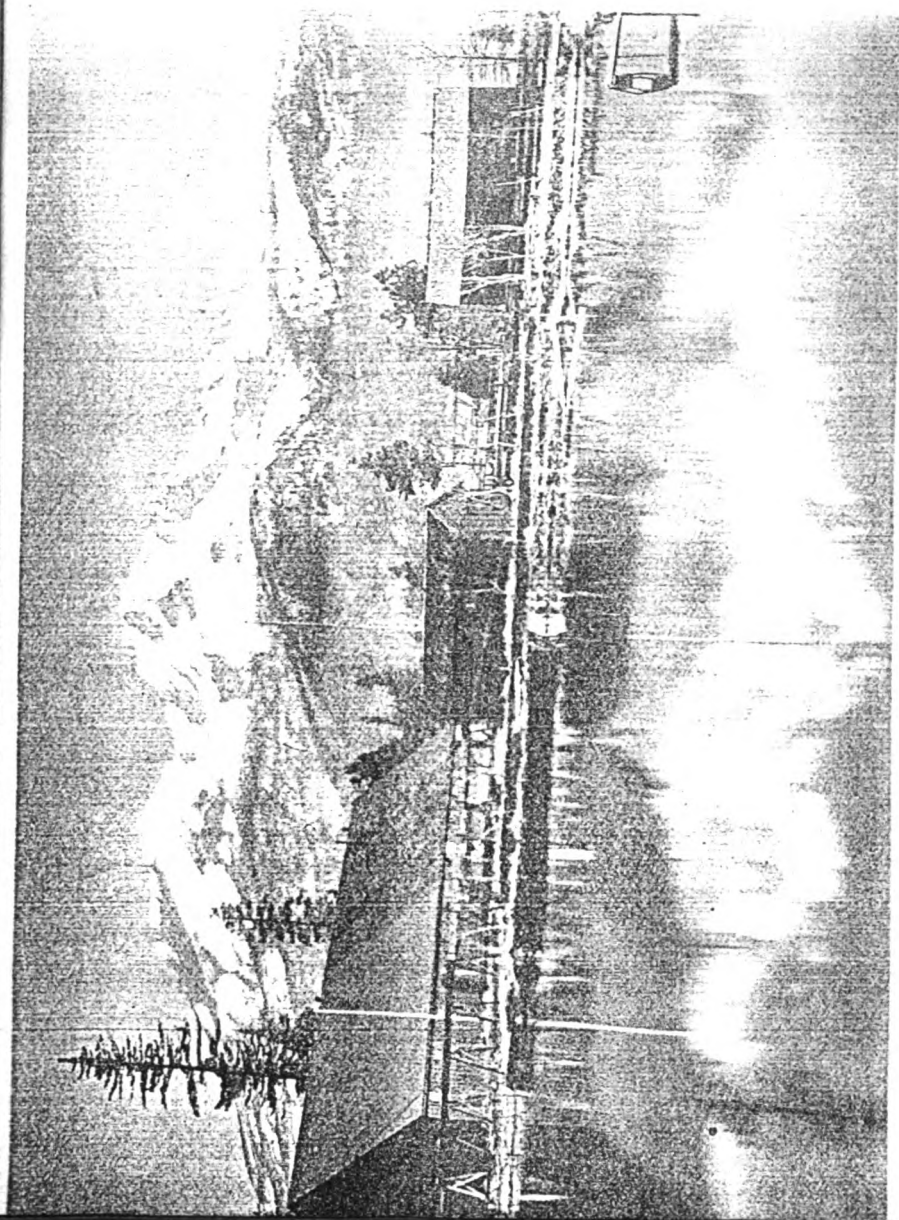


SACRAMENTO:

A. J. JOHNSTON, : : : : : SUPERINTENDENT STATE PRINTING.
1900.

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SISSON HATCHERY, 1898.

REPORT.

To the Honorable JAMES H. BUDD, Governor of the State of California:

According to law, the Board of Fish Commissioners of the State of California herewith submits its Fifteenth Biennial Report, being the record of its work from September 1, 1896, to September 1, 1898.

There has been no material change in the policy of the Board since our last report. We fully realize that the principal object of our official existence is the conservation of one of the great food supplies of our people, and we therefore have devoted our efforts chiefly to the fostering, propagation, and protection of our commercial fishes.

The membership of the Board has changed since our last report. Mr. W. C. Murdoch resigned in September, 1896, and Mr. Alexander T. Vogelsang was appointed by you, in November, 1896, to succeed him. Mr. H. F. Emeric resigned in September, 1897, and his successor, Mr. C. B. Gould, was appointed by you at that time. Upon the resignation of Mr. Emeric, Mr. Alexander T. Vogelsang was elected President. The office of the Board was removed from the Flood Building to the Mills Building, San Francisco, in March, 1898. Regular meetings of the Board have been held during the first week of each month, and at such other times as was necessary. Complete minutes of the meetings are on file in our office.

We have made but few changes of employes in the last two years.

Mr. Arthur G. Fletcher, who was clerk of this Board for four years, died in February, 1898. He was a native of Vermont, and was first employed by this Commission to take charge of its interests in the southern part of the State. In this field his activity and success in arresting and prosecuting offenders against the fish and game laws, and his concise and intelligent reports of the conditions prevailing in Southern California, induced the Board to appoint him to the office of clerk. He performed the duties of this office with signal ability. His statistical work in our Thirteenth and Fourteenth Biennial Reports won favorable comment throughout the United States. In 1896 he operated the Wawona hatchery, and made a careful survey of the streams and lakes of the Yosemite National Park, with the result that they have been thoroughly and systematically stocked with fish. His genial nature, his industry, and his intelligence were so marked that we feel his death to have been a distinct loss to the fishery interests of California.

We have to say that the success of our labors, as here recorded, has been rendered possible only by the fidelity and ability of our employes; and in this connection we add that we have exacted from them no qualification except ability and attention to duty.

The generous co-operation and support given us by the United States Fish Commission has enabled us to so extend the propagation of salmon that the result surpasses all previous records in this line. Our salmon work now far exceeds the combined output of all other Pacific States. The work of propagation and the protection of the interests confided to our charge have been conscientiously performed, and we feel warranted in referring with satisfaction to the record which we offer you. No State in the Union has received so large a return for the moneys expended in fostering its fisheries as California, notwithstanding that the benefits of much of the work are not yet fully appreciable. If all moneys expended by this Board had yielded no other result than the successful introduction and protection of the striped bass in our waters, the people of this State would be amply repaid. We feel confident that no other expenditure of State funds has resulted in greater benefit to its people. Our native fishes have been so propagated and protected that they continue in full supply.

The low stage of water in the streams of our State during the past season has greatly injured the game fish supply. Streams that have been well stocked by us, and which afforded our people a supply of desirable game fish, have in many instances become dry. The work of restocking these waters will be taken up by us next season, though it may require the efforts of several years to restore them to the condition of food producers. During the season of 1898 the work of restocking has been confined, therefore, to only a few of the largest streams of our State, with the result that the Sacramento, Feather, Truckee, Yuba, and American rivers and the lake system have received unusually large consignments.

We have maintained an effective patrol of San Francisco, San Pablo, and Suisun bays and the Sacramento and San Joaquin rivers during the run of fish by the constant operations of our launch "Quinnat." The salmon, therefore, have been protected in their passage from the sea to and upon their spawning-beds. The Russian, Garcia, Eel, and Mad rivers have also been patrolled during the fall and winter runs of steel-head trout and salmon. We have guarded the interests of Southern California from Los Angeles, and the north and northwestern counties from Eureka, the men being assigned as the needs of the season required. During the spawning and the spring months of the closed season, we have also kept a vigilant watch upon Lake Tahoe and its tributary streams. By moving our force of patrolmen rapidly and intermittently from place to place, we have kept the trout streams of the State, and in particular those along the coast, under reasonably constant supervision.

We may add that a constant patrol of all streams during the close season for those who forestall the law and, during the open season, for dynamiters and other malefactors, is entirely impracticable and utterly impossible under our appropriations, and we respectfully submit that without the hearty co-operation of county peace officers, this work can never be thoroughly and properly done.

The decision of the Supreme Court in the case of *The People vs. Truckee Lumber Company*, which is found in the Appendix, has settled the question of dumping sawdust into the streams of this State for all time. All our rivers and streams, with very minor exceptions, are now free from sawdust or mill or factory refuse.

We were unable to compel the construction of a suitable fishway on the dam of the Klamath River Lumber Company, in the Klamath River at Klamathon, during the season of 1897, in time to permit the passage of the spring run of spawn fish. The Lumber Company was bankrupt and claimed to be unable to comply with the laws, and we failed in our efforts to compel it to do so by law. During the fall of 1897, through the generous action of Scott & Van Arsdale, Hervey Lindley, Jesse D. Carr, Edson Brothers, and the Southern Pacific Company, in contributing money and labor, a very strong and efficient fishway was constructed at this important point. The work was undertaken by the engineering department of the Southern Pacific Company. Without the assistance of these public-spirited citizens, the law's delays would have left the obstruction unprovided for during the spring run of 1898. The ladder has worked successfully, and the run of fish to the headwaters of the rivers during the past season equaled that previous to the construction of the dam. We are greatly relieved to have a suitable fishway therein, for the reason that all rainbow trout eggs collected by this Commission are taken from Shovel Creek, a tributary of Klamath River above this obstruction.

In the distribution of game fish, we have made every effort to reach every section of the State. During the season of 1897 we were more successful than previously, and we were fully prepared to follow up this work in 1898, but on account of low waters in the southern and central sections, we were compelled to abandon the work for the year in those localities. In the distribution of the past two years, we have reached many portions of the State that theretofore have been considered inaccessible, but with the aid of Major H. C. Benson, U. S. A., and Mr. A. D. Ferguson, the efficient Game Warden of Fresno County, the barren waters of the Yosemite National Park and the high Sierras have been effectively stocked. In the years to come these waters will afford much food and pleasure to the tourist and camper, and the benefits of this work will then be fully appreciated.

We have carefully expended our funds for the protection and propagation of game by maintaining such a patrol and by importing into

the State such numbers of game birds as our limited appropriation would permit. This work is beset with many difficulties. The reduction of our heretofore wild and unoccupied lands to cultivation is the greatest factor in the depletion of our game supply, except, perhaps, the work of the lawless miscreants who pursue game regardless of the season and to whom our peace officers and courts have not yet brought home the fact that this work is essentially criminal and heavily punishable. The wholesale dealers and the proprietors of French *rotisseries* in San Francisco are most persistent and blameworthy violators of the game laws. We are glad to state, however, that in San Francisco the courts are beginning to see the law, and have lately manifested an inclination to deal with these criminals as they deserve.

The work of propagation of Mongolian pheasants has been seriously and thoroughly undertaken, and we are in receipt of many encouraging reports from sections of the State of the result of our labors in this behalf. We hope that we may continue the importation for several years to come.

In the pages which follow we present in detail the results of our efforts and the conditions affecting the fishery and game interests of the State.

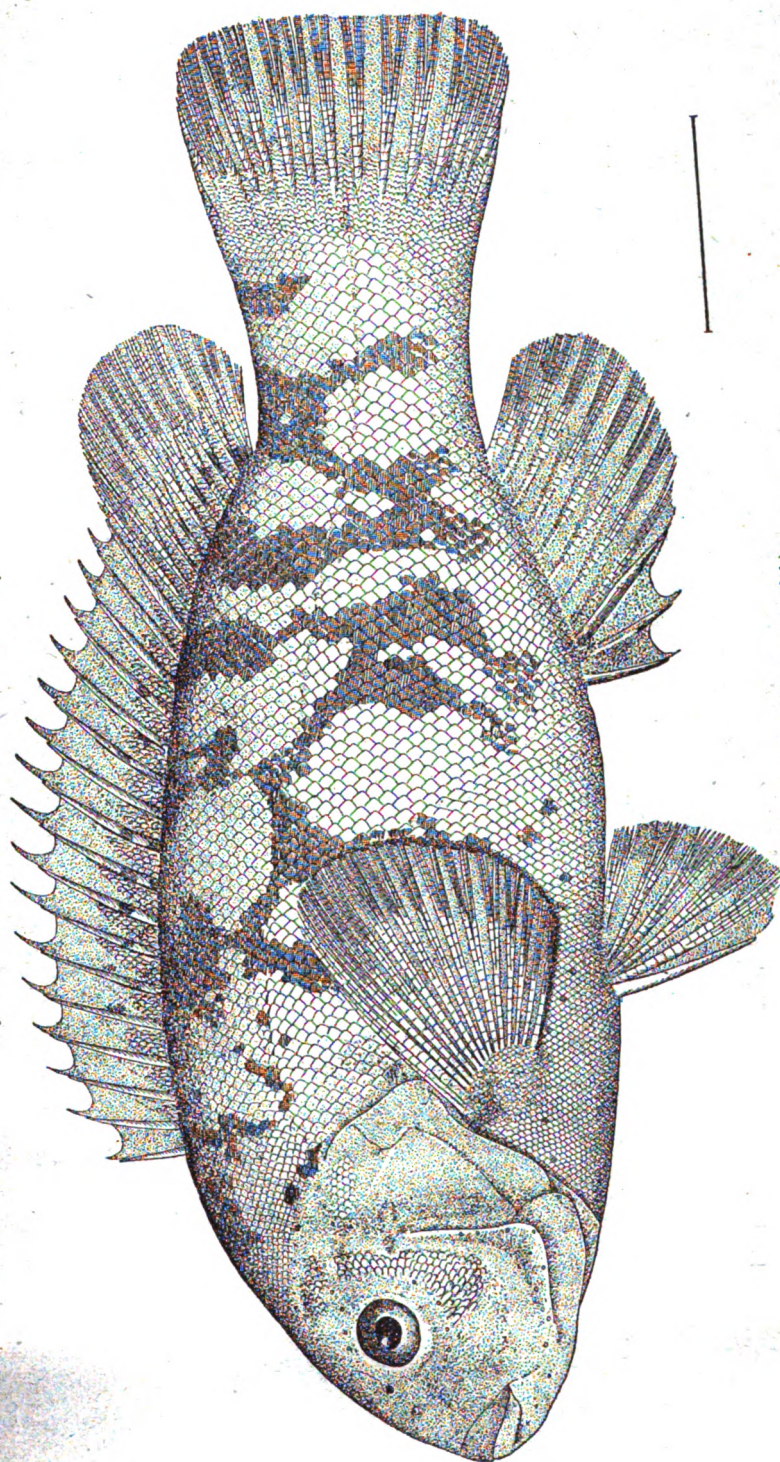
The resources and expenditures of the Commission have been as follows:

Forty-eighth Fiscal Year.

	Resources.	Disbursements.
Support and Maintenance of State Hatcheries—		
Appropriation	\$7,500 00	\$7,500 00
Restoration and Preservation of Fish and Game—		
Appropriation	10,000 00	10,000 00
Fish Commission Fund—		
Balance on hand July 1, 1896	1,664 45	
Receipts from licenses, fines, etc.	4,232 50	
Amount expended		4,683 56
Balance on hand		1,213 39
Totals	\$23,396 95	\$23,396 95

Forty-ninth Fiscal Year.

Support and Maintenance of State Hatcheries—		
Appropriation	\$10,000 00	\$10,000 00
Restoration and Preservation of Fish—		
Appropriation	10,000 00	10,000 00
Restoration and Preservation of Game—		
Appropriation	2,500 00	2,500 00
Fish Commission Fund—		
Balance on hand July 1, 1897	1,213 39	
Receipts from licenses, fines, etc.	4,342 50	
Amount expended		3,184 67
Balance on hand July 1, 1898		2,371 22
Fish Commission Boat Fund—		
Balance on hand July 1, 1897	1,100 00	
Appropriation for purchase of launch	1,500 00	
Expended for purchase of launch "Quinnat"		2,600 00
Totals	\$30,655 89	\$30,655 89



THE TAUTOG (*Tautoga onitis*).

In the Appendix will be found a detailed statement, showing to whom, and for what purpose this money was paid by the State Treasurer, after having been approved by the Board of Examiners.

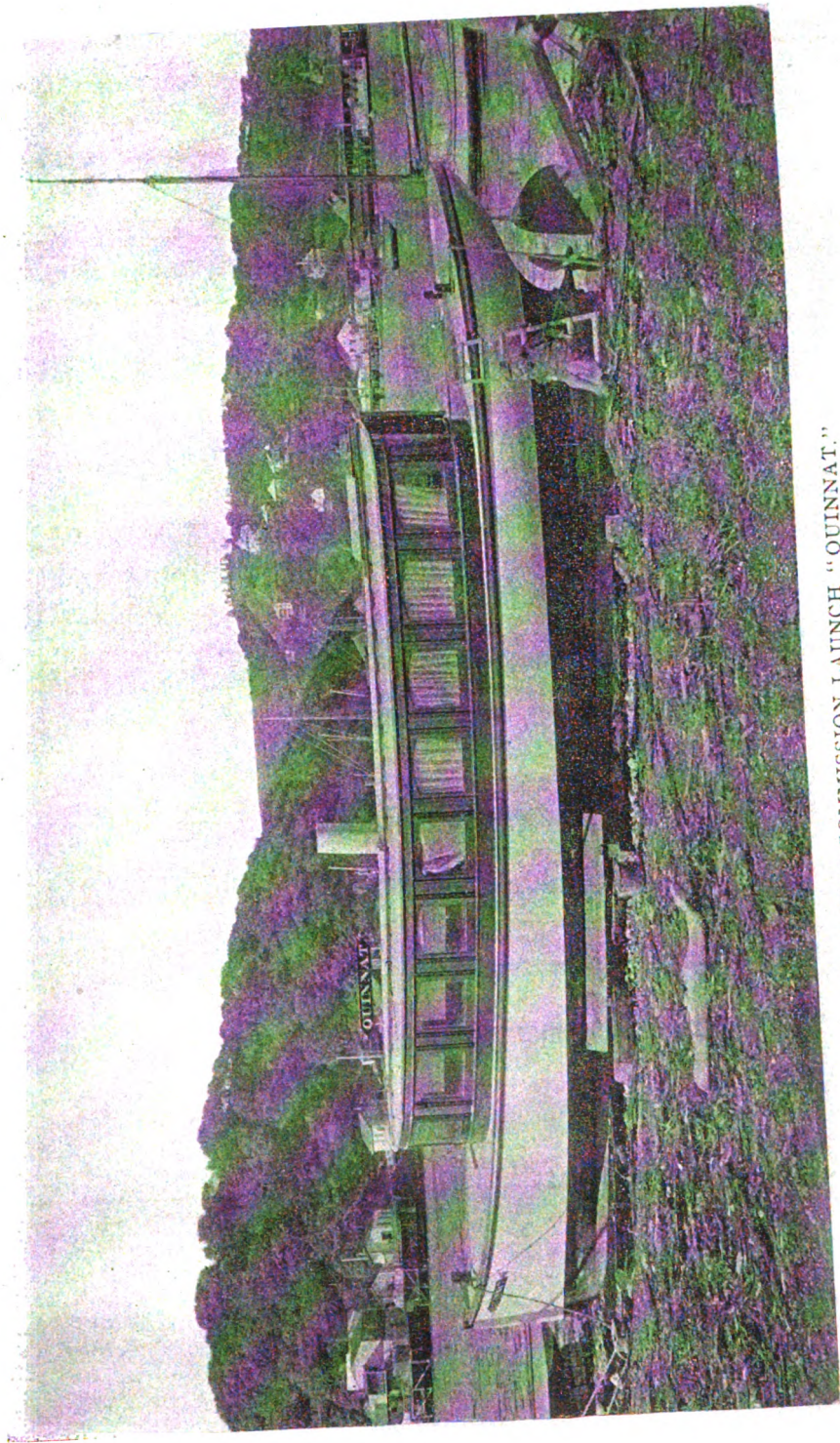
In the Appendix will be found a statement showing the
LICENSES. number, class, and amount received from the sale of licenses sold during the past two years. The collection of these licenses was made by the patrol department.

In addition to the propagation of salmon carried on in this State by the National Commission, it has, since our last report, made three plants of Atlantic marine species in our waters, as follows:

Species.	Point of Deposit.	Number.
Lobster	Cypress Point and Farallones	360
Terrapin	San Francisco Bay	120
Oysters	Humboldt Bay	25 bbls.
Tautog	Monterey Bay and Farallones	570
Blue Crab	San Francisco Bay	162

The lobsters were adult, egg-bearing specimens, that were received in prime condition and were held in fresh salt water until fully recuperated and were then liberated in favorable places. If this desirable crustacean will thrive in our waters, these plants should demonstrate the fact. The blue crabs were adult, and very strong. It is the soft-shell crab of the Eastern market, and will prove a valuable addition to our aquatic food. There seems to be no reason why they should not become acclimated. The tautog is a very common and highly prized fish of the Eastern coast market. The oysters planted in Humboldt Bay have thrived, and specimens carrying spat have been forwarded to us, but so far no evidence of their propagation has been offered. The conditions, however, are favorable.

