

18.—NOTES ON A RECONNOISSANCE OF THE FISHERIES OF THE PACIFIC COAST OF THE UNITED STATES IN 1894.

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NARRATIVE OF THE TRIP.

Under date of May 8, 1894, I was directed by the Hon. Marshall McDonald, U. S. Commissioner of Fish and Fisheries, to proceed to the Pacific coast "for the purpose of making a study of the apparatus and methods of the fisheries of that region." I was instructed to make observations on the condition of the salmon industry of the different sections that it was deemed advisable to visit; to consider the development of the market fishery and the sardine industry; to investigate the history, growth, and present extent of the sturgeon fishery of the Columbia River; and to look into any other branches of the fisheries that possessed special interest. I was directed to give particular attention to the shad, the striped bass, the black bass, the catfish, the carp, and the eel, which have been artificially introduced from the east, especially observing their distribution, size, commercial importance, and food value.

I was ordered to leave Washington on or about May 16, and to return not later than July 10. Pursuant to these instructions, I left Washington May 18 and arrived at San Francisco May 24. Ten days were spent in that city, devoted chiefly to an inspection of the fish and other water products exposed for sale in the markets; to visits to the fishermen's wharf where the catch is discharged, the nets are dried, and the boats are moored; and to an examination of the books of the wholesale dealers for the years 1893 and 1894 for the purpose of taking off an account of all shad, striped bass, carp, and catfish handled. The American Union Fish Company, A. Paladini, G. Camilloni, and J. H. Kessing very obligingly permitted this examination of their records when the object of the inquiry was made known, and are entitled to the thanks of the Commission for this and other courtesies shown. Several other dealers whom it was not possible for me to visit, owing to the short time available, later gave to representatives of the California Fish Commission figures similar to those furnished to me, copies of which were forwarded to this Commission by the California Commission.

On June 2, I went from San Francisco to Los Angeles and San Pedro, chiefly in order to examine the sardine industry centering at the latter place and to interview the proprietors of the cannery, who had offices in Los Angeles. Through the courtesy of Mr. A. P. Halfhill, vice-president of the canning company, who, in San Francisco, had given me a letter of introduction to the superintendent of the cannery, I was enabled to make a very satisfactory examination of the methods of this new, interesting, and important branch of the fisheries during the two days passed in this part of the State. I returned to San Francisco June 6.

At the invitation of Mr. John P. Babcock, chief deputy of the California Fish Commission, I accompanied him and Mr. Wilson, of the fishery protective force, on an official trip in the commission's launch, to the important fishery districts lying between San Francisco and the upper part of the delta of the Sacramento and San Joaquin rivers. I left San Francisco on June 8 and returned June 10, passing the whole of the intervening time in a very interesting and helpful sojourn in the waters named.

The route from San Francisco lay north, past the fishing station of Messrs. Lynde and Hough, in Marin County, and the Chinese fishing-camps, in Marin and Contra Costa counties. San Pablo Bay, Carquinez Strait, and Suisun Bay were then traversed, all of these being important fishing-grounds for salmon, shad, and striped bass. Late in the evening the San Joaquin River was entered and a stop was made for the night at Antioch. Next day a short visit was first paid to Collinsville, on the Sacramento River, where I attended the trial of some gill-net fishermen arrested for violation of the State law prohibiting the setting of gill nets so as to obstruct more than one-third the width of a stream. Although the evidence of an infraction of the law was indisputable, the jury failed to convict, being evidently impressed with the recent decision of a local justice that the law is ambiguous and that the words "more than one-third across the width" of a river may involve the distance between two remotely distant points on opposite sides of the river! During the remainder of the day, the launch cruised through the numerous sloughs intersecting the interesting tule lands of the delta of the Sacramento and San Joaquin rivers, these being the favorite spawning-grounds for shad and striped bass, as well as important fishing-grounds for them and salmon. The forenoon of the following day was spent in the same region, and in the afternoon I returned to San Francisco.

A visit occupying parts of two days (June 12 and 13) was made to Monterey and Pacific Grove from San Francisco. Monterey Bay represents the southern limit of the distribution of the salmon, shad, and striped bass, and is additionally interesting because of the Chinese and other important fisheries there carried on. At El Monte, Mr. B. C. Winston has shown commendable enterprise in bringing together and arranging for exhibition a magnificent mounted collection of the marine algae of the Pacific coast which has been admired by students of this branch of botany. Mr. Winston has also arranged in a large private exhibition hall many of the rarer and more attractive fishes of that part of the Pacific coast, including sharks, skates, and other large species.