By reason of the moneys in the Fish Commission boat
THE LAUNCH fund, \$1,100, and the appropriation of \$1,500, made
"QUINNAT." by the thirty-second session of the Legislature, we were enabled to enter into a contract with John Twigg & Sons, San Francisco, under which they built for us a twenty horse-power gasoline launch, 40 feet over all, 7½ feet beam, and a depth of 42 inches. This boat has an average speed of eight knots, is completely housed in, and fitted with living accommodations for four men. She is a staunch and seaworthy boat. We have called her "Quinnat," the Indian name for the Sacramento river salmon. She was placed in commission in August, 1897, and has ever since been used in the patrolling of the bay and rivers. The addition of this boat has added greatly to the efficiency of our patrol. By its means we have been enabled to make repeated visits to all the fishing grounds and examine most closely into the methods practiced by our fishermen. The presence of this boat among these hardy men has a most beneficial effect in giving weight to the regulations affecting the



THE FISH COMMISSION LAUNCH "QUINNAT."

fisheries, and while our deputies have been enabled by its use to make many arrests, remove set nets, and destroy miles of the prohibited Chinese sturgeon gear, the knowledge that the launch was in commission and liable at any time to visit the fishing grounds has forcibly impressed upon the fishermen the necessity of a close observance of the regulations.

Section 628 of the Penal Code requires persons owning
SCREENS. or operating ditches or canals, etc., to place and maintain over the inlets of their ditches a screen of such fineness, strength, and quality as shall prevent any fish from entering such ditch, "when requested to do so by the Fish Commissioners." In other words, this power is discretionary with the Board. We have gone to considerable trouble and expense in investigating this problem, and find that in nearly every instance it brings us in collision with other important interests of the State, to wit: mining, agriculture, and horticulture. To be of any avail whatever screens must be fine enough to keep out small fish, and such screens are naturally prone to become clogged and impassable to water, as all streams carry large quantities of débris in the form of leaves, grasses, and subaqueous growths, which gather upon and cling to them, so that in a very short time the water is shut off below and they must be cleaned.

From our experiences with all forms of devices for screening waterways, we have, as yet, found nothing that does not require constant attention to secure a free flow of water. This is the case with even the smallest ditches, and miners, fruit-growers, and farmers rise up in wrath when called upon to maintain a device which entails upon them constant employment of labor for the purpose of keeping the screens clean. They claim, with much reason, that their interests are already sufficiently taxed. We find that most irrigating companies, and nearly all persons to whom we have addressed ourselves upon this matter, are willing to obey the law if we can suggest to them an effective device.

Of the food fishes, the trout suffers the most by this condition. The salmon of the Sacramento Valley are not affected. In the San Joaquin Valley they are too scarce to be considered, although in that section the black bass may hereafter become the sufferers. The question then becomes a contention between the trout interests and the farmer, miner, and fruit-grower. While we admit that the damage to the trout is considerable, we are slow to believe that it is sufficient to enforce the hardship of additional continuous expense upon these industries.

We have considered the matter fully, carefully, and almost prayerfully, and have withheld the exercise of our discretionary power until such time as the inventive genius of our people shall produce such a screen as may be used without entailing a great additional expense to the miners and irrigators.

During the fall of 1897 we sent an agent to Oregon to PHEASANTS. purchase Mongolian pheasants for distribution in suitable localities in this State. Three hundred and twenty-three birds were purchased and assigned in five-pair lots to locations in almost every section of the State, where they were turned down in suitable cover. We have reports from almost every shipment, showing that nides of young birds have been seen during the past season, and we feel confident that in nearly every locality they have propagated. These birds will be a decided addition to our covers, and will damage no interests. To show the value of these birds, attention is called to the statement made by Oregon's Fish and Game Warden, Hollister D. McGuire, that upwards of ten thousand of these pheasants were marketed in Oregon in 1897, at an average price of fifty cents each. In the Appendix there will be found a statement showing the location where these pheasants were liberated.

DEPLETING
TROUT
STREAMS.

The anglers of this State should remember that the taking of small fish from our trout streams is one of the greatest factors in depleting them. The stories of the "remarkable catches" made from many of our streams of from 70 to 150 fish to the creel, so common in the "rod and gun" columns of our newspapers, show the great injury done by thoughtless fishermen, many of whom are the loudest in the cry that the streams are being fished out and require more stocking. So long as the three- and four-inch fish are killed, no surprise should be expressed because the streams have no large trout. The work of planting fish fails of its purpose where this practice prevails. Take for consideration Paper Mill Creek and its tributaries in Marin County. Though comparatively small, it is one of the greatest natural trout-breeding streams in California, and it is probably more frequented by fishermen than any other stream in the State. It is persistently fished from the beginning to the end of the season by a very large number of men, many of whom kill every trout they catch, regardless of its size. Many of these fish are not over three inches in length. This slaughter goes on until the first of December, with the result that the fry hatched out in the late winter months are almost entirely destroyed before the season closes. The State has, in addition to the natural propagation, stocked this stream year after year, and the work has been well done, but it has been of little or no benefit to the anglers who go there. This condition must prevail so long as the fry of each season is destroyed in this thoughtless manner. There should be an unwritten law among fishermen, as with anglers, that all fish under six inches in length should be returned to the water, and until such a law is recognized by the men who frequent the streams, the sport will decrease.

CONDITIONS
PREVAILING
IN OUR
FISHERY
MARKETS.

Prof. H. C. Bumpus, of Brown University, read a paper before the Fishery Congress held at Tampa, Florida, in February, 1898, that is so applicable to the conditions prevailing in our fishery markets that we extract the following, with the hope that our fishermen and dealers may take active steps to improve their methods:

In one direction in particular there is crying need of both extended and extensive scientific research. I refer to a matter that received some attention at the Chicago congress, namely, that research which shall result in the development of the market for food fish. I think I do not overstate the fact when I say that there should be three times as much fish consumed as is consumed at the present time. The problem is not alone how shall we produce more fish, but how shall we improve the industry by providing a better and a more stable market for what is already produced. I feel that the fisherman and the fish-dealer are in a measure responsible for the fact that the average American cannot endure fish oftener than one day in seven, and were it not for a wise provision of the Church, perhaps one day in seven would be far too frequent. While the dressing and shipping of meat and poultry has almost become an art, the methods of dressing and handling fish are crude in the extreme.

The abuse of fish as an article of food begins at the moment it is captured, and extends to and often beyond the kitchen. I need not relate the rough handling on board the smack, the careless packing, and the slovenly condition of our markets. These are all prejudicial to the consumer, as well as to the fish; but I wish to emphasize the fact that they are also sources of great loss to the dealer.

The blood that is ordinarily allowed to remain in the fish is the very medium that the bacteriologist uses for the culture of microbes, and its retention in the body of the fish provides the very medium in which the germs of decay delight. Should the fisherman bleed the fish immediately on its capture, he would do much toward its reaching the consumer in a healthy condition.

The digestive organs of the fish are very active, and the processes of digestion continue after death, but while before death the contents of the alimentary tract are alone acted upon, after death the digestive ferments attack the surrounding tissues, and they attack these tissues with great energy. A few minutes is often sufficient for the deterioration of the flesh immediately inclosing the abdominal cavity. It would be a great saving to the dealer if the fish could be disemboweled and thoroughly washed as soon as captured.

Decay is practically an infectious disease. It is the direct result of the activity of certain microscopic organisms. If these organisms have difficulty in entering the tissue of the fish, or if their activity is inhibited through the application of cold, or certain chemicals, the process of decay is retarded. Every time a fish is roughly handled, thrown upon the deck or pitched about as so much offal, walked upon or bruised in any way, the continuity of its flesh is broken and decay germs flood into the rupture. The slightest bruise of an apple or pear results in the formation of a center of decay quite visible to the eye. In the fish the center of decay is not so easily detected by the eye, but it is nevertheless present, and its presence is damaging to the dealer and disappointing to the consumer.

Animal tissue absorbs water very readily, but on the absorption of water it changes its structure, loses its flavor, and rapidly deteriorates. Fish should not be allowed to lie in their own slime on wet floors, or in poorly drained barrels and boxes.

The present method of shipping fish by the use of chopped ice is crude, expensive, and often ineffectual. Poultry, meat, or anything but fish would find no market, if shipped in a similar way. The fish arrive at their destination in a thoroughly uninviting condition; they are reeking with slime and filth, ghastly to the sight, offensive to the smell, and disgusting to the touch.

If the retailer along the coast, as well as inland, can be provided with fish that have been properly killed, skillfully cleaned, and carefully handled, he will be in a position

to present them to his customers in an attractive form, and the consumer will discover that all fish do not taste alike, which is synonymous with saying all fish are not equally bad.

While urging that all lines of research already undertaken by the Government should be continued, I would suggest that a definite series of experiments be instituted which shall ascertain the best methods of preparing, packing, shipping, storing, and retailing fish, for I am convinced that improvements are possible along all these lines, and that with improvements the demand for food fish will be very materially increased.

Though there are extensive fishing interests carried on along the entire coast, the principal supply of fresh salt-water fish consumed in the State is captured in the ocean near San Francisco, and of this supply the great bulk is furnished by the two companies who use the drag or paranzella nets upon the bottom of the sea outside of the Heads. This method of fishing is the only one of its kind carried on in our waters. It is of Italian origin. The mud banks off the coast of California south of Point Reyes and extending to Monterey afford a large field for this method of drag-net fishing, and our principal market supply of flounder, sole, and tomcod is captured there. This method of fishing has excited some considerable adverse comment, as being very destructive of small fish, but so far as we have been able to determine, the method is not so destructive as the practice of drawing small-mesh nets upon the beaches, and in the bays along the coast, while it has resulted in furnishing our markets with an abundance of fine fish at low prices. The effect of this fishery upon the market price is fully demonstrated during the time of heavy weather outside of the Heads, when this method cannot be used, by the sharp advance in price of all kinds of fish. The introduction of these nets in this fishing has unquestionably driven a considerable number of bay fishermen out of the business, but it has also lowered the price of fish to the consumers, and assists in protecting the spawn fish that enter our bays.

The laws regulating the killing of game have given general satisfaction, save in the length of the open season for ducks and quail. We believe the season should be shortened by making the closed season begin February 1st, and extend to October 31st.

The killing of pheasants should be prohibited indefinitely. When they have become established, provision can be made for an open season. The catching or killing of all wild birds by means of nets should be prohibited. Many thousands of insectivorous, as well as game, birds, are killed in this manner. A naturalist wrote us a letter last May concerning this method of taking birds, from which we extract the following:

Sunday, February 15th, I took a spin in the country on my wheel, and witnessed a sight I never expected to see outside of Europe. I was following along on a levee when I came upon two Italians, who had a net of fine mesh, about fifty feet long, stretched

across a patch of brush. This brush extended along the levee for miles, and is inhabited by thousands of small birds, especially the intermediate white-crowned sparrow and Heerman's song sparrow. When I saw this net I supposed it was used for catching fish, and that the Italians were simply repairing it. I sat down to watch the men fix the net, and was very much surprised to see them begin to beat the brush with sticks. They began about one hundred yards from the net and came toward their snare, all the while keeping up their whipping of the brush. As soon as I saw this I thought they were snaring birds, and sure enough when they had finished their drive they had captured about 50 birds, which was a very small number, as I afterwards found out. When they had removed the birds from the net, I examined them and found about 20 intermediate sparrows, 15 Heerman's song sparrows, 5 spurred towhees, 5 golden-crowned sparrows, and several California towhees. These happened to be all the varieties in this brush, for had there been more they would have captured them, as not one bird escaped. During the afternoon they captured 300 birds. I questioned them and found that they had been practicing this very same thing for some time, and had captured as high as 2,000 birds in one day. It makes no difference what kind of a bird they drive into their snare, and I think if it is kept up it will prove disastrous to some of our songsters. These Italians go out nearly every Sunday, and probably there are more practicing this very same thing. I am told that these birds are skinned and shipped to the market as reed birds.

We believe that every dealer in game should be required
DEALERS to take out a license, and should be required to keep a
IN GAME. record of all game received or purchased by him. This
 record should give the name and address of the persons
 from whom the shipments come, together with the date, number, and
 variety. This record should be open to the inspection of the Com-
 missioners or their assistants at all times, which would enable us to
 determine the market value of the game interests, and recommend
 legislation for its protection and propagation. We would also suggest
 that any dealer violating the provisions of such an act should forfeit
 his license, pay a fine, and be prohibited from selling game for two
 years.

The people of the State appropriate money to protect and propagate
 game, and why should not those who make money by selling it pay a
 license to assist in our work? The fishing interests pay a license, and
 the money so collected is devoted to the propagation of fish. Why not
 require a license of the game dealers, and devote the money so obtained
 to the propagation and protection of game?

In almost every instance where Boards of Supervisors
GAME have exercised their powers to appoint fish and game
WARDENS. wardens, there has resulted a manifest advantage to the
 fish and game interests. It is to be regretted that more
 counties have not appreciated the importance of such appointments.
 It appears to be owing to a lack of public sentiment favoring the pro-
 tection of fish and game, that so few counties have appointed wardens.
 The sportsmen of the State should bear in mind that the Supervisors
 have the power to appoint game wardens, and should combine to see
 that they are appointed. One active resident warden in each county
 can compel a more thorough observance of the fish and game laws

than a dozen stranger deputies. It is true that there are enough peace officers in each county to enforce these laws, and that they would enforce them if the public sentiment was stronger in their favor. We believe that in many sections the necessity for and the benefits to be derived from the protection of fish and game are fully appreciated. But in many of the outlying sections (and they are the game sections) this sentiment is lacking.

In counties where there are wardens we know the laws are closely observed. In these counties we have shown special favors in the distribution of fish, and feel that in this way the State's money is best expended. Results prove it. We have granted all applications for fish made by county wardens, and in the distribution of pheasants we have been generous in our allotments to them.

In the enforcement of the fish and game laws, the efforts of our small force have been more successful than heretofore. The number of violations detected have been increased, and we have obtained a greater number of convictions. All complaints made to us have been promptly investigated. When we were unable to send our own deputies to examine into such reports, we have authorized the Sheriff of the county to engage a man to do so, guaranteeing him compensation and expenses. We have been given much assistance in this work by the fish and game wardens in counties where such appointments have been made. We regret that more counties have not appointed such officers, as we believe there have been few violations in such counties that have not resulted in the arrest of the guilty parties. We have given particular attention to enforcing the laws that regulate the catching of fish for the markets, and we believe that they are now more generally observed than in the past. The market fishermen seem to realize fully that these laws further their own interests, and that a violation will cause them trouble and expense.

In the work of protecting the commercial fisheries the launch "Quinnat" has been of great assistance.

Punishment for the violation of the commercial fisheries laws has been made so severe that the market fishermen understand that their catch will not compensate them, under ordinary conditions, for the risk taken. The result is that they seldom attempt the violation of the law, and when they do, and are convicted, they serve their time in jail rather than pay the heavy fine.

We have during the past year maintained a paid force detailed to enforce the game laws, and to watch and hunt the class of men known as "hide hunters," who kill deer for their pelts. We have found much trouble in securing the conviction of these persons. The business of killing deer for their hides is conducted in outlying districts, where the

few residents regard such killing for meat and even for hides as being a matter of no importance. In these sections Justices' Courts are widely separated and wildly conducted, and every possible obstruction is placed in the way of securing a conviction. There is no denying the fact that a considerable part of the farming community do not regard the game laws as being binding upon a man who has a family and wants meat, and they refuse to be parties to his conviction, even when the evidence offered is conclusive. There is, even among men who style themselves sportsmen, a considerable class who seem to lose sight of the right and wrong of killing fish and game, once they get into the stream or field. This, probably, results more from thoughtlessness than from an intent to do a wrong to others, but the result is the same, as it encourages a class who already regard the law lightly. No law prohibiting the killing of fish and game becomes effective until there is a local sentiment created which recognizes its importance and demands it. In addition to the efforts made by the peace officers for the enforcement of the laws, several clubs and Boards of Supervisors in the State have assisted by offering rewards for the arrest and conviction of violators.

Of all crimes against the fish and game laws, that of killing fish by means of explosives is the most damnable, and should certainly bring down upon any person convicted of their use the full penalty of the law; but in no case where we have secured a conviction has the court given more than the minimum fine. The use of powder to kill fish is much more common than is generally known. It, like arson and poisoning, is one of the hardest crimes to prove. It is seldom that evidence sufficient even to warrant an arrest can be obtained. In fighting this practice we have offered a reward of \$25 for the arrest of any person so engaged, regardless of a conviction being secured, provided that the District Attorney of the county where the action is taken certifies to us that he believed the evidence warranted the arrest.

The following is a summary of the arrests made and actions begun by our patrol force since the last report:

Summary of Arrests Made for Two Years ending September 1, 1898.

No. of Arrests and Complaints Filed.	Offenses Charged With.	Pleaded Guilty.....	Convicted.....	Acquitted.....	Dismissed.....	Cases Pending.....	Served Time.....	Complaints "John Doe".....	Fines Imposed.....
31	Using illegal mesh nets		3	7				21	\$300 00
30	Using "set nets"		3	5			2	22	100 00
32	Using Chinese sturgeon lines		1				1	31	100 00
9	Taking salmon, "closed season"		2	5			1	2	100 00
10	Taking salmon, Saturday and Sunday	3	2	2			4	3	100 00
18	Fishing without license		18						135 00
8	Possessing underweight striped bass	1	5	2			1		100 00
4	Possessing underweight lobsters		3	1					60 00
9	Taking trout, "closed season"	3		6					30 00
3	Taking trout in traps		1	2					20 00
19	Using explosives to kill fish	1	6	12			6		1100 00
77	Possession of young fish	2	25		20	30			500 00
7	Possession of female crabs		7				7		140 00
4	Dumping sawdust in streams			2	2				
14	Possessing wild ducks, "closed season"	2	3	1		1		7	200 00
4	Possessing quail, "closed season"			3	1				
11	Killing deer, "closed season"	3	3	5					100 00
3	Trapping quail	1	2				2		40 00
4	Selling deer hides			2				2	
297		16	84	55	23	31	24	88	\$3125 00

The Sacramento and Truckee rivers have been carefully inspected. There are some fish-ladders on the dams in that part of the Truckee River in this State that are not satisfactory, but we hope before the first of the year to have all defects fully remedied. The ladders, generally, in this State, are kept in good repair, and there is no question but that they permit the free passage of fish during the high stages of water, though some are not as effective as we could wish.

There are several dams in the Truckee River in the State of Nevada that obstruct the passage of fish, which, for the joint interests of Nevada and California, we hope to have equipped with efficient fishways, and have undertaken to bring about this result with the State officials of Nevada. It is our keen desire to have a free and open passage for fish through the entire length of the river from Lake Tahoe to Pyramid Lake, and should our efforts in Nevada meet the success that we now have reason to expect, we shall undertake to stock the river with the most desirable varieties of trout each year, to its fullest capacity.

AN ATTOR-
NEY FOR
MINOR
COURT
CASES.

In the prosecutions of offenders in the Justices' and Police Courts we have felt the need of an attorney to look after the cases. Under the law it is the duty of the prosecuting attorney of the county to represent the people in all such matters, and a few of the District Attorneys have given our cases their hearty support, but in most of them this attention has been lacking and the prosecution consequently weak. In the trials in the San Francisco Police Courts the prosecuting attorneys are too much engaged to give our cases more than slight attention, with the result that they have dragged their weary way along with one continuance after another, and in many cases failed of conviction for lack of legal support. These results weaken the effect of the arrests made.

The Attorney-General has been very attentive to all of our requests for legal advice and assistance, and upon two occasions has detailed a deputy to help prosecute for us in the Justice's Court, but he has done this at the expense of other and possibly more important matters in his office. While he has been disposed to assist us in every possible way, he has been unable to furnish us with attorneys for minor court cases, and they have suffered.

There should be authority given this Board to employ an attorney to look after these cases. We believe that an active attorney could be paid from the additional fines collected by a vigorous prosecution, and request that the Legislature empower us to employ an attorney for this work. We do not ask a separate appropriation for this purpose. The expenses should be met by drawing upon our regular appropriation.

TRIALS IN
SUPERIOR
COURT.

The amendment in the law which places the trials for violations of the salmon and set-net laws in the Superior Court instead of before the Justice's Court, has been of great assistance in the prosecutions under these acts.

Trials conducted in many of the Justices' Courts of the State are farcical. Many of them are not conducted seriously, and usually result in an acquittal regardless of the evidence. The trials in the Superior Courts are conducted with dignity. The defendants must employ an attorney, and so well is this understood that in most of these cases a plea of guilty is entered at the preliminary hearing, while in many cases where the owners of the apparatus used were not captured and are unknown to our officers the apparatus is left in our charge. The owners prefer to lose it rather than face a trial in the Superior Court.

THE DIS-
POSAL OF
ILLEGALLY
POSSESSED
FISH AND
GAME.

The Code should have made provision for the disposal of illegally possessed fish and game, and fishing apparatus illegally used or possessed. By advice of the Attorney-General our men seize all fish and game illegally possessed, and remove all illegally used gear and place the same in the custody of the Justices' Courts, to be held as evidence in the trial that follows; but there appears to be no provision for the disposal of apparatus so held if the owners or users are not discovered, as is often the case. The lines and nets taken by our men are cumbersome, and must be held by some storage company under expense, and the Justice is given no funds to pay for it, nor has he authority to dispose of the property. The result is that neither the Justice nor the storage companies are willing to undertake its custody, and our men are embarrassed in handling them.

This condition prevails also with illegally possessed fish and game. Our men cannot turn over to the custody of a Police Court several hundred pounds of illegally possessed fish or game. The State is the original owner of all fish and game and does not lose its title if they are illegally taken or possessed, and it is manifest that a person illegally possessing must surrender them to the officer making the arrest. In all cases where such fish and game are seized, all but that desired for evidence is sent to some charitable institution, but the Code makes no provision for our doing so. We have called the attention of the Code Commission to this matter, and are informed that they will cover the point in their report to the Legislature.

THE CAP-
TURE OF
SHRIMPS
AND SMALL
FISH.

During the season of 1897, we caused a very careful inspection of the Chinese shrimp fisheries, in order to ascertain the nature and weight of their catch. For this investigation, we employed Mr. N. B. Schofield, of Stanford University, who was indorsed by Mr. David Starr Jordan. The inquiry was carried on for a period covering several months. In order that this fishery may be fully understood, we make the following extract from Mr. Schofield's report for July, 1897:

The Chinese shrimp boat is of Chinese make and pattern, and is 40 feet long by 10 feet on the beam; it carries a 30-foot mast, which bears a typical Chinese sail. The crew is invariably made up of five men.

The fishing is done by means of bag nets made in China expressly for the shrimp fishing. Each net is about 20 feet across its mouth, and narrows quickly into a narrow bag about 40 feet long. The end of the bag is open, so that the contents of the net can be easily let out by untying a string which holds the opening closed. Near the mouth of the net the mesh is large (about 2-inch), but it gradually grows smaller till in the last half of the bag the mesh is $\frac{1}{2}$ -inch.

Each boat operates from twenty to thirty nets, which are set on the bottom with their mouths against the current. Some position is selected in the channel where the Current is strong, and here a line is stretched across the current—lying on the bottom

and anchored at either end and occasionally in the middle—the position of the anchors marked by buoys. The nets are set along this line, usually at low tide, and are taken up again at the next high tide; depending on the current to drift the shrimps into the nets.

By a special contrivance the nets can be set and taken up without lifting the anchors by which they are held in place.

In drawing in the nets the fishermen pull up one end of the line to which the nets are attached, and pass it over a pulley at the bow of the boat and reel it in by a windlass in the stern. As each net comes up to the surface at the bow of the boat, it is unfastened from the line and carried around to the side of the boat, where it is pulled up by hand and its contents dumped into the boat. The nets are taken ashore and dried, and at the next low tide a second set of nets is taken out, each boat having two sets.

The number of shrimps caught by each boat varies greatly. At some times they catch only a couple of baskets, which weigh about 90 pounds each; at other times, when everything is favorable, they catch as high as eighty baskets. These numbers include everything caught.

The shrimps when brought into the camp are first boiled in large open vats. Salt water is used for the boiling, coarse salt being added in large quantities. After boiling about thirty minutes they are spread out on the ground to dry. After they are sufficiently dried they are swept together and rolled thoroughly with heavy cleated rollers, which break the shells away from the "meat" of the shrimp. Then, after a process of alternate sifting and beating and picking over by hand and running through a fanning mill, the "meat" is gotten out. For this dried shrimp meat the fishermen get 8 cents a pound in San Francisco. The shells and other impurities are saved and are made use of as a fertilizer, and with the rest of the shrimp product are sent to China.

A few shrimps are taken at this San Rafael fishery and sent fresh each day to the San Francisco market.

The time of setting the nets varies. Sometimes the best catch is made while the tide is running out; at others, the catch is equally good for the outgoing and incoming tide—due probably to a general movement of the shrimps, independent of the current.

When the catch is large the men stay at the nets and pull them in every hour or two.

The average catch per day for each boat at the San Rafael fishery during the last two weeks of July was 70 baskets, each basket weighing about 90 pounds, making in all 6,300 pounds. The average number of boats out each day was seven, making in all a daily catch of 44,100 pounds. For fifteen days this number is swelled to 661,500 pounds. One half of this consisted of small fish, principally of the following species: *Osmerus thaleichthys* (smelt); *Engraulis mordax* (California anchovy); *Porichthys notatus* (midshipman); *Leptocottus armatus* (sculpin).

The small *Osmerus thaleichthys*, about $2\frac{1}{2}$ to $3\frac{1}{2}$ inches long, were very abundant, making up over one fourth of the entire catch. The estimated amount of these young smelt taken in the last fifteen days of July is 165,375 pounds, or about 16,537,500 small fish. It is more than probable that this particular smelt is the principal food of the young salmon descending the Sacramento River.

When the nets come to the surface of the water these small smelt are dead, so that to throw them back would do no good. The only way to prevent this destruction would be to stop the fishing entirely during the time from April to October, when these fish are so abundant.

The Chinamen save a good many of these young smelt, drying them on trays. They say they get 10 cents a pound for them.

During July they caught but few flounders. These were saved and dried, along with a few sculpins, etc., which are not eaten by any one else. During May and June the catch of flounders is very much greater than at the present time.

There is but one way to effectually stop this destruction of small smelt, and that is by prohibiting the catching of shrimps during the time when the young smelt are found in the bay, namely, April to October. The necessity for the passage of such a law should be impressed

upon the Legislature. Fully eighty per cent of the catch of the shrimp-fishermen is dried and sent to China. Why should our bay be depleted of small fish that the Chinese may carry on this export? We have caused the arrest of many of these shrimp-fishermen, and have maintained as close an inspection over their work as our force would permit, and by this means have to a considerable extent limited their destruction of small fish; but their camps are so scattered around the bay that the patrol has not been as effective as could be wished. The consumption of shrimps in a fresh state is considerable. They furnish a valuable and cheap food to a large number of people, but they cannot be taken without the destruction of other fish. The young fish are present in San Francisco Bay in considerable numbers between October and May, and during that time our markets are well supplied with an abundance of food fish, so that our people would not materially feel the withdrawal of shrimps during that time.

No other of our fishery interests so urgently demands the attention of the Legislature as this, for unless there is a close season placed upon this fishery it will be but a few years when the fish-food most desired by the spawning fish in the bay will be entirely destroyed.

Since the establishment of the salmon egg collecting station at Battle Creek, the output of salmon has been increased. The State has a practical protective salmon law, and a station where an unlimited number of salmon eggs can be obtained. We have now only to determine the best possible disposition of the young salmon, and to this study the Commission is giving full attention.

We have inaugurated a scientific investigation of the movements and food of young salmon in our streams, with every confidence that intelligent planting of fry will soon restore the harvest of salmon from our streams to its original proportions.

It is unquestionable that the work of the State in propagating salmon has maintained the supply in our rivers. Our figures given below show that it has done more than this—that they are increasing, which, considering the comparatively small numbers planted previous to 1895 and the thorough manner in which our rivers have been fished, must be considered a most gratifying record, for, under natural conditions the salmon of the Sacramento River would have been decimated.

The supply of salmon handled in the San Francisco markets continues to show a satisfactory increase, and prices have been lowered during the months of full supply.

In considering the salmon supply of the State, it should be remembered that the table which follows shows only the fish handled in the San Francisco markets, as taken from the books of the principal dealers there. No very accurate data can be obtained of the large amount

which goes to the interior consumers direct from the fishermen, but it is safe to estimate the receipts of the San Francisco markets as representing seventy per cent of the fish handled in a fresh state. From this showing, the great importance to our people of this fishery product is manifest, as well as the reasons why we have devoted so large a part of the appropriation and our efforts toward increasing it.

The effect which our efforts in propagating salmon have upon the market price of all other fish is easily demonstrated. The salmon is the favorite fish in our markets, and, excepting a very few other fish, such as trout, sturgeon, and pompano, sells for a higher price than any other fish offered. When salmon are abundant the price is low, and this necessitates the lowering of the price of all other kinds in order to sell them in competition with salmon; hence the propagation of salmon increases their supply and lessens the price of all varieties of fish to the consumer, and accomplishes the end for which the Commission was created and is supported.

The following table shows the receipts of salmon in the San Francisco markets from 1893 to July 1, 1898:

Salmon Received in the San Francisco markets.

Month.	1893.	1894.	1895.	1896.	1897.	1898.
January.....	137,460	128,556	161,641	168,366	276,402	310,499
February.....	93,263	103,801	146,250	173,278	242,710	78,348
March.....	139,401	163,131	155,791	197,043	331,421	85,000
April.....	374,478	211,552	365,387	301,964	488,425	332,072
May.....	325,170	242,126	401,787	291,310	404,035	513,631
June.....	70,216	133,675	161,989	134,922	278,010	303,396
	1,139,933	937,341	1,392,845	1,266,833	2,021,003	1,622,946
July.....	149,217	117,516	115,592	91,292	176,285	.....
August.....	575,609	576,991	447,094	399,362	721,385	.....
September.....	.....	.....	.....	.....	381,522	.....
October.....	249,753	403,340	.....	.....	76,647	.....
November.....	183,789	276,768	431,453	350,707	342,359	.....
December.....	155,090	192,153	326,474	298,189	258,137	.....
Totals.....	2,453,446	2,554,609	2,713,458	2,406,433	3,979,500	.....

The canning operations on the Sacramento River are regulated by the market demands for the fresh fish. Until this demand is supplied the canners cannot compete with the dealers. The pack on the river, therefore, represents the supply in excess of the market demands. During a season like that of 1896, the pack was small, though the total catch exceeded that of 1895, when the total pack was less. This result was produced in 1896 by the fish coming into the rivers during each of the first six months in large numbers, instead of all coming during April and May as usual. This permitted the fish being handled by the marketmen. In the early years of this fishery the canners were the main factors in disposing of the catch, but with the increase of population and the

SALMON PACK.

opening of markets in the interior the cannery interest became secondary, and no longer controls the supply. The canneries act as the safety valve of the salmon catch and preserve only the surplus. The pack on the Sacramento River since 1888 is as follows:

Salmon Pack of the Sacramento River.

Year.	Cases.
1888	61,200
1890	25,065
1891	10,353
1892	2,281
1893	23,336
1894	28,463
1895	25,185
1896	13,387
1897	38,543
1898	29,731

SALMON DISTRIBUTION.

Being now assured of securing millions of salmon eggs annually from the Battle Creek station, we have been compelled to find additional waters for the distribution of the output of salmon fry from our hatcheries.

Until the winter of 1896 all the salmon propagated by the State had been planted in the streams tributary to the Sacramento River near its source, and these waters afforded ample feeding grounds for the young fish up to that time; but with the enormous increase of the output we were obliged to extend the work to other streams. During the winter of 1896 we made plants in Klamath River near Kalmathon, and in the coast streams in Marin and Sonoma counties.

In 1897 we built and operated a hatchery on Eel River, in Humboldt County, and that season's hatch of eight millions was planted in Eel River. This was the first direct effort made to increase the run of salmon in that locality. After consideration of ways and means for the distribution of our enormously increased output of salmon fry, this Board, with the valuable coöperation and suggestions of its Chief Deputy, concluded to try the experiment of hatching eggs at our auxiliary hatchery at Olema. Our experience has taught us that the salmon at a very tender age seeks its natural home, the sea. Specimens less than four inches in length have been taken in smelt seines on the Presidio beach. We could see no reason why liberation within ten miles of salt water in streams free from predatory fishes or water animals should not be beneficial to the fry and allow a greater percentage to enter the ocean, rather than to put them to a three hundred mile course down the Sacramento, through which they must run the gauntlet of a thousand dangers. Another moving consideration was the fact that our plants in the Sacramento and its tributaries were likely to overtax the food capacity of these waters.

We desired, also, to so conduct our experiments as to permit full opportunity of studying the movements, growth, food, and habits of the fry. To this end, we selected Olema and Paper Mill creeks in Marin County. These streams were utter strangers to the Quinnot salmon, and we were therefore assured that any fish taken by us after liberation must necessarily be of our hatch.

The streams were all small enough to disclose the movements of the fish, which were easily seined. All these streams finally join, and their waters run but three miles before entering Tomales Bay. At this point is formed a considerable body of fresh and brackish tide water, through which the young salmon pass in entering salt water. This condition is similar to that found by the young fish at the end of their descent of the Sacramento River.

Added to these natural advantages, we possessed a small but well-equipped hatchery on Bear Valley Creek, near Olema, where the eggs could be hatched, and from which the fry could be distributed. For these reasons the experiments and observations were conducted in that vicinity.

Owing to scarcity of funds for carrying on this work, we appealed to the United States Commission of Fish and Fisheries to assist us, presenting our reasons for desiring to carry on the work. Our appeal met with a ready response from Commissioner Brice, who assigned \$500 to defray the expense, and detailed a trained assistant to study the results of the plants for two months, after which we carried on the work through the early summer months.

The details of this work are set forth in full in the Appendix of this report, from which we make the following brief summary:

The young salmon were planted upon the absorption of the yolk sac. It was found that the young fish did not pass up the stream above the point where they were liberated. From the first, they passed rapidly down the stream, though a few lingered in favorable stretches of the creeks for weeks. Few specimens were captured after entering salt water, but those which were secured showed a much more rapid growth during the first two months than those taken from fresh tide water, having attained more than double the size. We present drawings showing the comparative sizes of the specimens taken from the fresh, brackish, and salt waters.

It was discovered that the trout and other fish found in the streams did not prey upon the young salmon. The stomach contents of hundreds of trout and other fishes were examined without finding a single specimen of either young salmon or trout.

Experiments were again carried on for a limited time in 1898 by the United States Commission, but the work was dropped shortly after the fish were planted, owing to lack of money, with the result that very little valuable data was obtained the past season from Olema.

In addition to the work carried on at Olema, we caused a study to be made of the movements of young salmon in the streams near the Sisson hatchery and down the Sacramento River as far as Redding during the season of 1897; and in 1898 we covered the same field and extended the work to the city of Sacramento.

At our request, and upon a showing of the importance of this work, the United States Commissioner of Fish and Fisheries, Hon. Geo. M. Bowers, detailed, in the spring of 1898, a trained force to study the life of the young salmon in the Sacramento River, and Suisun, San Pablo, and San Francisco bays, and this work is now being carried on by them.

We set forth the necessity for this work in our Fourteenth Biennial Report, and have since advanced it in every way. We believe the work thus begun will ultimately be of great advantage in the distribution of our output of fry, and result in a consequent increase in the productiveness of our salmon rivers.

Formerly there was a considerable run of salmon in the
SALMON IN San Joaquin River, but as a result of mining and the
THE SAN diverting of water for irrigation, the run has decreased
JOAQUIN until now it is confined to a short period in the fall. This
RIVER. fall run does not seek the extreme headwaters to spawn
as formerly, and while a few enter the Stanislaus and
Merced rivers, the majority seem to prefer the San Joaquin proper.

It is an interesting feature in regard to the movements of the spring run of salmon to note that very few pass up the San Joaquin River beyond Georgiana Slough, but having passed up the river to that point most of them turn and go through this slough to the Sacramento, this being their last opportunity to leave the San Joaquin and enter the Sacramento.

The water of the San Joaquin River during the spring run is at its highest stage, and is cooler than in the fall. Why the spring run does not go up this stream instead of preferring the Sacramento, while some of the fall run continue up this river, presents a phase of the salmon's habits that remains unsolved. That the condition described is well recognized by the net-fishermen is proved from the fact that none of them are to be found above Jersey Island in the spring, while a number of boats are used above that point in the fall.

In commenting upon the peculiar movements of the salmon in our rivers, it may be of interest to note that there is a spring run of salmon in Smith and Klamath rivers, in Del Norte County, and in the Sacramento River, but no spring run in Eel or Mad rivers in Humboldt County. They run in Eel River only in the fall and early winter months. Why there should be no spring run there, while the principal rivers to the north and south are frequented by them, is another one of the many unaccountable peculiarities of this remarkable fish.

**THE
SALMON
LAW.**

The present law—the Act of 1897—regulating the fishing for salmon, affords these fish the protection their movements make necessary, as the closed season prescribed for their capture permits of their passage to and protection upon the spawning grounds. As a result, an increased number of salmon eggs have been taken at the egg-collecting stations. This law has given general satisfaction to our fisher folks, save in Tehama and Shasta counties; and we believe the dissatisfaction existing in those counties arises from a lack of full knowledge of the habits and movements of the salmon. When the habits of this fish are carefully observed, we do not believe that any fair-minded citizen will fail to appreciate the necessity of protecting it in the waters of these counties during the months of October and November.

The salmon is anadromous. When mature, it comes in from the sea, passes to the headwaters of our large rivers, deposits its spawn, and dies. The eggs hatch, and the young fish descend the rivers to the sea, where they mature.

The salmon enters the rivers from the sea in large numbers in April and May, and again in August, September, and the early part of October. There are a few entering the rivers every month, but there are pronounced runs in the months mentioned. Those that enter the rivers in the spring, and escape the nets, because of the Saturday and Sunday closed season and the high stage of water, pass to the extreme headwaters of the Sacramento, Pitt, and McCloud rivers with little trouble, where they remain until August and September, when they spawn. The fish that enter in August, September, and the early part of October have much more to contend with in the ascent of the streams. They are confined to the main channels, the water is of a higher temperature, shallow and clearer, they find themselves exposed to view in the pools and upon many of the riffles, and are sought for by man and beast. These fish that enter the river in the fall do not pass up to the extreme headwaters reached by the spring run, and they spawn in October and November.

The salmon is a prime article of food when it comes from the sea and during the early part of its life in the rivers. It deteriorates in fresh water, and as the breeding season approaches becomes soft and is attacked by disease, so that but few of the fall run fit for food reach the spawning grounds of the Sacramento River in Tehama and Shasta counties.

Under the law, these fish cannot be taken after September 10th, with the result that the fishermen in the lower rivers are compelled to take their nets from the river and permit the salmon an unobstructed passage up to their spawning beds in Tehama and Shasta counties, although the run is at its height, and the fish are in prime condition and demand.

The fishermen, marketmen, and canners know and appreciate that a considerable number of these fish must be permitted to reach their spawning beds in order to perpetuate the supply. Under the law, no salmon can be caught between September 10th and October 15th, and after that only in tide waters until November 15th. This opening of the tide water to fishing on October 15th does not benefit the fishermen on the lower Sacramento River to any extent, for the reason that the run there is over before that time. The fishery interests of the Sacramento and San Joaquin rivers were agreed to a closed season until November 15th, for they receive no benefit from its opening on October 15th. Therefore, the persons who claim that the law discriminates in favor of the fishermen in Solano and Contra Costa counties during September, October, and November, and against those in Tehama and Shasta counties, are in error.

In reading the law without a knowledge of the movements of these fish in the different rivers of the State, there does appear to be a discrimination, but with this information no such contention can be maintained.

The tide-water clause of the law was enacted to permit the taking of salmon in Eel and Mad rivers in Humboldt County, where the conditions are very dissimilar to those in the Sacramento River. There is no spring run of salmon in the rivers of Humboldt County. They enter Eel and Mad rivers only in the fall and winter. The run does not begin until about October 15th, and continues until January.