At Pacific Grove, situated at the southern side of the entrance to Monterey Bay, the summer biological school of the Leland Stanford Junior University has been established. This, at the time of my visit, was in charge of Dr. Oliver P. Jenkins, the professor of physiology in the university, by whom the purposes and plans of the school were courteously explained. This is generally conceded to be the best site on the west coast for a biological laboratory. It is located somewhat like Woods Holl with respect to the distribution of the fauna of the northern and southern parts of the coast. The buildings are placed on a rocky bluff at the extremity of the point of land marking the division between the ocean and Monterey Bay. On the rocks at the very doors of the laboratory anemones, echini, mollusks, and other invertebrates can be gathered without the use of apparatus, while the water in the immediate vicinity teems with a great variety of fish and other marine forms of animal life. I was informed by Dr. Jenkins that the university authorities are very desirous that the U. S. Fish Commission shall be represented at the laboratory. There are certainly

many scientific problems affecting the commercial fisheries of the west coast which could here be studied to great advantage.

On June 13 I left San Francisco for Portland, Oreg., where I arrived June 15, and where the three following days were passed in interviewing persons interested in the salmon industry.

While at Portland a day (June 16) was occupied in a visit to the U. S. Fish Commission station on the Clackamas River and to the falls of Willamette River at Oregon City. Both streams were high and muddy. A close personal inspection of the falls disclosed the presence of a large number of salmon immediately below the cascades, although no fish were observed in the act of ascending the falls. The rocks over which the water was breaking and at the sides of the falls were literally covered with lampreys (*Entosphenus tridentatus*) endeavoring to reach the headwaters of the river.

From Portland it was my intention to visit the Cascades and The Dalles, but this had to be abandoned, owing to the high floods, which had caused a discontinuance of fishing, had entirely suspended railroad communication with the upper Columbia, and had rendered water transportation uncertain. This state of affairs made it possible to study the fisheries of only the lower river, which were but little affected by the high water.

Portland was left on June 19 and Astoria was reached on the next day. The three following days were occupied in examination of the canneries and fisheries of that place and vicinity.

My inspection of the important fisheries of the lower Columbia River was greatly aided by Mr. M. J. Kinney, of Astoria, who, in addition to other courtesies, extended the use of his steam launch for a visit to the pound-net and seining grounds at Sand Island and in Baker Bay, thus permitting a closer and more satisfactory study of the conditions than would have otherwise been possible.

I returned to Portland on June 24 and left the next day for Washington, D. C., where I arrived July 2.

GENERAL REMARKS ON THE WEST COAST FISHERIES.

The general commercial fisheries of the Pacific States are of more recent origin than those of any other coast section of the country, and, with the exception of the salmon fishery, they are less developed than those of any other region. It is true that some branches of the fisheries were established before the acquisition of the territory by the United States, but it was only at a comparatively recent date that the taking of the salmon for commercial purposes began, while the utilization of most other fishery resources has had a much later origin. Nevertheless, in the period of thirty years, during which it may be said the fisheries of the west coast have existed, the industry has attained great importance and now ranks next to that of the New England and Middle Atlantic States in extent and value. There seems no reason to doubt that the business will assume vastly greater proportions in the near future, although there is cause to apprehend a decline in several important branches, as, for instance, the salmon, the whale, the fur-seal, and the sea-otter fisheries.

The various phases of the fishing industry of the west coast, including Alaska, give employment to about 17,000 persons, the capital invested amounts to about \$8,900,000, and the annual value to the fishermen of the products taken is approximately \$7,300,000.

The special fisheries which give this region much of the prominence it possesses are the salmon, the whale, the oyster, the fur-seal, the shrimp, the cod, the crab, and the herring, in the order named. The value of the salmon fishery is about equal to that of all other fisheries combined, while the canning industry connected with the fishery has an annual output but little less in value than that of all the fishery products of the coast. The salmon are by far the most important fishes or fishery products of Alaska, Oregon, and Washington, but in the fisheries of California they are surpassed by whales, oysters, and shrimps.

A conspicuous feature of the fisheries of California is the entire absence of pound nets, trap nets, weirs, and other similar fixed devices. While it is true that a few fyke nets are employed in the Sacramento-San Joaquin delta, their use is so restricted and their importance so slight that they may be dismissed from consideration. The absence of this class of nets, which are such prominent factors in the fisheries of the other States of this region, is owing wholly to legislation. The State has shown a disinclination to permit the use of such appliances, and no very determined efforts have been made by commercial fishermen to secure the repeal of the existing prohibitive law. While the setting of fyke nets is enjoined, the law is not strictly enforced, for the reason that in the opinion of the State Fish Commission the obvious purpose of the act was to prevent the destruction of desirable food-fish, and especially immature fishes; whereas the few nets employed are set in such situations and under such conditions that only fishes generally regarded as worthless, or nearly so, are or can be taken.

In no other region in the United States are the people more generally impressed with the beneficial results of artificial propagation and more ready to aid and approve any fish-cultural measures that are properly recommended. While the results of salmon-culture have in some places been marked and are readily acknowledged by fishermen and others, this alone is not sufficient to account for the widespread advocacy of fish-culture which exists among all classes and in all parts of the Pacific coast. We must look further for the cause. There seems little reason to doubt that to the marvelous success of shad and striped bass acclimatization on the west coast must be attributed the firm belief in fish-cultural work that pervades all localities in which fish is an article of food or an object of capture. One or both of these new species are well known in almost every accessible coast settlement in the three States, and they are an enduring testimony to the influence of man over fish production.

As may be readily understood, the time available for the inspection of the fisheries of the west coast was so short as to preclude a complete study of the subject, and it was necessary to restrict the inquiry to those places which afforded the best opportunity to see the greatest variety of fish and fishing in the shortest time, and to those fisheries possessing the greatest interest and importance.

The chief object of the visit to the Pacific Coast was to give the writer a proper conception of the principal phases of the commercial fisheries there carried on, in order to better equip him for the administration of the affairs of the division under his charge. A great many memoranda were made on the various aspects of different branches of the fishing industry, of which the following notes form a part. Much of personal interest to the writer that was noted, however, would not have sufficient importance to deserve mention in this report.

The notes herewith presented cover only a few of the fisheries of the west coast, and mostly relate to only a few of the phases of those branches which are considered. They represent the personal observations and researches of the writer, and are

selected for incorporation in this report because some of the topics discussed are now the subjects of much attention in the Pacific States, while others have not before been considered and are legitimate news outside of circumscribed geographical limits.

A special object in view in visiting this region was an investigation of the fisheries for shad, striped bass, black bass, catfish, carp, and eel, which have been artificially introduced. A discussion of this important subject, to which much attention was devoted, is, by permission, reserved for a separate report.

SARDINES, ANCHOVIES, AND SARDINE-CANNING.

Notes on the sardine and anchovy of the Pacific coast.—The California sardine (*Clupea sagax*) is very closely related to the sardine of Europe (*C. pilchardus*), from which it chiefly differs in having no teeth and less strongly serrated scales on the belly. It attains a length of nearly a foot. It is found along the entire Pacific coast of the United States. The fish is, however, most constant in appearance and most abundant on the southern part of the coast, and it is doubtful if it exists in sufficient numbers to maintain a regular fishery north of San Francisco. Even at that place the supply is uncertain. While there have been periods of years in which the sardines were found in San Francisco Bay in large quantities, and for a considerable time in each season, for the past five years they have been very scarce.

The distribution of the anchovy (*Stolephorus ringens*) is similar to that of the sardine. It occurs in abundance along the entire coast, and is often found in enormous quantities in Puget Sound, San Francisco Bay, and elsewhere. It reaches a maximum size of about 7 inches. In most places it is known as the anchovy, but in Puget Sound, according to Swan, it is called "sardine."

Prospects and desiderata for sardine-canning.—With the exception of salmon, practically no attention has been given to the canning of fish on the Pacific coast. The packing of salmon has up to this time absorbed nearly all the interest in fish prepared in this way. The question of canning other kinds of fish has, however, been considered; the prospects for the inauguration of profitable work of this kind have been discussed, and, as will hereafter be shown, several factories for the canning of small fish have been built.

The natural advantages which the west coast possesses for the canning of sardines and other similar fish are unusually good, and are superior in some respects to those of the east coast. At least the two fishes named, the sardine and the anchovy, suitable for canning as "sardines," occur in large quantities, the first-named very closely resembling and being an excellent substitute for the sardine of southern Europe. The dry atmosphere and other climatic conditions of the southern coast of California are very favorable for the preparation of a good grade of canned fish. The culture of the olive supplies a native oil of superior quality, which is essential in the canning of the best goods. Another item of importance to canners in this connection is the abundance of cheap labor.