Under the Constitution, regulations may not be made permitting the catching of salmon in the Sacramento River during certain months and in Eel River at a different time. It would be special legislation. The Legislature, therefore, wisely framed the present Act, authorizing the catching of fish entering our rivers after October 15th, provided they were taken in tide water, thus permitting the catching of the run of salmon in Eel River. The fish that enter the rivers of Humboldt County in October are in prime condition, like those that enter the Sacramento River in August and September, and constitute our market supply of first-class salmon during November, December, and January. There can be no objection raised to the catching of these fish in the tide water of Eel River, as the distance is short; and by reason of the Saturday and Sunday closed season a sufficient number are permitted to ascend the river and pass to the spawning beds to insure their reproduction.

As we have stated, the tide-water clause of the law avails the Sacramento River fishermen but little, and was enacted to enable the Humboldt County fishermen to catch the fish in Eel River, thus affording our markets a supply without interfering with the natural and artificial reproduction.

If the fish that enter the lower Sacramento River after September 10th are to be taken at all, they should be caught while they are in fit

condition to market. If the change in the law desired by some of the people of Tehama, Shasta, and Butte counties, *i. e.*, to permit them to be caught in October and November, were granted, it is not to be supposed that the fishery interests of the lower river, which is the greatest in the State, would consent that the closed season begin at the height of the run, on September 10th, and if the taking of fish in the lower river were permitted during September and October, very few would be enabled to pass up the river to Tehama and Shasta counties in the fall. The fishermen would gain but little and the salmon interest would be destroyed.

As a matter of fact, the residents of Tehama and Shasta counties are the gainers from the present law to a greater extent than any other section, and are not the losers, for the reason that the principal salmon propagating station is carried on at Battle Creek, in Tehama County, near the Shasta County line. The State and National Fish Commissioners expend 100 per cent more money and employ 100 per cent more men in that section than were interested there in this fishery before the law was passed. The Commissioners expended at the Battle Creek station in 1895 over \$5,000, in 1896 \$7,500, and \$10,000 in 1897 for labor and material in collecting salmon eggs. The laborers employed were mainly residents of Tehama and Shasta counties. The fish taken at the station that were fit for food, after being manipulated, were given away to whoever applied for them—over six hundred families were given fish in 1897. Thus, hundreds of residents of these counties were benefited, and most of these people would have received no fish under an open season law.

Our contention, then, is that a greater number of the residents of Tehama and Shasta counties reap benefit from the present law than from the old. The fishery produces more money to the county, more men find employment and for a longer period, and the salmon interest of the State is fostered instead of being destroyed. As it is necessary to protect these fish during the spawning period, it is fortunate for the counties of Tehama and Shasta that the State expends its moneys each season among their residents for the propagation of salmon. We submit, therefore, that the present law should not be changed or amended in any particular, since for the first time in the history of the State we have a law that permits the marketing of the greatest number of salmon possible, and yet gives these fish the protection necessary for their propagation, and which they must have in order to perpetuate their run. Under this law, the markets are supplied with an abundance of fish in prime condition, the hatcheries are filled with all the spawn they can handle, and if the provisions made by the State for disposing of the fry produced are executed with care, the run of salmon must increase.

We are constantly asked what proof we have that the work of propagation of salmon has been of benefit to the State. In reply, we refer to the figures of the number of pounds of salmon sold in the San Francisco markets each year. These figures are reliable so far as they go, but they do not show all of the fish marketed in that city. They have been taken by our deputies from the invoice books of only the leading fish-dealers. It may be added in passing that only these leading dealers keep any record. While these figures do not show a remarkable increase from year to year, they do show an increase; while before the State began the work of propagation, the records show that the fish were diminishing from year to year, and at an astonishing rate. Had the State failed to take up this work, the product of our rivers would have ceased by now. As it is, the Sacramento River is the only salmon river on the coast that shows an increase year after year. Some critics of this work have expressed surprise that the work of propagation has not produced greater results. We think they lose sight of the fact that fishing has increased; that irrigation and cultivation of our valleys have cut off the extent of fish-rearing waters; that with the increasing settlement of our lands, natural production has almost ceased; and that in the natural order of events there would be no run now but for the propagation which the State has carried on. We do not desire to be understood to say that there is a marked sentiment that questions the success of the State in this line of its work, for the converse is true. The interest of our people in this work continues to increase.

The spiny lobster fishery shows an increased product. The closed season has been strictly observed. In addition to the restrictions placed upon their capture we believe the catching and possession of egg-bearing female specimens should be prohibited at all times.

The following statement shows the receipt of lobsters in Los Angeles markets during the past three years:

The Spiny Lobsters taken in Los Angeles County.

Month.	1895.	1896.	1897.	1898.
January.....	9,502	14,153	8,908	21,098
February.....	9,225	12,669	6,930	23,915
March.....	19,765	11,045	18,334	33,386
April.....	15,114	10,830	22,210	25,382
May, to the 15th.....	5,743	4,851	9,049	9,873
July, from the 15th.....	8,891	14,237	10,205	-----
August.....	14,323	13,060	16,418	-----
September.....	15,056	15,104	21,525	-----
October.....	17,129	15,845	23,436	-----
November.....	13,917	12,357	17,400	-----
December.....	15,073	7,000	21,995	-----
Totals.....	143,738	131,211	176,410	-----

The supply of shad continues far in excess of the demand.

SHAD. As heretofore, the principal supply is taken from San

Pablo and Suisun bays. Large numbers, however, are taken in the Sacramento River and its tributaries as far north as Tehama County, and in the San Joaquin and its tributaries as far south as Fresno County. The thousands of pounds taken in the rivers can only be estimated. It is a large and valuable product, and not yet fully appreciated by our people. That the value of this fish is not more highly prized in this State has often been commented upon by Eastern authorities, and can only be accounted for by the bountiful supply of less bony fish offered in our markets. This fish seldom yields the fishermen over half a cent per pound, and at times they are retailed in our markets for 5 cents each, regardless of weight.

The figures given below represent only the supply as found on the books of the wholesale dealers in the San Francisco markets and do not include the fish that are sold by the fishermen direct to the hucksters, nor does it include those handled in the interior valleys.

Number of Pounds of Shad Received in San Francisco Markets.

Month.	1893.	1894.	1895.	1896.	1897.	1898.
January	2,774	41,266	369	4,600	5,672	15,696
February	8,781	11,767	2,106	6,000	13,338	48,745
March	10,019	17,747	14,257	14,375	88,853	62,780
April	32,389	39,115	23,960	75,625	104,373	215,175
May	80,557	57,823	36,729	95,392	120,531	65,343
June	36,184	22,027	25,787	38,620	47,482	23,136
July	170,704	189,745	103,208	234,612	380,249	430,975
August	3,319	7,754	3,213	8,151	5,467	-----
September	2,796	1,764	805	27	1,725	-----
October	698	475	3,317	2,264	9,116	-----
November	53,652	23,496	5,788	4,383	6,957	-----
December	96,340	37,987	23,534	14,926	19,898	-----
Totals	77,882	8,158	6,534	10,404	21,138	-----
Totals	405,391	269,379	146,399	274,767	444,550	-----

**STRIPED
BASS.**

The striped bass continue to multiply. During the past two years it has been sold for less than salmon. It is for sale every month in the year for less than the New York and Philadelphia quotations. As interesting and remarkable as this showing may be, it is doubtful if the yearly increase as expressed in the market figures is not due more to the improved methods of fishing than to the actual yearly increase of these fish in our waters. Our fishermen have now become familiar with their habits and movements and are expert in pursuit of them. They began to catch them in the latter part of the '80's, but as late as '94 they had not become sufficiently acquainted with their habits to take full advantage of the runs. Striped bass move in large, compact schools and are easily alarmed. They must be approached with caution. In favorable waters

at the proper stages of the tide the fishermen silently lay out their nets around the school. Every oar is muffled and every precaution taken that neither the lead nor the cork lines shall strike the boat, otherwise the school is scattered and the greater part is lost. This the fishermen now fully understand, with the result that they secure much greater numbers than formerly.

While the market receipts show an increase in these fish, we believe that they should be protected for a part of their spawning period. We therefore recommend that the month of June be declared a close season for capture or sale. A large per cent of the fish offered for sale during the months of May and June are spawn fish, and their flesh at that time is soft and flavorless. As they frequent the waters through which the salmon pass to their spawning grounds, many are taken in the salmon nets during April and May. The run of salmon in these waters is very light during June. To prohibit the catching of striped bass during that month would not materially interfere with the capture of salmon, and would afford the bass ample protection, though they chiefly spawn in May. Should the month of June be made a close season, we recommend that the restriction prohibiting the possession and sale of striped bass of less than three pounds in weight be amended so as to allow their sale when not less than one pound in weight.

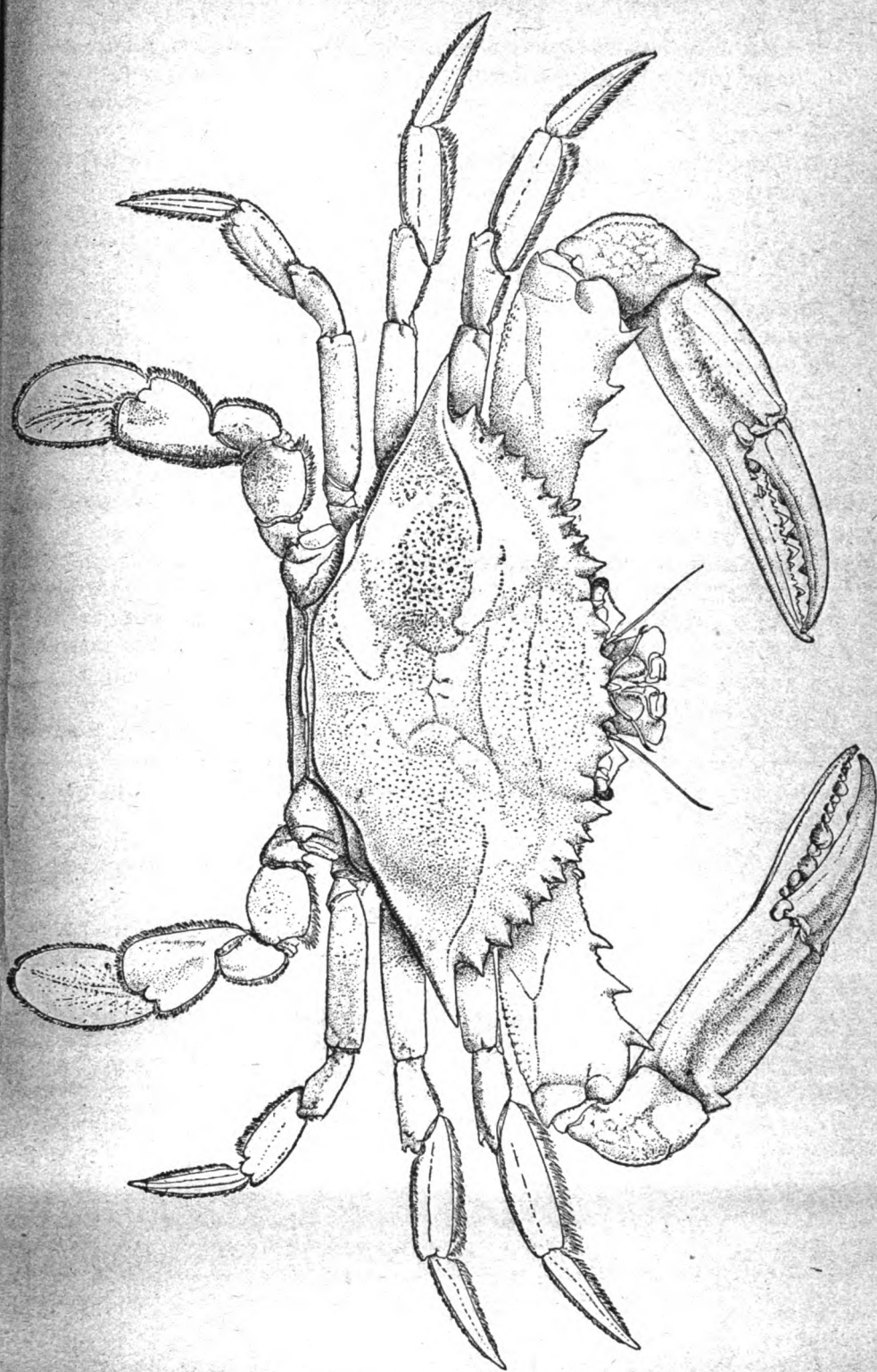
The following table shows the market receipts of these fish in San Francisco since 1893:

Number of Pounds of Striped Bass Received in San Francisco Markets.

Month.	1893.	1894.	1895.	1896.	1897.	1898.
January	3,041	14,177	28,328	27,179	25,081	18,206
February	2,752	12,572	15,611	36,107	31,271	21,060
March	5,190	9,002	11,281	38,340	36,448	31,215
April	8,351	9,638	22,000	41,740	45,550	101,400
May	7,232	9,413	12,639	45,903	36,765	59,752
June	4,353	4,820	11,532	15,047	18,011	31,511
	30,919	59,622	101,391	204,316	193,126	263,144
July	2,950	7,273	13,782	13,531	19,882	-----
August	2,655	5,956	12,419	15,574	23,279	-----
September	8,517	10,021	21,063	24,214	34,114	-----
October	6,720	22,591	28,724	40,704	33,921	-----
November	10,473	17,319	50,245	40,089	31,718	-----
December	17,504	21,972	24,553	25,319	22,154	-----
Totals	79,738	144,754	252,177	363,747	358,194	-----

Our large edible crab (*Cancer magister*) continues in full supply. The law prohibiting the capture and sale of the female has been favorably received by the fishermen, and is closely observed. This seems to be the only necessary restriction upon this fishery. The principal market supply is taken from the ocean off San Francisco to the north and south of the Heads.

No very accurate estimate of the value of this fishery can be given, owing to the method of marketing the catch. Only a small percentage



THE BLUE CRAB (*Callinectes hastatus*.)

is handled by the regular fish-dealers. Many hucksters obtain their supply direct from the fishermen. The supply has been abundant and the price low. This is one of the most valuable varieties of the food crabs of the sea. Efforts are being made by the United States Fish Commission to propagate them in Atlantic waters. The experiment of introducing them upon the Los Angeles coast, made by this Commission in March, 1896, has, up to this time, produced no apparent result.

During the season of 1897 the United States Fish Commission forwarded us a shipment of the blue crab of the Atlantic coast, which were planted in San Francisco Bay, where the conditions are favorable for their propagation. If they establish themselves in our waters they will make a valuable addition to our supply of aquatic food.

The catfish is one of the finest flavored fish in our waters, and the demand is in excess of the supply. This statement may be doubted by many people who have denounced their introduction, claiming that they have destroyed other and more valuable fish. The fallacy of this position may be understood when it is known that the shad and striped bass propagate in waters most frequented by catfish and carp.

The figures for catfish given below are for dressed fish only. They are taken from the books of the dealers, other than Chinese, in San Francisco markets. The Chinese dealers do not keep books that are intelligible to our deputies, so that the large quantities of catfish and carp handled by them are not shown in the following table. There is little demand for carp. These fish, that are so highly prized in Europe and which find a ready sale in many of the Eastern markets, are not desired by our people. The Chinese handle most of the carp in this market.

Number of Pounds of Carp and Catfish Received in San Francisco Markets.

Month.	1893.		1894.		1895.	
	Carp.	Catfish.	Carp.	Catfish.	Carp.	Catfish.
January	624	1,175	10,142	4,117	6,017	568
February	519	1,766	4,755	1,696	3,755	680
March	4,356	2,988	6,798	4,766	3,851	831
April	3,101	3,705	2,839	5,290	1,568	2,358
May	560	3,265	767	2,978	555	3,644
June	1,469	2,155	699	2,630	650	3,151
	10,629	15,054	26,000	21,477	16,416	11,232
July	4,570	2,299	729	695	560	753
August	1,665	710	383	357	150	1,159
September	1,132	5,800	4,396	2,748	785	3,257
October	3,782	5,547	4,969	2,795	1,355	7,162
November	5,969	3,932	4,461	1,526	4,043	3,047
December	5,337	3,202	1,642	1,867	3,555	5,672
Totals	33,084	36,544	42,580	31,465	26,864	32,282

Number of Pounds of Carp and Catfish Received in San Francisco Markets.—Continued.

Month.	1896.		1897.		1898.	
	Carp.	Catfish.	Carp.	Catfish.	Carp.	Catfish.
January	22,045	3,896	3,916	1,520	9,644	3,765
February	13,159	2,714	2,756	1,728	8,148	6,452
March	8,659	4,807	2,122	5,739	10,674	5,490
April	4,282	3,461	2,161	7,876	5,490	7,240
May	1,913	9,160	160	6,602	2,200	9,433
June	2,437	4,830	974	3,331	1,800	6,917
	52,495	28,868	12,089	26,786	37,956	39,297
July	560	950	400	2,573	-----	-----
August	151	3,480	905	3,959	-----	-----
September	893	6,333	105	3,336	-----	-----
October	1,428	4,980	4,305	6,187	-----	-----
November	3,500	6,784	3,529	6,260	-----	-----
December	2,020	3,011	2,795	4,949	-----	-----
Totals	61,047	54,406	24,218	54,060	-----	-----

We are often questioned regarding the results of propagation and acclimatization of the carp in the waters of California, and are always confronted with the statement that its introduction has resulted in great injury to the waters and to our native fish. There is no doubt that they have damaged some of the water of this State by discoloring it. This is particularly the case in Lake and Mendocino counties. There seems to be no way by which the carp can be exterminated in Clear or Blue lakes. The success of the Spring Valley Water Company in clearing them out of Lake Merced by means of sea lions has led to the suggestion that the introduction of sea lions in Clear and Blue lakes might bring about the same result. We do not believe this possible in such extensive bodies of water, because the swamp and tule lands surrounding these lakes would harbor the carp and furnish them with breeding and rearing grounds that the sea lions might not reach. Large numbers of black bass have been liberated in these lakes, and it is claimed, as a result, that Clear Lake is less discolored than formerly. We have endeavored to obtain a shipment of pike perch from Eastern waters, in the hope that they might assist in reducing the carp in these waters. This is one of most voracious as well as one of the finest fresh-water fishes. We consider its introduction for these purposes desirable, and shall continue our efforts to secure from the United States Commission a shipment of this species.

The introduction of carp is, however, not without benefit to our waters. They are continually sold in the San Francisco markets and in the interior along the Sacramento and San Joaquin rivers, and have furnished an abundance of food for the striped bass. They have been of no injury to other fish, as is clearly demonstrated by the excess of shad and striped bass which propagate in waters most frequented by carp.

In discussing the subject of introducing foreign fish, the carp question seems to be more generally misunderstood and commented upon than the great value resulting from the introduction of striped bass and shad.

The supply of sturgeon continues to be far below the STURGEON. demand, and it is now one of the highest priced fish in our markets. The law protecting them was enacted in 1895, and sufficient time has not yet elapsed to produce any visible change in the market supply, but reports come to us from many sections announcing the presence of these fish in waters where they have not been seen for many years. The law protects them during a part of their spawning season and prohibits the use of the Chinese set-line. It also places a limit upon the size of the young fish that may be taken or sold. The law as it stands meets the approval of the intelligent class of our fishermen and dealers. It is surprising that only a few years ago large numbers of these fish were annually destroyed by the river and bay fishermen as being of no market value, while during the past three years their flesh has been sold for higher prices in our markets than salmon or striped bass. Experiments in the propagation of sturgeon have been conducted in the United States and in Germany, but thus far with limited success.

The following table shows the amount of sturgeon handled in the markets of San Francisco during the past two years:

Number of Pounds of Sturgeon Received in the San Francisco Markets.

Month.	1896.	1897.	1898.
January.....	34,181	28,634	21,189
February.....	26,955	25,274	36,711
March.....	18,625	16,040	.....
September.....	15,791	20,533	.....
October.....	20,892	32,041	.....
November.....	27,802	37,692	.....
December.....	31,429	30,231	.....
Totals.....	175,675	190,445	.....

MARKET SUPPLY OF TROUT.

The principal supply of trout offered in our markets continues to come forward from the Lake Tahoe region and Pyramid Lake in Nevada, though there is a considerable supply taken from the Klamath River. Owing to ordinances passed by the Boards of Supervisors of El Dorado and Placer counties, continuing the closed season for the capture of trout until June first, the receipts from that section were cut off during April and May of 1898. As the fish taken from Lake Tahoe and its tributaries at that season are spawn fish, which are soft and flavorless, the consumers can well afford to forego the supply for these months.