The chief desideratum in the establishment of a factory for the canning of sardines (and other similar fish) is a regular supply of fish during a certain period. This is thought to be of greater importance than an abundance of fish at uncertain or irregular intervals.

While the sardine ranges along the whole western coast of the United States, and is at times very abundant even as far north as Puget Sound, it is doubtful if in Washington or Oregon a supply sufficiently large and regular exists to warrant the

outlay for a cannery. Some years ago, the establishment of a factory for the utilization of sardines was contemplated at the mouth of the Columbia, where, during a brief period in each year, sardines may usually be taken in abundance; but the shortness of the season deterred the consummation of the plan. It is possible that within a few years the canning of sardines may be undertaken in connection with the packing of salmon at a few places on the more northern parts of the west coast, where there is a short run of sardines that can be utilized without the necessity for expensive special machinery, etc. This matter has already received the consideration of some salmon-canners; but the general canning of sardines by salmon-packers is not anticipated so long as the supply of salmon lasts.

Personal observation and inquiry, the testimony of fishermen and dealers, and the studies of ichthyologists afford ground for the belief that the successful operation of a sardine cannery can not be expected any farther north than San Francisco, and the history of the industry at that place seems to indicate that the northern limit of satisfactory work is even farther south. South of San Francisco the prospects of a profitable business appear to be in direct relation to the latitude; the more southern the location of the cannery the more constant and abundant the supply of fish.

It is probable that at some places on the coast, more especially to the northward, the conditions for the successful canning of anchovies are very good. In a paper presented to the World's Fisheries Congress at Chicago, entitled "Notes on the fisheries and fishery industries of Puget Sound,"* Mr. James G. Swan devotes a chapter to the sardine (i. e., anchovy) fishery of that region, and mentions the advantages which the sound possesses for the establishment of a canning industry. Writing of the anchovy, he says:

When taken in Monterey or San Diego bays, it is only fit for bait; but in Puget Sound, which is its northern limit, it is in perfection, and is one of the fattest and most deliciously flavored of the small fish, and is considered by experts to be far superior, in point of flavor and richness, to the best Mediterranean sardine. Some Norwegian and Russian fishermen here have put them up, in limited quantities, in vinegar and spice, and they are delicious and sell readily; but the men who attempted the enterprise are without capital, and there has been no one with executive ability to push the business forward to a success. The anchovy come to Puget Sound in enormous quantities, and during their season, from May to November, every bay and inlet is crowded with them. When they first come from the ocean they appear in Clallam Bay, on Fuca Strait; then in Port Angeles, Dungeness, and Sequin bays; then in Port Discovery, and next in Port Townsend and Scow bays, where their numbers are almost incredible. I have known them to be in such masses at Port Hadlock, at the head of Port Townsend Bay, that they could be dipped up with a common water bucket, but as there has been no demand for them the fishermen do not consider them of value, and when hauling their nets for smelt they generally let the anchovy escape. The anchovy differ from herring in one respect—the herring, when they visit the bays, keep inshore and are easily caught in seines and landed on the beach; anchovies, on the contrary, keep out in deep water and seldom approach the shore, so that drag seines are of no use to capture them. They can be best taken with purse seines, as mackerel are taken in the Atlantic. As these fish are small, not much over 6 or 7 inches in length, they require a net with a small mesh, and with suitable gear an enormous quantity can be secured.

Sardine-canning at San Francisco.—In June, 1889, a canning factory was established in San Francisco, which continued in operation until August, 1893. During the five years in which the cannery was run the yearly pack was from 5,000 to 15,000 cases.

The canned fish consisted chiefly of anchovies in oil in quarter-pound cans and large sardines in 1-pound and 2-pound round cans. The fish consumed at the factory were caught in San Francisco Bay with haul seines. In the earlier years sardines

* Bulletin U. S. Fish Commission 1893, article 42, pp. 371-380.

small enough for use in quarter-pound cans were obtained, but during the last two years of the cannery's existence no sardines of size suitable for "quarter oils" could be had. This was the chief reason for closing the works.

Sardine fishing and canning at San Pedro.—In June I made a visit to a sardine cannery at San Pedro, in Los Angeles County, which had been established in December, 1893, and is now the only cannery of the kind on the west coast. Sardine-canning is a part of the business of the California Fish Company, of Los Angeles. Through the courtesy of the officers of the company I was enabled to inspect the factory, obtain full knowledge regarding the methods pursued, and gain much valuable information relating to the fishery carried on for supplying the raw material to the cannery.

Fishing for the San Pedro cannery is carried on by a vessel of 22 tons' burden, the motive power of which is furnished by gasoline. The engine has 24-horse power, which is produced by the hourly consumption of one dollar's worth of gasoline. The vessel is sloop-rigged, and when on the fishing-grounds jogs along under sail while looking for fish. Its value is \$5,000. Seven men constitute the crew, including a cook.

The vessel carries two purse seines, one of which is used for sardines, the other for mackerel; it is by this apparatus that all the fish are taken. A seine boat and a tender form a part of the equipment. The sardine seine is 120 fathoms long, 50 feet deep, and has a 1-inch (stretch) mesh; its value is about \$800.

The fishing-grounds resorted to by the vessel are San Pedro Bay, off Redondo Beach, and around the Catalina Islands. The last named are the best grounds, and fish are there often found in large quantities close inshore in sheltered places.

After the sardines are pursued up in the seine they are bailed into the vessel by means of a hand windlass. They are not dumped in the hold, but are retained on deck by means of a gunwale 12 to 16 inches high. Pending their discharge at the cannery a little salt is spread over them.

The lay on the vessel is as follows: The owners furnish provisions, fuel, apparatus, etc., and meet all running expenses, and pay 1 cent a pound for the fish delivered at the cannery. The captain and cook are paid salaries of \$20 and \$15 per month, respectively, and the value of the fish is divided among the entire crew. The vessel, however, draws half the share, so that the price actually paid for the fish is one-half cent a pound. In May, 1894, the crew shared about \$75 each.

In this region sardines are found throughout the year. They "show" at the surface at times, and thus permit the use of the purse seine. They sometimes go in immense schools. Single hauls of several tons are often made, and 10 tons have on several occasions been taken at a single set of the seine, such a catch being obtained about May 1, 1894. In December, 1893, several very large bodies of sardines were observed, and a haul of 10 tons of small-sized fish was taken. From January to June the fish appear to gradually increase in numbers. Some schools are made up of fish of uniform size, while in others they are mixed. The smallest fish caught are 4 inches long, the largest 12 inches, the average 7 inches.

The condition of the fish as regards fatness varies considerably with the season. Mr. J. H. Lapham, the president of the fish company operating the cannery, states that in December, 1893, when the canning began, the smaller fish were poor while the larger ones were fat. In January and February the conditions were about the same. In March the smaller fish began to improve, continued to grow fatter through April and May, and in June sardines in excellent condition suitable for "quarters oils" were taken. In May, 4 or 5 tons of large fish that were very poor were seined on one occa-

sion. The factory is under the superintendence of an experienced fish-canner from Maine. It is a large two-story structure, with a salting house attached. The plant is worth about \$10,000.

The principal processes to which the sardines are subjected before emerging as the canned product are as follows: When the fish are unloaded from the vessel they are received into a large, airy room, where the cutting and washing are done, and then transferred to the second floor by means of an elevator. There they are next arranged on latticed trays (32 inches square) and dried. If the weather is fair and the atmosphere dry the drying is done in the open air, occupying, as a rule, about two and a half hours. On rainy days, or when the air is especially humid, drying is accomplished inside the building by means of steam, which requires about ten hours.

After drying the fish are placed in wire baskets (22 inches long, 18 inches wide, 3 inches deep) and immersed in boiling oil for two to six minutes, depending on their size. The oil is contained in a shallow sink, into which the wire baskets fit and are lowered and raised by means of long wire handles. The boiling of the oil is done by means of a steam pipe entering at the side and running under the sink. After draining and thoroughly cooling the fish go to the packers, thence to the sealers, thence to the bathmen, and, after cooling and testing for leaks, to the boxing room.

The cutting of the fish is done by men and girls, the average number of whom employed is 25. They are paid by the basket or the bucket of cut fish, and by working steadily earn about 25 cents an hour. The flakers number 12 to 14, and are the same girls who pack the fish in the cans. Ten men act as sealers and can-makers, and 10 others are employed in the remaining branches of the work.

The sizes and grades of canned sardines placed on the market from this cannery, and the wholesale prices received, are as follows: Quarter oils, 100 cans to a case, \$6.50 to \$8.50 per case, according to the quality of the oil; half oils, 50 cans in a case, \$5.60 per case; 2-pound oval cans, with mustard, spices, and tomato sauce, \$2.25 per dozen cans.