STRIPPING SALMON, BATTLE CREEK, 1897.

EXPORTS. The export of fishery products from San Francisco during the past six years is shown in the following table, which was furnished by the United States customs officials, San Francisco:

Value of Exports of Fishery Products from San Francisco.

Article.	1892.	1893.	1894.	1895.	1896.	1897.
Codfish	\$26,681	\$21,412	\$16,557	\$21,945	\$15,548	\$13,956
Dried fish	34,439	27,043	39,558	20,351	28,543	37,796
Salmon, canned	1,810,567	621,336	1,766,619	2,285,711	2,382,008	2,239,602
Salmon, in barrels	46,986	44,157	43,028	42,756	49,180	65,985
Other canned fish	10,715	9,828	13,397	25,820	16,253	19,284
Oysters	9,655	7,432	7,369	7,151	8,334	7,765
Other shell-fish	226,063	188,532	167,453	179,734	173,460	181,362
Totals.....	\$2,165,106	\$919,740	\$2,053,981	\$2,583,468	\$2,673,326	\$2,565,750

**THE HATCH-
ERIES.** The total output of fish from the State hatcheries during the past two years was 57,094,182. The work of each station is given in the following summary:

**BATTLE
CREEK
STATION.** In the last report of this Commission reference was made to the inability of the Commission to operate the salmon egg-collecting station located on Battle Creek, in Tehama County, to its full possibilities, and that the Board had arranged with United States Commissioner of Fish and Fisheries, John J. Brice, for the sale of the State's interest, thus insuring operation to its full limit. At the session of Congress in 1896, no appropriation was made to carry out this transfer, which resulted in the station being operated jointly by this and the United States Commission in 1896 and 1897. The United States Commission assumed the expenses of operation and advanced the necessary moneys for the construction of an additional building at the station. Our hatchery force, under the direction of our Chief Deputy, John P. Babcock, conducted the operations during both seasons. The result of this joint operation was most remarkable. During the season of 1896, twenty-six million eggs were collected, and in the season of 1897 forty-eight million. Each of these takes exceeded the total collection at all other stations on the coast during those years. The eggs collected during the season of 1896 were hatched and distributed from the hatcheries of this State with the exception of five million that were sent East to United States Fish Commission stations, and three million that were sent to stations in Oregon. In 1897, six million of the eggs collected were sent East, three million to Oregon, and the balance of thirty-nine million were hatched and planted in the waters of this State.

The location and operation of the Battle Creek station has been the most successful propagation work ever undertaken on this coast, and in its magnitude and importance equals any work of its kind in the world.

The results attained by the addition of this station have exceeded our greatest expectations, have crowded our hatcheries beyond their capacity, and have forced us to increase our hatching room. We have been enabled to extend our hatchery operations to Eel River in Humboldt County, thus insuring the continuance of the important salmon interests of that section.

In considering the value of the Battle Creek station and its importance to the salmon interests, it must be remembered that its value depends entirely upon the protection afforded the salmon during September, October, and November. If fishing were permitted during that time, the spawn fish would be caught before they entered the traps at the station and no eggs would be secured.

During the winter session of Congress in 1897, an appropriation was made for the purchase of the State's interests in the Battle Creek station, and negotiations are now pending for its transfer in accordance with the Act of the Legislature approved March 9, 1897.

Distribution of Salmon (Onchorhynchus tshawytscha) Eggs and Fry from Battle Creek Station—Seasons of 1896 and 1897.

Distribution.	Number of Eggs.	Number of Fry.
1896.		
California Fish Commission, Sisson	13,645,000	.....
Eastern stations	5,150,000	.....
Baird Station, California	2,000,000	.....
Clackamas Station, Oregon	3,000,000	.....
Olema Experimental Station, California	750,000	.....
1897.		
California Fish Commission, Sisson	16,000,000	.....
Baird Station, California	4,247,000	.....
Eastern stations	6,000,000	.....
California Fish Commission, Eel River Station	8,000,000	.....
Olema Experimental Station, California	2,000,000	.....
Clackamas Station, Oregon	3,000,000	.....
Hatched at Battle Creek Station .....	.....	5,885,000
Totals	63,792,000	5,885,000

Total output for two years..... 69,677,000

Fully appreciating the value of the salmon interests of EEL RIVER Humboldt County, we determined to establish a salmon HATCHERY. hatchery upon Eel River, and in August of 1897 we caused an investigation to be made of all available sites on the river, which resulted in the erection of a hatchery building upon Price Creek, a small tributary which enters from the south about twelve miles above the mouth. We regard the location favorably. The hatchery building is 60 by 40 feet, and has capacity for hatching eight million eggs. The supply of water is taken from the creek about half a mile above the building.

In the location and construction of this station we were given invaluable aid by Hon. J. N. Gillette, the Pacific Lumber Company, the Eel River Valley Lumber Company, and the merchants of Ferndale. Without this aid we could not have undertaken the construction at that time.

The building, dam, and flume are located upon land belonging to Mr. G. W. Weymouth, who gave the State a ten years' lease, upon the sole condition that the hatchery be operated annually.

The first eggs were received at the station in December, 1897. They were shipped from the Battle Creek station on the line of the Southern Pacific Company to San Francisco, thence to Eureka via the Pacific Coast Steamship line, thence by the Eel River and Eureka Railroad Company, free of all expense to the Commission. These transportation companies generously franked the shipments. The balance of the eggs were received early in January of 1898, and operations continued until February 7th, when the water system of the hatchery was damaged to such an extent by a flood that we were compelled to plant the entire hatch in Price Creek and Eel River one month in advance of our plans. However, we regard the operations as successful, and have rearranged our water supply in such manner as to prevent accident hereafter.

This station is a valuable addition to the hatcheries of the State, and by its operation we confidently expect to maintain and increase the catch of salmon in Eel River. It is not generally known that the market supply of salmon of the State is obtained from Humboldt County during October, November, December, and January. Over a million of pounds of salmon are shipped to San Francisco markets during that period.

Eel River has no predatory fish save trout, which makes it a most favorable stream in which to liberate young salmon. If the young salmon pass to the sea the first season after being hatched, as we now believe they do, this station is most favorably located, it being less than fifteen miles from the sea.

Summary of Distribution of Salmon from Eel River Hatchery—Season of 1898.

Species.	Number.
Salmon	7,857,388

During the fall of 1896 we enlarged the hatchery located THE SISSON at Sisson by the construction of an addition to the HATCHERY. original building, of 60 by 40 feet, thus doubling its capacity. The expense of this improvement was met by drawing upon the Fish Commission Fund. This hatchery is now the largest and best equipped of any of the State's stations, and has a capacity for hatching sixteen million salmon eggs at one time. The station has been operated to its fullest extent during the period covered by this report, with the result that the output of salmon fry has exceeded that of any previous two years since the organization of the Commission, by more than 100 per cent; and the output of trout from the station has equaled the work of any previous season. The United States Commission of Fish and Fisheries, as heretofore, has furnished us with most of its collection of summer and early fall take of salmon eggs at its Baird station. This early take of eggs fortunately can be hatched and removed from the building before the eggs collected at Battle Creek station are forwarded. This will explain how, with a hatching capacity of sixteen million, we can hatch twenty-one and a half million of salmon eggs in a season. We continue to lease the Sisson and Klink ponds situated near the Sisson hatchery, which, together with the State ponds at the station, gives us a considerable retaining and nursing capacity, though there is need that this be increased. The mature Loch Leven trout in the Emeric pond were spawned for the first time in October, 1897, and produced three hundred thousand eggs. These were the first eggs of this variety taken by this Commission. The manipulation of these fish was accomplished without loss, and they were returned to the pond. We expect a large increase of eggs from these trout this fall. In Klink's pond we have three thousand adult Brown trout, which we expect to spawn this season. The Sisson pond is stocked with mature big-mouthed black bass imported from the East in 1896. They spawned for the first time in 1897, and we made shipments of a part of the young. The increase of the past season, which is large, will be distributed this fall. As we have remarked, the Sisson hatchery is the largest and most productive of the State's hatcheries. In the ponds connected with the hatchery we have every variety of salmon, trout, and black bass native to or introduced into the waters of the State, besides yellow perch and green sunfish; also pond shiners, which we are propagating for fish food. An examination of the following table discloses the magnitude of our work at this station. It is unequaled by any similar station in the West. The total output of fish for the years 1897 and 1898 is 41,591,454.

Summary of the Distribution of Fish from Sisson Hatchery—Seasons of 1897 and 1898.

Species.	1897.		1898.	
	Fry.	Yearlings and Adults.	Fry.	Yearlings and Adults.
Salmon	17,268,000	-----	21,601,000	-----
Cut-throat trout	878,500	-----	900,000	-----
Rainbow trout	-----	-----	475,000	-----
Mackinaw trout	98,000	-----	-----	7,000
Loch Leven trout	13,000	1,109	260,000	-----
Eastern Brook trout	-----	30	85,000	-----
Brown Brook trout	-----	160	-----	6,000
Landlocked salmon	-----	-----	-----	700
Large-mouthed black bass	750	205	-----	-----
Totals	18,258,250	1,504	23,321,000	13,700

In order to enlarge the nurseries for the propagation of fish we have arranged to purchase five acres of ground adjacent to the property owned by the State at Sisson, upon which we will begin the construction of rearing and breeding ponds.

Operations were successfully conducted at the Lake Tahoe hatcheries during the seasons of 1897 and 1898.

TAHOE AND TALLAC HATCHERIES. All our supply of trout eggs in 1897 was obtained from this lake. Seining operations were conducted at the mouth of Taylor Creek, near Tallac, and the eggs collected were eyed at the Tallac and Tahoe hatcheries. The trout eggs hatched at Sisson and Ukiah hatcheries were shipped from here. The water supply at the Tahoe hatchery is limited and we have not increased the output as we otherwise should have done.

The conditions affecting the fishing interests of Lake Tahoe have been greatly improved by the timely action of the Boards of Supervisors of El Dorado and Placer counties in extending the closed season at the lake until June first. The fish of this section spawn during April and May, and previous to the past season the market fishermen have annually taken large numbers of these spawn fish from the lake in the vicinity of the mouths of the tributary streams, thus destroying numberless thousands of eggs. The collection of trout eggs at the lake the past season could have been two million in excess of any previous season's work had the water supply of the hatcheries permitted. As it was we ceased operations early in May, 1898, at a time when the run of spawn fish was still large. We maintained a constant patrol of the lake and its large tributary streams during the past season, with the result that the Nevada Indians were not permitted to make their annual descent upon the spawning fish in the creeks, and a notable increase in young fish must have resulted. The effectiveness of this patrol of Lake Tahoe was increased by the timely assistance rendered by the game warden of Placer County. In this connection we beg to recom-

mend to the Boards of Supervisors of all mountain counties the great importance of passing ordinances shortening the open season for the taking of trout. It is common knowledge that fish in the higher altitudes spawn from six weeks to two months later than they do in the valley. Therefore, to insure constant reproduction the fish should be protected to a later date in the northern and northeastern counties.

The output from the Tahoe and Tallac hatcheries for the past two years was 4,402,900 fish, and 3,550,000 eggs were shipped to other hatcheries, as is shown by the following table:

Summary of Distribution of Fish from Tahoe and Tallac Hatcheries During 1897 and 1898.

Station.	Point of Shipment.	1897.		1898.	
		Eggs.	Fry.	Eggs.	Fry.
Tahoe City	Sisson Hatchery	1,100,000	-----	1,100,000	-----
Tahoe City	Ukiah Hatchery	750,000	-----	300,000	-----
Tallac	Wawona Hatchery	-----	-----	300,000	-----
Tahoe City	Waters in vicinity	-----	1,116,000	-----	1,000,000
Tallac	Waters in vicinity	-----	1,089,000	-----	1,197,900
Totals	-----	1,850,000	2,205,000	1,700,000	2,197,900

During the season of 1897, Mr. A. W. Foster, President of THE UKIAH the San Francisco and North Pacific Railroad Company, HATCHERY. being desirous of adding to the attractions of the streams along the line of his road by thoroughly stocking them with fish, caused to be built at Ukiah a fish hatchery having a capacity of two million eggs, and arranged with us to supply the hatchery with trout spawn, upon an agreement from him that the fish should be planted in public waters. Mr. Foster employed competent men to operate the hatchery, and in the spring of 1897 we forwarded seven hundred thousand mykiss trout eggs to the Ukiah hatchery from the station at Tahoe. They were there successfully hatched, and afterwards liberated in the public streams of Marin, Sonoma, and Mendocino counties. In the spring of 1898 we again forwarded to this place two hundred thousand eggs from the Tahoe hatchery. The number was reduced because the water supply of the section was affected by the dry season. The addition of this hatchery has been and will continue to be of great assistance in stocking the 1200 miles of trout water in these counties.

Table of Distribution of Trout from Ukiah Hatchery.

Date.	Species.	Number of Fish.
1897	Tahoe Trout (<i>Salmo mykiss</i>)	700,000
1898	Tahoe Trout (<i>Salmo mykiss</i>)	200,000
1898	Steelhead (<i>Salmo gairdneri</i>)	260,000
	Total	1,160,000

OPERATIONS AT SIMS. During the early part of the present year we caused traps to be placed in Mear's and Hazel creeks, tributaries of the Sacramento River near Sims, hoping to increase the output of rainbow trout. Owing to the lack of rain these creeks did not rise and the usual run of spawn fish did not attempt to ascend them, and our attempts failed. The location, however, is considered good, and we will renew the effort next year. The expenses of our work at Sims were borne by the Southern Pacific Company.

SHOVEL CREEK STATION. The egg-collecting station located upon Shovel Creek, near Beswick, Siskiyou County, was not operated during 1897, because the fishway on the dam in the Klamath River, at Klamathon, was not in working order. A new ladder was placed upon the dam in the fall of 1897, which permitted a free run of fish during the spring of 1898. We began operations in March and worked until the 6th of May. The season's collection of rainbow trout eggs was 725,000. Of these, 200,000 were sent to Wawona and 500,000 to Sisson; 25,000 were hatched at the station and planted in Shovel Creek.

WAWONA HATCHERY. The hatchery located in the Yosemite National Park, near Wawona, was not operated in 1897, because of our failure to procure eggs at the Shovel Creek station in the spring of that year, and owing to the fact that the road from Tahoe City to Truckee was impassable until too late to admit of our forwarding eggs from the Tahoe station. The high temperature of the water supply to the Wawona hatchery in June makes it necessary that the eggs hatched there be received early in May in order to insure healthy fish.

The conditions the past season being favorable, we operated the station. Three hundred thousand mykiss trout eggs were received at the station from Tahoe on May 4th, and two hundred thousand rainbow trout eggs were received from Shovel Creek on May 11th. The water used at the station is taken from Big Creek by means of a large open ditch. On the night of May 11th this ditch was broken by the work of gophers, which shut off the water from the hatchery for a considerable time, and resulted in the loss of about two hundred thousand eggs. For this reason the output from this station was smaller than we expected. The balance of the eggs was successfully hatched and distributed. The temperature of the water during both May and June did not rise above 67°, from which cause the fish planted were the best ever reared at this station.

Summary of the Distribution of Fish from the Wawona Hatchery During the Year 1898.

Species.	Number.
Tahoe trout.....	120,000
Rainbow trout.....	167,000
Total.....	287,000

In addition to the fish planted at Wawona in 1898, we forwarded a shipment of trout to the waters of Yosemite Park from the Sisson hatchery in 1897. Two shipments of Loch Leven and yearling Brown trout were made in 1898 to Yosemite Valley and adjacent waters.

The black bass fry distributed in the past two years were mainly taken from the landlocked overflow waters from BLACK BASS WORK. Russian River. This river has become the best stocked bass stream in the State, and is the only one now affording black bass fishing. The deputies assigned to the work of collecting young bass from Russian River were those who have always been assigned to this work, and are painstaking, careful men. The parent fish seek favorable waters early in April and in May, in which they build their nests, deposit their eggs, and care for their young. During this time, and before the young bass are capable of caring for themselves, the waters in the river recede and many of the young fish find themselves landlocked. If they were permitted to remain they would die before the river again rises. The removal of these fish saves them, and we are thus enabled to obtain stock for other waters without levying upon those in the river. Our operations at this point have not been well understood by some of our sportsmen, who believe that our work has damaged the fishing in the river. The reverse is true, for many of the schools of fry are returned to the river when old enough to shift for themselves.

In the distribution of black bass we have aimed to stock all suitable waters. Particular attention has been given to the waters of the San Joaquin Valley.

Summary of Distribution of Black Bass During Seasons of 1897 and 1898.

Variety.	1897.		1898.	
	Fry.	Adult.	Fry.	Adult.
Small-mouthed.....	14,815	1,937	6,000	2,330
Big-mouthed.....	750	205	.....	.....
Totals.....	15,565	2,142	6,000	2,330

The big-mouthed bass distribution for 1898 will not be made until November first.

The work of artificial bass propagation has never been successfully carried on. The only way to breed young fish is to confine the parent stock in ponds where they propagate naturally, and from which the young can be secured. In order to supply the necessary bass for stocking we have leased a number of suitable ponds in different sections of the State, which we have stocked. We hope to be able to obtain from them the necessary supply for stocking other waters.

The big-mouthed bass which we brought into the State in 1896 were retained in the pond at the Sisson hatchery until the summer of 1897, when we distributed a part of the increase.

The Sacramento and the San Joaquin valley sections offer many miles of suitable waters for black bass, and we have devoted much of our attention to stocking them, the success of which gives us every prospect of adding the black bass to the food fish supply of the State.

ACKNOWLEDGMENTS. We desire again to express to you our full appreciation for the many courtesies extended. We also thank our people for the interest shown in our work. Their actions prove their great interest, and have made our work a pleasure, and have insured its success.

To Hon. John J. Brice, retired United States Commissioner of Fish and Fisheries, we desire to extend our sincere thanks for his generous assistance. Throughout his administration he and his able assistants have advanced the work of the National Fish Commission in this State in every possible way.

To Hon. George M. Bowers, present United States Fish Commissioner, we extend our acknowledgments for the able and courteous manner in which he has met all matters which we have presented to his attention. Many of the statistics used in this report were furnished by him.

To the Southern Pacific Company, the San Francisco and North Pacific Railroad Company, and the North Pacific Coast Railroad Company our thanks are due for free transportation of all our employés, apparatus, and fish. Without this very generous help our appropriations would have been utterly inadequate. In addition to free transportation, the railway employés have at all times assisted our men in every possible way when called upon to do so, and we also thank them.

To the Attorney-General, Hon. W. F. Fitzgerald, and his able and courteous staff, we are under deep obligation. They have been attorneys in fact as well as attorneys in name, and have ever been prompt and thorough in responding to our calls for advice.

To Major H. C. Benson, U. S. A., we are indebted for valuable help in transporting and stocking the waters of Yosemite National Park. During the season of 1897, Major Benson succeeded in placing fish in twenty-seven barren lakes and streams of the National Park. Owing to the withdrawal of troops from the Park this work was less effective in 1898.

We are much indebted to Messrs. Washburn Brothers, of Wawona; M. Lawrence & Co., of Tallac; Bliss Brothers, of Glenbrook; Pacific Coast Steamship Company, Mr. George Weymouth, Pacific Lumber Company, Eel River Valley Lumber Company, and Hon. J. N. Gillette, of Humboldt County, for donations and assistance in our hatchery work.

To the wholesale fish-dealers of San Francisco and Sacramento markets; to the Sacramento River Packers' Association, and to the Carquinez Canning Company, our thanks are extended for valuable information furnished.

We have been given valuable assistance by persons who hold commissions under our authority, who have received no compensation for their efforts in the enforcement of the laws. These outside deputies have regularly reported the conditions affecting their sections, and through their efforts we have promptly compelled many persons to observe the laws. To these men who have performed this labor of love we extend our sincere thanks.

RECOMMEN-
DATIONS
FOR AMEND-
MENTS TO
THE LAWS.

For reasons heretofore set forth, we recommend that the following changes be made in the fish and game laws: Section 623 of the Penal Code should be amended to prohibit the catching of steelhead trout with hook and line, *except* in tide water, between the first day of February and the first day of April.

Section 628 of the Penal Code should be amended to permit the possession and sale of striped bass of over one pound in weight, and to prohibit the catching, selling, or possession of striped bass between the first day of June and the first day of July.

The catching or sale of female egg-bearing lobsters should be prohibited.

The catching, possession, or sale of shrimps, fresh or dried, should be prohibited from May first to October first.

The killing or possession of any pheasants should be prohibited for an indefinite period. The present provision protecting them will expire in March, 1899.

Snipe should be protected, and the season for killing them should be from October first to March first.

The use of nets or traps in the capture of any kind of wild birds should be prohibited.

In conclusion, we beg to say that we feel a justifiable pride in the record of the Commission during the past two years. This report is submitted with full confidence that our work has never been surpassed in any biennial period since the creation of the Board.

We trust that we have herein demonstrated to our citizens and to you

that this is a business commission of great economic value. Our guiding principle has always been the protection and propagation of cheap and nutritious food for all the people of the State. The success that we have attained in this behalf has been rendered possible by the fair appropriation made at the thirty-second session of the Legislature, and we feel assured that an examination of the results of our labors by the members of the thirty-third Legislature will insure at least a similar allowance for the continuance of the work.

Yours respectfully,

ALEXANDER F. VOGELSANG.

C. B. GOULD.

Owing to lack of funds, the Appendix of this Report is not published in its entirety, but we are enabled to present the following extracts.

BOARD OF FISH COMMISSIONERS.

EXTRACTED FROM THE APPENDIX
OF THE
FIFTEENTH BIENNIAL REPORT.

STATEMENT OF FISH PLANTED BY BOARD.

NOTES ON THE PLANTING OF SALMON FRY,
WITH PLATES.

IN THE MATTER OF DUMPING SAWDUST INTO
THE TRUCKEE RIVER.

MISSION.

Year.	Eastern Lobster (<i>Homarus americanus</i>)	Silver Pels (<i>Anguilla chrysopa</i>)	Muskallunge (<i>Lucius masquamongii</i>)	Tautog (<i>Tautoga onitis</i>)	Blue Crab (<i>Callinectes hastatus</i>)	Diamond-back Terrapin (<i>Malaclemmys palustris</i>)	Eastern Oyster (<i>Ostrea virginica</i>)	Totals.
1871								15,000
1872								53,000
1873								35,000
1874	*4	*12						850,566
1875								2,080,000
1876								2,099,000
1877								2,796,488
1878		*4,000						2,768,500
1879	*21							3,019,393
1880		*10						2,548,860
1881								2,917,362
1882								1,680,881
1883								1,195,300
1884								239,500
1885								150,000
1886								1,300,000
1887								2,700,000
1888	*332							1,941,332
1889								3,195,500
1890								3,272,357
1891								2,886,250
1892								3,474,655
1893			*93,000					3,759,105
1894								12,115,940
1895							Barrels.	7,775,939
1896	*89			*4		*120	*25	19,498,042
1896	*271			*325	*162			21,181,964
1897								35,912,318
1898								
Totals	717	4,022	93,000	529	162	120	25	141,462,152

* Italics sh

A REPORT ON THE PLANTING OF QUINNAT SALMON FRY IN THE SHORT COAST STREAMS OF MARIN COUNTY, CALIFORNIA,

WITH RESULTS OF OBSERVATIONS MADE UPON THEIR
MOVEMENTS, FOOD, RATE OF GROWTH, ENEMIES, ETC.

By N. B. SCHOFIELD, of California Fish Commission.

DESCRIPTION OF PLATES. The three accompanying plates are to illustrate the rate of growth of Quinнат salmon fry from the streams of Marin County, California.

In Plate I are four outline figures of the fry at progressive ages. Fig. 1 represents the young salmon with yolk sac just absorbed; Fig. 2, 25 days after absorption of yolk sac; Fig. 3, 46 days after absorption of yolk sac; Fig. 4, 62 days after absorption of yolk sac. Figures 1, 2, 3, and 4 are from specimens 1.35, 1.7, 2.51, and 2.98 inches, respectively.

Plate II represents a young Quinнат salmon taken in brackish water, 107 days after absorption of yolk sac—showing loss of markings below lateral line and the faded out parr marks, caused by the brackish water. Drawn from an average specimen 3.2 inches long. This drawing should be compared with Plate III, which figures a young salmon from fresh water.

Plate III shows a young Quinнат salmon taken in fresh water 162 days after absorption of yolk sac. Drawn from an average specimen 3.55 inches long.

The planting of Quinнат salmon fry in the short coast streams of Marin County was primarily an experiment. The Quinнат salmon has never been known to spawn in these streams, probably due to their proximity to the Sacramento River, which is the popular spawning ground for the salmon of this region. (North of the Russian River, the Quinнат spawns in the small streams as well as in the larger rivers of the coast.)

Paper Mill Creek and its tributaries are exceptionally rich in aquatic insect life, affording an abundance of food for the fry; and the absence of predaceous fishes, excepting the trout and blob, make them apparently better streams for the rearing of young salmon than the Sacramento. It was thought that if the fry could thrive in these streams and pass successfully into salt water, it would be of advantage to utilize coast hatcheries and plant in the smaller streams where the young salmon would not be subjected to their enemies like they are during the long journey from the upper Sacramento to the sea.

In December, 1896, 855,000 eyed Quinнат salmon eggs were shipped from the Battle Creek hatchery to the Bear Valley hatchery in Marin County, California. Here they were hatched early in February, 1897, and after the yolk sacs were absorbed, which was about thirty days

later, they were fed for a few days on curds of milk, and then, in the second week of March, were turned into Paper Mill Creek and its tributaries—Nicasio, Olema, and Hatchery creeks. The fry were strong and healthy, and as the streams were near the hatchery, and the fish were in no case over two hours in transportation, they were turned into the streams in the best of condition.

The young salmon were watched day after day and systematic observations made upon their movements, habits, etc. The work was first begun by the United States Fish Commission, and carried on until the middle of May. After a break here of three weeks, the California State Commission carried it on to completion.

The thing to be feared in this experiment was that the streams would prove too short and that the young salmon would arrive at salt water before they were ready to conform to the kind of life they would have to lead there.

The observations carried on in connection with the fate of these young salmon fully demonstrate the success of the experiment and prove that the fry can be as safely planted in these streams as in the Sacramento. They grew more rapidly than the same fry in the Sacramento; had fewer enemies, and passed successfully into salt water and thrived there.

By far the most interesting part of the experiment was the knowledge gained as to the habits, enemies, and growth of the fry after being turned loose. The streams being free from any young salmon but those planted from the hatchery, an excellent opportunity to observe the rate of growth was afforded. Any knowledge in this line is of great economic importance, as it enables us to more intelligently choose the right time and place to plant the fry, and proves that they do not require two or even three years to reach salt water.

Paper Mill Creek, the largest stream in Marin County, rises in the high land just north of Golden Gate, and runs northwest for about twenty-five miles, where it empties into Tomales Bay after passing through a three-mile stretch of tide water. The bay continues a very narrow stretch of water in the same northwesterly direction for thirty miles before the open sea is reached. Paper Mill Creek is formed by the junction of the San Geronimo and Lagunitas, each of which is quite small, the water cold and swift, running over a rough rocky bottom, and everywhere overhung with trees and bushes. After uniting to form the main stream, the water frequently runs over quiet stretches of gravelly bottom, but for the most part the bed is rough and rocky and there are many cascades and deep rocky pools. The stream for nearly its entire length is well shaded with overhanging trees. The width of the stream in its normal state is about fifty feet, and its depth averages about two

DESCRIP-
TION OF
STREAMS.

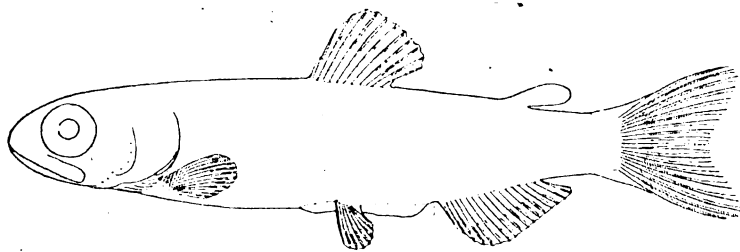


FIG. 1.

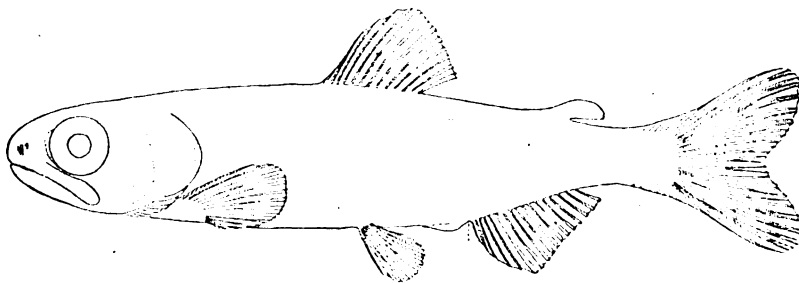


FIG. 2.

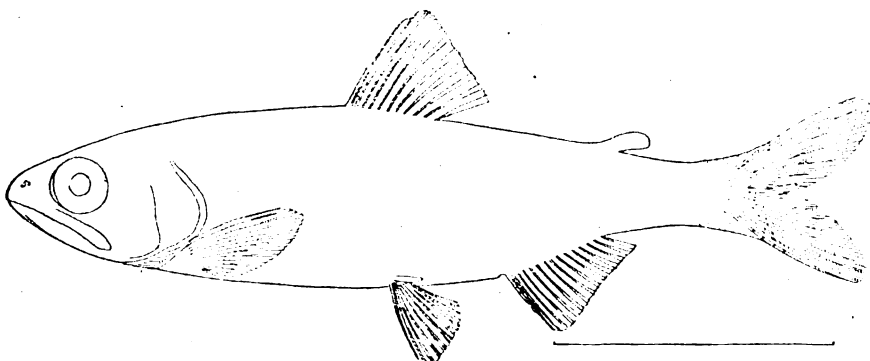


FIG. 3.

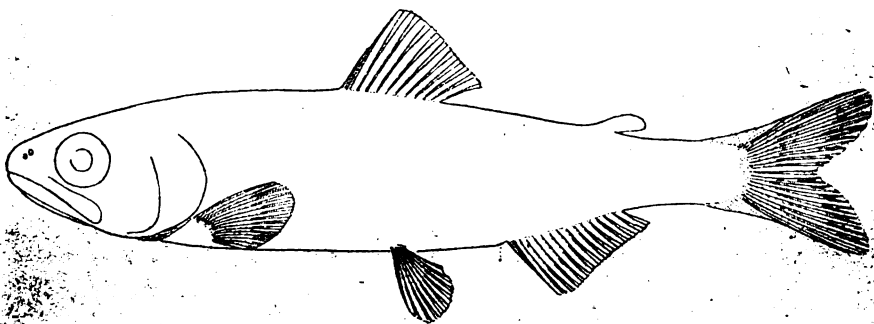


FIG. 4.

PLATE I—SALMON FRY.

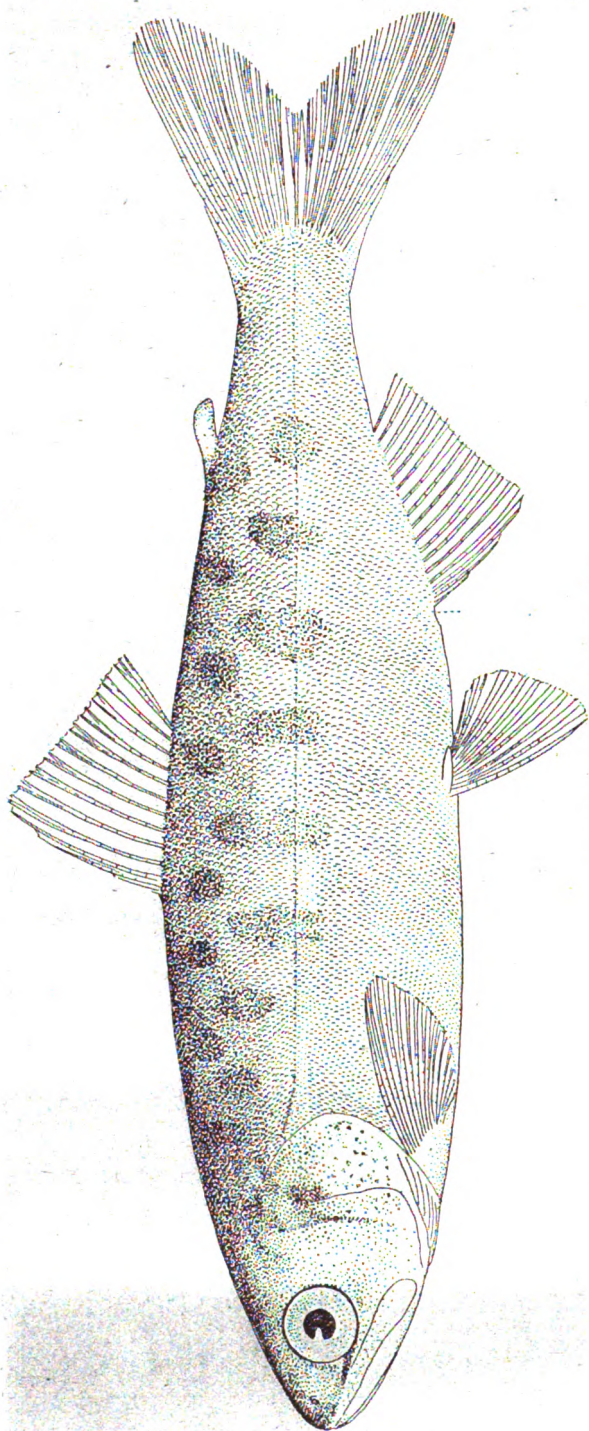


PLATE II.—SALMON FRY.

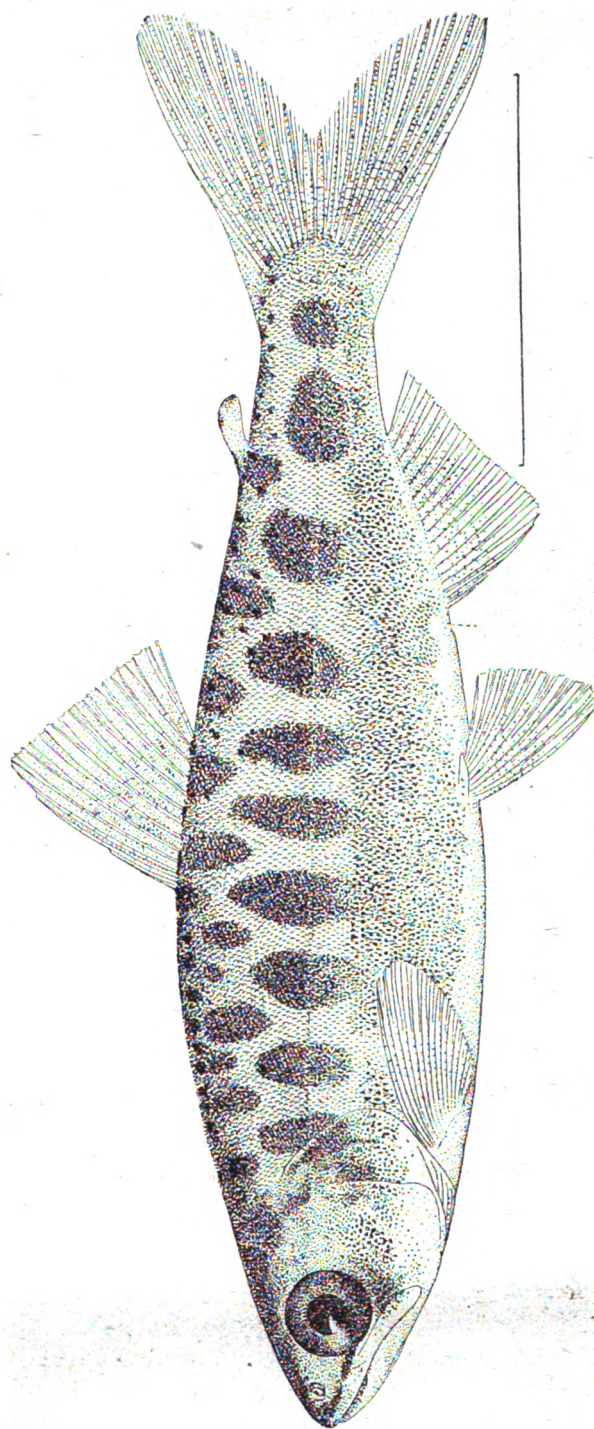


PLATE III.—SALMON FRY.

feet, but its size is increased enormously after each heavy rain. The water in the upper end of Paper Mill Creek during the six months after planting the fry had an average maximum temperature of 64°, while at the lower end in tide water the average was 71°.

Nicasio Creek rises to the east of Paper Mill Creek, and flows into it about five miles above tide water. Nicasio Creek is very much smaller than the Paper Mill, being only about twenty feet wide, with an average depth of six inches. Throughout its length it flows over flat, gravelly beds, with few trees or bushes to shade the water. The sun has full sweep at it and heats the water each day during the summer to a temperature of 75° or 80°.

Olema and Hatchery creeks rise to the west of the main Paper Mill, and flow almost parallel to it, emptying into it near together about one mile below upper tide-water mark. Olema Creek is about the size of Nicasio, but carries more water during the dry season. The water, too, is much cooler, and the upper stream has more of the character of the upper Paper Mill. The banks are thickly grown with brush and trees. The last two miles of the creek runs through low swampy land, with its banks most of the way heavily lined with willows. The average maximum temperature for lower Olema was 63°, and the upper stream averaged but one degree colder.

Hatchery Creek is very much smaller than Olema Creek, and is not nearly so long. At first fed by springs and running through cool, shady woods, the water is quite cold, but on gaining the open valley and running through two miles of marshy lowlands, with but little shade, it becomes, on reaching Paper Mill Creek, even warmer than the water in Olema Creek. The average maximum temperature of the upper Hatchery Creek was 54°, while at the lower end the average was 64°.

The species of fish found in these streams are limited to four. The most important is the steelhead (*Salmo gairdneri*), which runs in from salt water each winter and spawns in the streams, keeping them well stocked with young trout. About the most abundant fish is the "chub" (*Rutilus symmetricus*). The "stickle-back" (*Gasterosteus cataphractus*) and "blob" (*Cottus gulosas*) are fairly abundant. Occasionally the dog salmon (*Oncorhynchus keta*) enters these streams and spawns.

Tomaes Bay, nowhere deep, grows very shallow at its upper end, where it receives Paper Mill Creek. No bar ever forms across the mouth of the creek, as is the case in most of the small coast streams, but is always open for fish to run either in or out. Temperature of Tomaes Bay at its upper end averaged 70°.

THE PLANT-
ING OF
THE FRY.

The young salmon at the time they were turned loose had an average length of 1.35 inches. On being liberated from the cans they scattered in all directions, the swift current at first carrying them some distance down stream.

But they soon recovered, and turned their heads against the strong current, and found their way immediately to the quieter waters along the shallow edges, in eddies, quiet pools, or among the stones at the bottom of the stream. Some few would even move a few yards up stream, and demonstrated that they were able to hold their own even against a very swift current. On gaining quieter waters they rested themselves, moving only enough to keep from drifting down stream. As soon as they gained a position of this kind they immediately began feeding on any particles of food that floated within their sight; often snapping viciously at flies half as large as themselves. Each individual acts for himself. They do not run in schools, and no more than two or three are found together unless the nature of the stream compels it. In eddies and pools they are thrown together, but in a long, shallow, quiet stretch of water they scatter out—each one taking a position in the eddy of a small stone, or other object, where they have to barely move a fin to keep their position, while the water above them is moving swiftly. Lying in such places they watch for insects or any particles of food that may be floating past. They feed principally upon objects floating on the surface, but often they are seen to strike at objects beneath. After striking at an object they almost invariably return to their old position. Frequently one would be seen to move a few yards down stream and take up another similar position. The young salmon undoubtedly move down stream in this manner: moving down individually and by dropping a few feet at a time.

After two weeks in the stream but very few of them were to be found in the shallow water; nearly all had moved into the deeper holes. Here they would be nearer the center of the current, where there is more floating food and where they could also hide, for by this time they are very shy, and dart into the deeper water or under a rock at one's approach. The young steelheads which hatched out shortly after this time were not nearly so shy at the same age.

Four weeks after planting, practically all had moved into the deeper holes, and as long as they remained in the streams they occupied these places. In the deep water of the lower Paper Mill, where the water was four and five feet deep, they would hang stationary in the center of the current a foot or two below the surface, darting now and then at objects on the surface.

**MOVEMENT
DOWN
STREAM.**

As before stated, the only noticeable movement down stream was the occasional movement of individuals dropping from one resting place to another. During the first three weeks after planting, the water in the streams was high and muddy, and, except in Hatchery Creek, good observations could not be made. It was only a matter of a couple of days until most of the salmon had dropped down out of the upper Hatchery Creek. If there was a similar movement of the young salmon in the other streams during the first few days I do not know; but when the first seining was done, a month after planting, the fry were found more abundant in tide water than in the upper streams where they were liberated. There can be no doubt that there was a decided movement down stream during the first month, which probably began immediately after planting.

Forty-five days after planting, the fry were found in considerable numbers in brackish water. As this was the first time seining was done in brackish water, we do not know how much sooner they reached this point. We subsequently learned that the fishermen near Marshall, fifteen miles down the bay, caught the young salmon in considerable numbers as early as the last of April, or fifty days after they were liberated. At this time for about a week they caught fifteen or twenty at a haul in their 300-foot nets. After a week they caught only two or three in a haul, and then, as the fish grew scarcer, they caught only two or three in a day's seining. After the middle of June, three months after planting, they caught no more.

It is unfortunate that we have to rely solely on the fishermen for information as to when the salmon reached salt water. Information obtained in this way cannot usually be relied upon, but the young salmon was a new fish in the bay and the fishermen could not help noticing it. The stories of the different fishermen agree so well that in this case it is safe to rely on them.

The first seining in the bay was on April 29th, fifty days after planting, on which day we caught one of the young salmon. This was at a place about two miles from the mouth of Paper Mill Creek. The seining was done with a thirty-foot net, and although we seined almost daily in the bay after this and with a fifty-foot net, not another salmon was caught.

The young salmon were found in brackish water, near the mouth of Paper Mill Creek, up to the 11th of May, two months from the time of planting. This date probably marks the end of the run. Those that remained, continued to go out a few at a time, until by the sixth month but very few were left in the streams. After the sixth month no seining was done until the eleventh month, which was after the winter rains. After the most thorough seining at this time only three of the fry could be found, showing that practically all had run out before the end of the year.

By the middle of the second month, when the water had become clear enough to watch the young salmon from the bank, it was found that they retained their positions in the current for hours without moving down stream even for a few feet. In one instance an albino (one without color) kept one position for three days, after which it could not be found either above or below its old position. These facts all tend to show that there was a decided movement of the salmon down stream during the first month, and after that time they moved out much slower. It probably took the rains of the next winter to drive them all out.

We tried another experiment. By stretching a net across a narrow place near the mouth of Paper Mill Creek as the tide was coming in, it was demonstrated that the salmon play back and forth with the tide before passing into salt water, as they repeatedly ran into the net ahead of the tide when it was fixed in this way.

MOVEMENT In all of the streams except Hatchery Creek the fry were planted where they could easily move up stream two or
UP three miles if they so desired. The streams were care-
STREAM. fully seined above the planting places to determine to what extent they moved up stream. In Nicasio Creek only a very few had moved up, and they had gone but a fourth of a mile above where they were liberated. We found a few in Olema Creek a fourth of a mile above where they were planted. In Paper Mill Creek I found that none had moved up stream. All of the side streams were seined to see if the fry had entered any of them, but it was found that they had entered only one—a very small stream fed by springs flowing into lower Hatchery Creek. The water in this small stream was much colder than the water in the creek and was grown full of water cress. Nearly a hundred of the fry had entered this and were found as far up as they could get. Some had even found their way through a perfect mat of grass and drifted rubbish. The current in this stream was very slow, and it entered the creek at such an angle that it was a sort of trap, and I have no doubt the fry got in there in trying to get down stream. Although some of the fry do work up stream for a short distance, they are the exception. Why they move down stream we do not know, and we will have to credit it to instinct. A young steelhead or other trout when frightened prefers to dart up stream rather than down, and if one wades down stream and attempts to drive them before him he will find that they will not drive, but will dart between his legs or around him in their frantic efforts to get up stream. Knowing this trait of the fish, in seining for them the net is always hauled down stream. With the salmon fry it is different—when frightened they will run even more readily down than up stream. By walking along a small stream they can be driven either up or down. In seining for them they are caught as readily by seining against the current as with it.

The most important part of the work was finding the rate of growth of the young salmon while remaining in the stream. This was determined by capturing series of the fry at intervals and making careful measurements of their length.

The young salmon were put in the stream on or about the 10th of March, thirty days after hatching, at which time their yolk sacs were absorbed. At this time their average length was 1.35 inches, and the rate of growth is figured from this time. Although the rate of growth could have been determined more accurately had larger series of fry been saved, it is accurate enough to demonstrate a remarkable growth and to enable us to make comparisons between the different streams and different parts of the same stream. It also gives us some idea what to expect in larger rivers.

The most rapid growth was during the first month, at the end of which time they had, in the lower stream, reached an average length of 2.28 inches; a gain for the month of .93 of an inch. A few individuals reached a length of 2.40 inches.

Through the second month the growth was not quite so great, and during the third and fourth months correspondingly less. At the end of the second month the salmon in the lower end of the creeks averaged 2.98 inches in length, and a few had reached a length of 3.1 inches.

During these first two months the fish in the lower streams averaged considerably larger than those above. At the end of the first month those above averaged 1.71 inches, against 2.28 inches for those below. At the end of the second month those above averaged 2.75 inches against 2.98 below.

After two months there was no marked difference between the salmon in the lower streams and those above, except in Hatchery Creek, where those above remained very small.

At the end of four months the average length of the salmon was 3.35 inches. The rate of growth during the four months, taken from an average of all the salmon retained, was .52 of an inch per month. After four months this rate of growth fell off very considerably, and at the end of the fifth month they had reached an average length of only 3.46 inches. After the middle of the sixth month no more seining was done in the streams until the following February, or eleventh month, when one salmon was found in Olema Creek measuring 3.64 inches. On April 14th, thirteen months after planting, another was found in Olema Creek 4.45 inches long. One other was found in Olema Creek, of which I have no measurements.

Nearly all the salmon had run out of the streams by the end of the fourth month, and those remaining after this time were evidently stunted individuals, as is shown by their very slow growth. An instance proving this is shown in the following: In March, 5,000 of the

fry were put in Bear Valley Creek, which is dammed at its lowest end and fixed with a screen so that the fish cannot get out. Here, eleven months after planting, two salmon were caught, each measuring 5.5 inches. At the same place, fifteen months after planting, two specimens were caught, one 6 inches, the other 7.5 inches long. This remarkable growth in a stream where they were confined is another point that leads to the belief that the salmon which preferred to remain, after four months, in the streams where they were not confined were individuals stunted or the physical inferiors of those running out during the first four months.

The growth of the salmon was the same in Paper Mill, Nicasio, and Olema creeks, but in Hatchery Creek the growth was not so rapid. The salmon in the lower end of the creek grew rapidly enough, but those above grew very slowly, gaining on an average the first three months only .15 of an inch per month. At the end of the fourth month they had all descended to the lower stream. The reason of this slow growth in the upper stream was due to the scarcity of food. Although the temperature of the water there is much lower than it is below or in the other streams, we cannot, knowing what we do of their growth in other cold streams, attribute their slow growth to the temperature of the water.

Owing to this difference in growth in the same stream, the variation in the size of the individuals is great. Out of thirteen specimens taken from lower Hatchery Creek at the end of three and one-half months, the largest was 3.53, the smallest 2.26 inches, a difference of a little over 1.25 inches; or, expressed in the amount gained by each since planting, the largest 2.18 inches, the smallest 0.91 of an inch. The variation in Olema Creek, where no difference was found between the upper and lower stream, after the second month was nearly as great. From seventeen specimens taken at the mouth at the end of three months the largest was 3.42, the smallest 2.58 inches.

The important points learned in connection with the rate of growth of the young salmon were: *First*, that during the first four months their growth averaged 0.52 of an inch per month; *Second*, that the few salmon remaining in the stream after four months were stunted, and grew very slowly in comparison with those confined in Bear Valley Creek.

An important fact to be noted in connection with the salmon confined in Bear Valley Creek is, that of the two salmon taken in February, 1898, both were males; one with the generative organs fully developed. It is not uncommon to find young 4 to 4½ inch male salmon remaining in the streams with the testes fully developed, but it was never before found in a salmon whose age was known. This individual found in Bear Valley Creek was 5.5 inches in length, and was just twelve months

old. It should also be noted that it was no smaller than the other male salmon taken at the same time. Evidently the development of the sexual organs did not retard its growth.

Although these young male salmon are occasionally found with the generative organs prematurely developed, no females, to the best of my knowledge, have ever shown such development. This premature development peculiar to the males, accounts for the undersized males, or "grilse," accompanying each run of salmon up the rivers, and it tends to prove that such "grilse" are not stunted individuals, but simply that they have matured at an earlier age and are younger than the salmon which they accompany.

THE AGE OF THE "GRILSE." The following is a mere speculation in regard to the age of the above mentioned "grilse": We have already seen that one out of the two males taken in Bear Valley Creek at the age of one year was sexually mature. In the headwaters of the Sacramento we have in November found among the young salmon remaining in the streams several sexually mature males, which at that time were under ten months of age. These few examples which have come to my notice represent a very small percentage of the number that must mature within ten months or a year in the large body of salmon that leave the stream immediately after hatching. Reaching maturity they would naturally follow the next run of salmon up the river. There are two runs of salmon up the Sacramento each year; the fall run starting up the river about the end of July and reaching the spawning beds at Battle Creek in October. The eggs spawned by this run hatch in January and February. Ten months after hatching, at which time the "grilse" would have matured, would be too late for them to catch the next fall run up the river, but they could catch the next spring run, which starts up the river in April, and reaches the spawning grounds in the McCloud River in June and July, the eggs hatching in October and November. The salmon hatching from this spring run get out of the river in time for the "grilse" to catch the fall run ten months later.

If this is true the "grilse" running in the spring are about sixteen months of age on reaching the spawning beds in June. Those arriving on the spawning beds in the fall are about twelve months of age. If this actually happens, the "grilse" of the spring run should average larger than those of the fall run. The age of these "grilse" can be determined by better and more extended observations, and such knowledge would be a long step toward determining the important question of how old the full-grown salmon are when they run.

FOOD.

The young salmon, from the time they first begin to feed, eat almost anything they can get, but they show a preference for insects and insect larvæ, and they prefer to capture food that is floating on the surface of the water. An examination of the contents of the stomachs of the young salmon taken from Paper Mill Creek and its tributaries, from the time they were planted to the time they reached salt water, shows that their food was almost exclusively flying insects which had dropped upon the surface of the water.

These streams abound in caddice worms of three or four species, small periwinkles, the larvæ of stone-flies, may-flies, and other insects; but they were all neglected for the flies, bees, beetles, caterpillars, etc., that fall into the stream. No caddice worms or periwinkles were found in their stomachs, and but very few of the larvæ of aquatic insects. This same thing was observed in the younger trout; and although the larger trout eat large quantities of caddice worms, the insect larvæ in the water do not furnish the amount of food to these fish that is popularly supposed.

Although these salmon live almost exclusively on insects that drop upon the water, we have found in their stomachs pieces of leaves and buds, small feathers, shells of salmon eggs, and the helpless young of their own species. (See notes on planting of salmon fry before yolk sacs were absorbed, at Sisson, November, 1897.)

In the salmon taken in brackish water I found they had been eating small salt-water crustaceans, and one three-inch salmon taken in salt water had eaten six of the young of the "silver smelt" (*Atherinops affinis*) and one small leaf-hopper of the kind that is found among the pebbles along the shore of the bay.

In almost every case the stomachs were filled to their utmost with food. Tomales Bay abounds in small crustaceans and the young of the "silver smelt," and the young salmon would have no trouble in finding an abundance of food on reaching salt water.

Scarcely any vegetable matter was found in their stomachs, and what little was found no doubt was taken by accident.

If these young salmon live almost exclusively on flying insects, the way to choose a good stream for planting would be to select one with plenty of trees, bushes, and grass along its banks, for such vegetation is a harbor for insects.

The principal source of danger to young fish in a stream

ENEMIES.

is from predaceous fishes, or even from older fish of their own kind. Of the four species of fish in these Marin County streams—chub (*Rutilus symmetricus*), stickle-back (*Gasterosteus cataphractus*), blob (*Cottus gulosas*), and trout (*Salmo gairdneri*)—the last two only are predaceous.

- After planting the young salmon, a number of these two species were caught daily, and the contents of their stomachs carefully examined. Altogether only about twenty-five specimens of *Cottus gulosas*, of size large enough to prey upon the young salmon, were caught. Out of these twenty-five, not one had eaten a fish of any kind. Thirty or forty specimens of *Salmo gairdneri* were examined daily for three weeks after planting, and in not one instance had a salmon been eaten. The only fish eaten by them was *Rutilus symmetricus*, and no more than ten of these were found in about seven hundred examined.

The other enemies to young fish observed were water snakes, kingfishers, herons, and divers. Although none of these were killed to find out what they were eating, it is safe to say that the loss of young salmon due to them was slight.

PLANTING OF QUINNAT SALMON FRY IN MARIN COUNTY STREAMS IN 1898.

In February, 1898, 2,000,000 Quinnat salmon fry were planted in Paper Mill Creek and its tributaries by the United States Fish Commission. On account of limited hatchery space and lack of funds, the fry were all planted before the yolk sacs were absorbed. The fry hatched at the same time as those liberated in these streams last year, but they were planted about three weeks earlier. The height of the water in the streams at the time of planting and during the next month was lower in 1898 than in 1897. Notwithstanding this, the salmon ran out earlier than the year before. In April there were not as many salmon left in the streams as in June of the year before. In June no salmon whatever could be found in Paper Mill Creek. Only a very few were found in Olema Creek, and they were not much more plentiful in Hatchery Creek—the same condition that existed two months later in 1897. The only reason I can give for this difference in time of running out is that they were planted at different ages. Apparently, planting before the yolk sacs are absorbed causes them to run out earlier. This brings up an important question: Does the holding of the fry until after the yolk sacs are absorbed keep them from running out as soon as they would under natural conditions?

From a series of specimens taken in April and June, it was found that their average growth was .52 of an inch per month. It should be noticed that this rate of growth during the first four months is almost exactly the same as that found for the same period in 1897—differing only .05 of an inch.

NOTES ON THE MOVEMENTS OF THE YOUNG OF THE STEELHEAD TROUT (*Salmo gairdneri*, Richardson) IN MARIN COUNTY STREAMS.

By N. B. SCHOFIELD, of California Fish Commission.

The steelheads ascend Paper Mill Creek and its tributaries regularly each year for the purpose of spawning. Late in October and early in November they appear in tide water, where they remain until the first good rains. They then ascend the creeks, and spawn on the gravel bars in December and January, reaching their height in early January.

After spawning the steelheads drop back down the stream, and remain for some time in the holes in tide water before running into salt water. Unlike the salmon, they do not die after spawning, but drop back into salt water and return to spawn again. Steelheads from the lower Paper Mill Creek examined in April after spawning showed the ovaries with the eggs forming, which would probably have matured by the next winter run.

The first young steelheads appear in shallow water along the edges of the stream after absorbing their yolk sacs late in March, but they do not appear in any great number until late in April. In 1897 they began to show themselves in considerable numbers by the 15th of April, and by the 25th the edges of the stream in places were fairly black with them. At this time they are not very shy and are not frightened when one comes near them, unless his shadow chances to fall on them. By being cautious one can with his hand scoop them out onto the bank. This cannot be done with the young salmon of the same age, as they are much more shy. These young steelheads as they lie in the shallow water kept their heads against the current, and were entirely absorbed with the task of catching something to eat—feeding in the same way as has been described in the case of the young Quinnet salmon. In a very few days they left the shallow water and moved more into the center of the stream, where there is more floating particles of food for them to catch. By the middle of May nearly all the small steelheads had moved from the shallow, quiet water along the edges into the swift water near the center of the stream or into the deeper holes.

On the 12th of June the average length of the young steelheads was taken from thirty-three fish measured, and was found to be 2.6 inches. The age of these fish we can estimate very accurately to be fifty days, counting from the time their yolk sacs were absorbed. At the time of

such absorption their length would average less than 1.15 inches. Thus, in fifty days their actual gain in length was 1.45 inches, or considerably over three-fourths of an inch per month. This is even a more remarkable growth than that found in the young Quinnet salmon.

To get at some idea of their abundance I will copy from my notes of June 16, 1897, on seining with a thirty-foot net in upper Olema Creek: "The first haul was through a hole thirty feet wide, fifty feet long, and three feet deep in the deepest place; caught 61 young steelheads, 27 large stickle-backs, and 3 blobs. The second haul was over a riffle with pebbly bottom; hauling about thirty feet we caught 25 steelheads and 10 stickle-backs. The third haul was made through a small hole ten feet across and two feet deep, with roots of an old stump at the edge, under which they could hide. Here we caught 165 steelheads, 7 stickle-backs, and 10 blobs. The fourth haul was through a hole ten feet wide, fifty feet long, and three feet deep in deepest place; caught 152 steelheads. The fifth haul caught 100 steelheads; the sixth, 75; the seventh, 28; the eighth, 58; and the ninth, 127 steelheads. In one-fourth mile seined we caught 578 steelheads, all under three inches in length. I have estimated that we took two thirds of the steelheads in that distance. There are twelve miles of the stream in which they are just as plentiful, which would make about 37,000 young steelheads for the stream. The number in Paper Mill Creek would be from five to seven times this amount, and the number in Nicasio and Hatchery creeks would, for each, be about one fourth the number in the Olema."

"Very few, if any, of the young steelheads have moved down stream, and nearly every one to be found in Olema Creek now has been hatched this year."

A thorough seining of the streams at that time showed that there was scarcely a steelhead over three inches in length. During the summer, when the water is low and warm, the steelheads, except those hatched the same spring, nearly all run into salt water. During June, while seining for young salmon in brackish water near the mouth of Paper Mill Creek, young steelheads were caught in considerable numbers, ranging from 5½ to 6½ inches in length. In all the red colors were not lost and the dark bars on the sides were bright and distinct, showing that they had just come from the upper stream—for the bars on the sides, and especially the red markings, are quickly lost in brackish or salt water.

After the first good rain in the fall, when the streams begin to rise, the young steelheads from 6 to 10 inches long appear in large numbers in tide water, with their sides bright and silvery and the dark bar marks almost lost. They gradually work up the streams and soon their color gets darker and the dark markings more distinct. After each heavy rain there is a fresh run of these steelheads, and as the water subsides again they drop back into salt water.

There is the best of evidence that these fish do not enter the streams for the purpose of spawning. In all the seining done from January to September, not one steelhead under three pounds was found sexually mature, and none were found that showed any sign of becoming so. By questioning people resident here and familiar with the fish in these streams I find that small steelheads under two pounds are very rarely if ever found with spawn.

Rainbow trout (*Salmo irideus*) are nearly every year liberated in Paper Mill Creek, but if they live they have gone back to the habit of running back to salt water and cannot, in habits, general appearance, or structure, be distinguished from the steelhead.

Although seining was done in tide water from the time young steelheads begin to hatch until the 14th of June, none of them were caught. Up to this time they had not begun to run out, but they did run out before the next January. They probably run out when the stream is at its lowest, late in August and early in September.

NOTES ON AN INVESTIGATION OF THE MOVEMENT AND RATE OF GROWTH OF THE QUINNAT SALMON FRY IN THE SACRAMENTO RIVER.

By N. B. SCHOFIELD, of California Fish Commission.

Aided by the knowledge gained in the study of the habits, movements, and rate of growth of the young salmon in Marin County, we were better enabled to carry on the more difficult work of finding out the movements and rate of growth of the salmon fry in the Sacramento River.

The work was begun in the headwaters of the Sacramento in the neighborhood of Sisson in August, 1897, and has been continued at intervals to the present time. During the present spring the United States Fish Commission has taken up the same work in the Sacramento, and in the following report I have made free use of some of the results of their work, especially of their work in the brackish and salt water of Suisun and San Pablo bays.

To make clear what is to follow I will explain that although a few salmon may spawn in some of the tributaries of the Sacramento in almost any month of the year, the vast majority of them spawn at two separate and distinct times. Eggs deposited by the spring run hatch in October, and the eggs from the fall run hatch the following February. After hatching it is another month before they begin to swim around and feed.

The adult Quinnat salmon, in its journey up the Sacramento for the purpose of spawning, never reaches Sulloway Creek, and it very rarely reaches a point as far up the Sacramento as the mouth of the Sulloway. The young Quinnat salmon found in the Sulloway and this part of the Sacramento are from the State hatchery at Sisson, and, knowing the age of the fry liberated, it is possible to estimate very accurately their rate of growth.

On August 28, 1897, I seined Sulloway Creek, and found the salmon fry quite plentiful. To better illustrate their number, in one haul, through a hole three feet deep, ten feet wide, and fifteen feet long, I caught twenty-seven young salmon. In other parts of the creek they were just as plentiful. None were found above the point where they had been liberated. These fry had been planted in February, and at the time their yolk sacs were absorbed—about March 10th—their average length was 1.35 inches. On August 28th, five months and twenty

days later, they had grown to an average length of 3.26 inches, or an actual gain in length of 1.91 inches; an average gain per month of .33 inch. The specimens from which this average was taken contained the smallest and largest salmon found, or 2.83 and 4.08 inches, between which two lengths there was a perfect intergradation.

On November 2, 1897, a little over two months later, Sulloway Creek was again seined, and only about one half as many young salmon were found, and from a representative series ranging from 3.30 to 4.18 inches in length, the average was found to be 3.5 inches, or a gain of .24 of an inch in the two months.

Early in November, salmon fry hatched from eggs taken at Baird, on the McCloud River, were planted in Sulloway Creek, and by November 22d they had absorbed their yolk sacs. In the February following, salmon fry hatched from eggs taken at Battle Creek were again planted. These absorbed their yolk sacs about March 10th. No seining was done between these two plants, and none after, until the 15th of May, 1898. On this date young salmon were caught, and, after measuring a larger series, it was found that they were of three well-developed sizes. Those making up the smallest size exceeded all of the others 8 to 1, and they had grown from a length of 1.35 inches on March 10th, to 2.18 inches, or a gain of .83 of an inch, a rate of .38 of an inch per month. The smallest salmon found belonging to this group was 1.64 inches, the largest 2.8 inches. The next size ranged from 3.58 to 3.9 inches, and averaged 3.73 inches. These had remained in the stream since the November preceding, and there were very few of them as compared with the smaller size. They had been in the stream nearly six months, and showed an average gain of .39 of an inch per month. Only two specimens were found larger than this size, and they each measured 4.6 inches. These had undoubtedly remained in the stream at least since March of the year before.

Although it had been only a little over two months since several millions of salmon fry were planted in this small stream, there were—compared with the immense number planted—scarcely any left. These observations seem to warrant us in drawing the following conclusions: That the great bulk of the fry planted in February and March leave the stream, on their way down the river to salt water, within two months; a few of them remain until the rains of the following winter, and a few individuals may even remain through the winter up to the beginning of the rains the next fall. Of the fry planted in November, nearly all leave the stream during the winter, and it is probable that they do the same as the others—leave the streams within two months. I should add that the observations of the young salmon in Marin County, which are to be found in a separate report, and the subsequent observations carried on in the Sacramento, all demonstrate the correctness of these conclusions.

On August 29, 1897, I seined in the Sacramento near Sisson, and found salmon ranging from 2.63 to 4.37 inches in length, with an average length of 3.25 inches. On November 3, 1897, I seined again in the same place, and found the salmon ranging from 3.25 to 4.50 inches, with an average length of 3.92 inches. They had gained .67 of an inch in the two months since the stream was seined before; or, for the eight months which they had remained in the stream, an average gain of .32 of an inch per month. In the two months their number had diminished about one-half, which was the same falling off as found in Sulloway Creek.

On November 6, 1897, I seined the upper Sacramento at Sims, and found the average length of the salmon there to be 4 inches, although they ran from 3.5 to 4.5 inches.

On May 17th of the following year, a little over six months later, the stream was again seined at the same place. The average length of the young salmon at this time was 2.67 inches, although they ran from 1.52 to 3.76 inches. In this series the fry were hatched from eggs spawned by two different runs, which accounts for the great difference between the largest and the smallest of the series. Those in the upper end of the series, and which average about 3.5 inches, had absorbed their yolk sacs and begun to feed six months before, while the lower end of the series represents those which had begun to feed only two months before. If two hatches of salmon as young as these and with such a difference between their ages had been found in a small tributary of the Sacramento we could expect to easily separate the two sizes, but in the main stream, as at Sims, where the young salmon are from several different tributaries, a large variation in the size of the individuals occurs and it is not strange that the two sizes cannot be readily distinguished. Out of a very great number of small salmon caught here the largest was scarcely larger than the smallest taken at the same place six months before, which is the best evidence that none of those in the stream six months before remained through the high waters of winter. If they had remained until this time they would have been fifteen months old.

In Hazel Creek, a tributary of the Sacramento near Sims, I found, on November 6, 1897, two sizes of young salmon. The smaller size varied from 2.65 to 2.95 inches, with an average length of 2.87 inches; the larger size ran from 3.93 to 4.42 inches, with an average of 4.19 inches. The larger size greatly outnumbered those of the smaller size, and agreed well with the size of the salmon in the Sacramento at Sisson and at Sims. Of the smaller size only four were taken. Assuming that they had grown at the same rate as the others, they must have hatched from the egg early in August, and allowing three months for hatching, they were spawned early in May. There is nothing remarkable in the fact that salmon spawned here in few numbers at that time of year. The first salmon of the spring run have been observed passing

Baird on the McCloud in April, and they have been observed spawning in considerable numbers in the river above Baird early in May. Although the spring run does not reach its height at Baird until late in July, a good many salmon arrive earlier, and move farther up the river. The number of these irregular salmon is so small in comparison with those of the regular spring and fall runs that the fry resulting should not materially affect the two sizes of fry hatched by the spring and fall runs.

On May 17th of the following year, after the winter rains, Hazel Creek was again seined, and the largest salmon found was 2.82 inches, the smallest 1.53 inches, with an average length of 1.79 inches. It will be seen by comparing these figures with those of fish taken six months before that none of the salmon of the two sizes then found remained in the stream, and that the smaller size found on May 17th were hatched since that time from eggs deposited by the salmon of the fall run.

In the first week of September, 1897, I seined the lower end of Battle Creek thoroughly, and found young salmon in considerable numbers running from 3.08 to 4.58 inches, with an average length of 3.58 inches. The next time this part of the stream was seined, on December 5th, it was found that none of the salmon found three months before had remained in the stream, but that their places were taken by a new lot, averaging 2.39 inches. These salmon were spawned in the upper creek by the spring run, had absorbed their yolk sacs only two months before, and were already dropping down the river on their way to salt water.

At the United States and State hatchery on Battle Creek practically all of the fall run of salmon entering the stream were caught and their eggs taken. Five million of the fry hatched from these eggs were liberated in Battle Creek in February, 1898. They were liberated before they had begun to feed, but it was estimated that their yolk sacs would have been absorbed by the 10th or 15th of March. Mr. Cloud Rutter, of the United States Fish Commission, seined the lower Battle Creek on April 30th and found large numbers of salmon ranging from 1.40 to 3.45 inches, with an average length of 2.13 inches. This shows a gain of .45 of an inch per month in length. Although a large number of salmon were found in Battle Creek, they were not found nearly as abundant as they should have been had all the immense number liberated remained in the stream. A very large part of them had unquestionably drifted into and down the main river, and this within a month and a half of the time they began to swim about and feed after absorbing their yolk sacs.

On April 28th Mr. Rutter found young salmon in the main river at Red Bluff more abundant than he found them in Battle Creek two days later. These salmon ran from 1.51 to 3.09 inches, and had an average length of 2.16 inches. As they were found below the mouth of

Battle Creek, and their size coincided within .06 of an inch of those in Battle Creek, and in view of the fact that a larger number of the salmon in Battle Creek had moved out, we are justified in saying that they came out of Battle Creek.

On May 4th he found salmon abundant at Redding, ranging from 1.8 to 3.65 inches and averaging 2.38 inches. On May 5th at Tehama he found salmon ranging from 2.14 to 2.91 inches and averaging 2.53 inches.

Beginning with the second week in May the United States Commission carried their investigations into the lower Sacramento River and into Suisun and San Pablo bays. In the second week of May young salmon were found at Collinsville and at Benicia, but I have no record of their number, and of their size I only know that it corresponded with those found in the same place later in the same month.

On May 17th, six were found at Pinole, San Pablo Bay, ranging from 2.4 to 3 inches and with an average length of 2.6 inches. On the same day one was caught at Point Richmond, San Pablo Bay, 3.31 inches long. On May 18th, one was taken at Rodeo, San Pablo Bay, 2.4 inches long. On the 20th, 23d, and 24th, five were taken at Benicia, in the strait between Suisun and San Pablo bays, running from 2.06 to 2.56 and averaging 2.29 inches in length. On the 30th, three were taken at Rio Vista, in the lower Sacramento, running from 2.03 to 2.18 inches and averaging 2.08 inches. On June 10th, two were taken at Marshall's Landing, near Antioch, the largest being 3.3 and the smallest 2.12 inches in length.

If this small number of salmon taken in salt water represents, as it unquestionably does, the first big movement of young salmon out of the river, it at first appears that more of them should have been found, but when we consider the vast expanse of territory the lower Sacramento covers with its many channels and bayous, to say nothing of San Pablo and Suisun bays, it is not so strange that so few were found—in fact, the strange part of it is that so many were found—and we can realize the vast number that must have distributed themselves in these waters.

During the last two weeks of May I accompanied Mr. Rutter on a trip down the Sacramento in a row boat. Our object was to stop and seine the river at every available place, and learn the abundance, size, and movements of the young salmon. At Redding, on May 18th, we found the young salmon abundant, with an average length of 2.43 inches. At this place, two weeks before, their average length was 2.38 inches. At Red Bluff, on the 20th, we found no salmon whatever, although two weeks before they were very numerous. Just below Red Bluff we found a good many, their average length being 2.16 inches. From here to a point opposite Chico we found the salmon not so abundant. In a haul with our fifty-foot fine-meshed net we usually caught from twenty to

thirty. Below Chico this number fell off, and we caught only four or five in a haul. At a point two miles below Knights Landing the last salmon was caught, although we seined thoroughly between this point and Sacramento.

Below Red Bluff the salmon were very uniform in size, averaging 2.4 inches. It should be remembered that while we were making this trip small salmon of this same size were being caught in salt water. They were all hatched from the fall run of salmon, and it had been but a little over two months since they were old enough to feed. Their rate of growth after the absorption of the yolk sac was almost .5 of an inch per month.

Early in July Mr. Rutter again made the trip down the Sacramento, but was unable to find any salmon whatever below Battle Creek. The run of small salmon out of the river had ceased.

The conclusions to be drawn from these observations are: That immediately or very shortly after the salmon are old enough to feed and begin to swim about they begin to drift down the river, and within two months of this time they reach salt water. By the end of the fourth month the run is over, and those remaining in the headwaters of the river stay until the high waters of the following winter. The number of these thus remaining is small compared with the number running out immediately.

The rate of growth of the salmon during the first two months after absorbing the yolk sac, taken from an average of all the salmon taken on the Sacramento, was .42 of an inch per month. Those remaining after two months do not grow so fast. Salmon from four to eight months old show an average gain per month of a little over .30 of an inch.

IN THE MATTER OF DUMPING SAWDUST INTO TRUCKEE RIVER.

(116 Cal. Rep. 397. See No. 209, Department One. April 3, 1897.)

**THE PEOPLE, ETC., *Respondent*, vs. THE TRUCKEE LUMBER
COMPANY, *Appellant*.**

FISH—OWNERSHIP OF STATE—TITLE TO LANDS IMMATERIAL. The fish within the waters of the State constitute the most important constituent of that species of property commonly designated as wild game, the general right and ownership of which is in the people of the State; and to the extent that waters are the common passageway for fish, whether such waters flow over lands, the title of which is in the government of the State or the United States, or over lands entirely subject to private ownership, they are deemed for such purposes public waters, and subject to all laws of the State regulating the right of fishery.

ID.—EXTENT OF STATE'S DOMINION—NON-NAVIGABLE WATERS—RESORT AND PASSAGE OF FISH. The dominion of the State, for the purpose of protecting its sovereign rights in the fish within its waters, is not confined to navigable waters, but extends to non-navigable streams, wherein fish are habited or accustomed to resort for spawning or other purposes, and through which they have freedom of passage to and from the public fishing grounds of the State.

ID.—JUDICIAL NOTICE—NON-NAVIGABLE STREAM CONNECTING NAVIGABLE LAKES—TRUCKEE RIVER—PASSAGEWAY OF FISH. The Court will take judicial notice that the Truckee River, though a non-navigable stream, has its source in Lake Tahoe, a large navigable body of water lying partly in this State, and that it empties into Pyramid Lake, in the State of Nevada, which is also navigable; and that the river has from time immemorial afforded a natural and free passageway for the passage of fish habiting those lakes.

ID.—INJURY TO FISH—POLLUTION OF TRUCKEE RIVER—REFUSE FROM SAWMILL—PUBLIC NUISANCE—INJUNCTION—ACTION BY STATE. The pollution of the Truckee River by refuse matter which is poisonous and deleterious to the fish therein, and which is deposited from a sawmill operated on its bank, to the injury and destruction of the fish in the stream, is a public nuisance, which may be enjoined in an action brought by the Attorney-General in the name of the State.

ID.—REMEDY—PUNISHMENT BY PENAL CODE NOT EXCLUSIVE. The fact that the acts complained of are made a misdemeanor, and punishable as such, does not make them less a nuisance, nor imply that the Legislature intended to make the criminal remedy exclusive of the civil.

ID.—RELATOR—INFORMATION BY ATTORNEY-GENERAL. The Attorney-General is privileged to maintain an action to enjoin a public nuisance on his information, without the intervention of a private relator.

Appeal from an order of the Superior Court of Nevada County, refusing to vacate an injunction. John Caldwell, Judge.

The facts are stated in the opinion of the Court.

- Thomas S. Ford and C. F. McGlashan for appellant.

Attorney-General W. F. Fitzgerald and Deputy Attorney-General Henry E. Carter for respondent.

VAN FLEET, J. Appeal from an order refusing to vacate an injunction.

The action is in the name of the people, on the information of the Attorney-General, to restrain the commission of an alleged nuisance, the complaint alleging in substance that defendant, a corporation, maintains and operates a sawmill and box factory on the bank of the Truckee River, at the town of Truckee, in this State, in which it cuts and manufactures lumber and boxes; that said river is a fresh-water stream, having its source in the State of California, and flowing into the State of Nevada, and is now, and for a long time prior hereto has been stocked with fish; that defendant in operating its mill and factory has heretofore, and does now, place and allow to pass into the waters of said river large quantities of refuse matter, consisting of sawdust, shavings, slabs, edgings, waste, and other deleterious substances, the effect of which has been and is to pollute said stream and the waters thereof, and render the same unfit for use, and which substances are poisonous and deleterious to the fish in said stream, and are killing, destroying, and exterminating them; all of which is alleged to be in violation of the rights of the people, and a public nuisance; that defendant threatens, and unless restrained will continue to commit said wrongful acts to plaintiff's irreparable injury.

A preliminary injunction was granted *ex parte* on the filing of the complaint, which defendant subsequently moved to vacate. The motion was made upon the complaint alone, based upon the objection that the facts alleged made no case for relief. The motion being denied, this appeal ensued.

The sole question is whether the complaint states a cause of action, and this is to be determined precisely as if the pleading were subjected to a general demurrer.

The first point made against the complaint is that the facts alleged do not constitute a public nuisance within the definition of our code. But this objection would seem to overlook the most material feature of the complaint. It is alleged that the acts of defendant have the effect of polluting and poisoning the waters of the river, and thereby killing and destroying the fish therein. Anything which is "an obstruction to the free use of property so as to interfere with the comfortable enjoyment of life or property by an entire community or neighborhood, or any considerable number of persons," is a public nuisance. (Pen. Code, Sec. 370; Civ. Code, Secs. 3479, 3480.) The fish within our waters constitute the most important constituent of that species of property commonly designated as wild game, the general right and ownership of which is in the people of the State (*Ex parte Maier*, 103 Cal. 476, 483; 42 Am. St. Rep. 129), as in England it was in the king; and the right and power to protect and preserve such property for the common use

and benefit is one of the recognized prerogatives of the sovereign, coming to us from the common law, and preserved and expressly provided for by the statutes of this and every other State of the Union. The complaint shows that by the repeated and continuing acts of defendant this public property right is being and will continue to be greatly interfered with and impaired; and that such acts constitute a nuisance, both under our statute and at common law, is not open to serious question. (*People vs. Elk River etc. Co.*, 107 Cal. 219; 48 Am. St. Rep. 121.)

But defendant urges that the facts do not show the infringement of any public right, in that the right, if any, shown to be interfered with is solely that of fishery, or the privilege to take fish; that this is a public right only so far as it pertains to navigable waters, while as to all other waters it is exclusively in the riparian proprietor; that, as the Truckee River is not a navigable stream, the destruction of the fish therein is not an injury to the public for which the people can complain, there being no allegation that the riparian proprietors thereon have been injured.

In the first place, the common right to take fish extends not alone to navigable waters, but exists as to all waters, the lands underlying which are not in private ownership—in other words, to all lakes, ponds, or streams, navigable or otherwise, upon the public lands of this State or the United States not protected by reservation; and since there is no averment that the lands along the Truckee River are held in private proprietorship, we think the presumption must be that the title remains in the Government.

But, in the next place, if this is not the presumption, the case would not be different. The dominion of the State for the purposes of protecting its sovereign rights in the fish within its waters, and their preservation for the common enjoyment of its citizens, is not confined within the narrow limits suggested by defendant's argument. It is not restricted to their protection only when found within what may in strictness be held to be navigable or otherwise public waters. It extends to all waters within the State, public or private, wherein these animals are habited or accustomed to resort for spawning or other purposes, and through which they have freedom of passage to and from the public fishing grounds of the State. To the extent that waters are the common passageway for fish, although flowing over lands entirely subject to private ownership, they are deemed for such purposes public waters, and subject to all laws of the State regulating the right of fishery. (*Cottrill vs. Myrick*, 12 Me. 222; *State vs. Franklin Falls Co.*, 49 N. H. 240, 6 Am. Rep. 513; *State vs. Roberts*, 59 N. H. 256, 47 Am. Rep. 199, 59 N. H. 484.)

For the purposes of the right involved in this action, then, the Truckee River, so far as it flows within this State, is a part of the waters to which the jurisdiction of the State in the protection of its fish supply

extends. This Court will take judicial cognizance of the fact that the river has its source in Lake Tahoe, a large navigable body of water lying partly in this State, and that it flows thence into the State of Nevada, and empties into Pyramid Lake, also navigable; and the Court may also take notice of a fact so common and notorious that between these two bodies of water the river affords, and has from time immemorial, a natural and free highway for the passage of the fish inhabiting these lakes. Even, therefore, if, as contended by defendant, the lands through which the stream flows are to be presumed, in the absence of contrary averment, to be owned in private proprietorship, it can make no difference as to the right here asserted. While the right of fishery upon his own land is exclusively in the riparian proprietor, this does not imply or carry the right to destroy what he does not take. He does not own the fish in the stream. His right of property attaches only to those he reduces to actual possession, and he cannot lawfully kill or obstruct the free passage of those not taken. "This right in the owner of the land must be regarded as qualified to a certain extent by the universal principle that all property is held subject to those general regulations which are necessary to the common good and general welfare, and to that extent it is subject to legislative control. It is a well-established principle that every person shall so use and enjoy his own property, however absolute and unqualified his title, that his use of it shall not be injurious to the equal enjoyment of others having an equal right to the enjoyment of their property, nor injurious to the rights of the public. Hence, while the riparian owner has the exclusive right of fishery upon his own land, he must so exercise that right as not to injure others in the enjoyment of a similar right upon their lands upon the stream above and below." (*State vs. Roberts, supra.*)

The mere fact, then, that the interference or obstruction complained of may in fact be in a stream where the right of fishery is exclusively in private riparian owners, does not make the acts here complained of any less an invasion of the public right, nor prevent the State from protecting its general interest in the property.

The fact that acts of the character alleged are by the Penal Code made a misdemeanor, and punishable as such, does not make them less a nuisance, nor imply that the Legislature intended to make the criminal remedy exclusive of the civil.

Nor is there anything in the objection that the Attorney-General is not privileged to maintain the action upon his own information, without the intervention of a private relator. (*People vs. Davidson*, 30 Cal. 388; *People vs. Stratton*, 25 Cal. 242; *People vs. Gold Run, etc. Co.*, 66 Cal. 138, 56 Am. Rep. 80.)

The other objections made do not call for particular notice.

Order affirmed.

HARRISON, J., and BEATTY, C. J., concurred.

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