BARRACUDA.

One of the most useful and valuable food-fishes of the California coast is the barracuda (*Sphyrana argentea*). Not only is it a favorite article of food when eaten in a fresh condition, but it is one of the best fish for salting found on the west coast. The normal range of the fish on the coast of the United States is from San Francisco to the Mexican border. It is, however, not generally abundant north of Monterey, and it is a noteworthy feature in the fisheries of only Santa Barbara, Los Angeles, and San Diego counties, in which over nineteen-twentieths of the catch is taken.

There is an active demand for fresh barracuda in the markets of California, and in San Francisco it ranks as one of the choicest fishes.

The annual catch is between 600,000 and 700,000 pounds, of which over 100,000 pounds are salted. The fresh fish yield the fisherman 3 to 5 cents a pound and the salt fish bring 3 to 4 cents a pound. The average wholesale price of the fresh fish in San Francisco is 7 or 8 cents a pound, or two or three times that of chinook salmon.

When properly salted the barracuda presents a very inviting appearance, and is justly regarded as one of the most palatable of fishes that are preserved in this way. It should be, and generally is, split down the belly like codfish. The silvery color of the skin is more or less persistent in salt, and the flesh retains its attractive white character. The largest quantities are salted in San Diego County.

In the spring of 1893 a singular phenomenon attended the appearance of the bar-

racuda on the coast of Los Angeles County. It is thus described in a letter to the Fish Commission from Mr. John L. Griffin, of Los Angeles, dated March 2, 1894:

Barracuda put in an appearance one month earlier than ever before. They came in immense quantities and something happened to them. Thousands came ashore dead, while the water was full of fish that seemed dazed, swimming about with their heads out of water. Among them were some halibut, yellowtails, and some other fish, but they were principally barracuda. All kinds of theories have been advanced; one that fishermen had used dynamite bombs; another that it was caused by volcanic disturbances from the bottom; another that the fish coming from tropical waters became chilled; then another, which the newspapers put forth much to the disadvantage of fishermen and fish-dealers, that it was disease, and there has been a great falling off in the consumption of fish in consequence.

The most plausible explanation of the phenomenon was that there was an unusually active eruption of the submarine oil springs off this coast, and that the fish were asphyxiated by having their gills coated with the oil.

MACKEREL AND MACKEREL-CANNING.

In connection with the capture and canning of sardines at San Pedro, a species of carangoid fish (*Trachurus picturatus*) is taken and utilized to some extent for canning and salting. At San Pedro it is known as "Spanish mackerel"; at other places on the coast it is called "horse mackerel." Dr. Jordan remarks of this fish:

It ranges from Monterey southward to Chile, appearing in California in the summer, remaining in the spawning season, and disappearing before December. It arrives at Santa Barbara in July and at Monterey in August. In late summer it is exceedingly abundant. It forms part of the food of larger fishes, and great numbers are salted for bait. As a food-fish it is held in low esteem, but whether this is due entirely to its small size we do not know. It is identical with the well-known Mediterranean species.

At San Pedro these fish are taken in the small steam vessel used for sardine fishing. A special purse seine, 135 fathoms long and 100 feet deep, with a 2-inch mesh, is used. The fish are caught in San Pedro Bay and around the Catalina Islands. They go in schools of varying sizes. Some large hauls are made; thus, in the fall of 1893, 150 barrels were taken at one set near the Catalina Islands.

The fish caught are mostly of small size. According to the statements of the gentlemen connected with the California Fish Company, the largest taken in their seine are 12 or 14 inches long, the smallest are about 6 inches, and the average length is about 9 inches. The smallest fish are packed in oil in half-pound square cans and in mustard, tomato sauce, and souse in 2-pound oval cans. The fish too large for canning are salted. They are never fat, however, and do not make a high grade of salt fish.

Another species of mackerel, the chub or bull's-eye mackerel (*Scomber colias*), occurs at San Pedro and is utilized to a small extent for canning and salting, as well as being sold fresh. It is there called the "steelhead mackerel." The head is said by the fishermen to be very hard, and in splitting the fish for salting an extra cut of the knife is required to divide the head. The fish is also sometimes designated as the "horse mackerel" in Los Angeles County. It reaches a weight of 3 or 4 pounds, but its average weight is only 2. The flavor and coarseness of the flesh of this fish make it undesirable for canning. Up to the present time, no first-class salt fish of this species have been prepared. The lack of oil in the flesh and the tendency of the latter to assume a dark color are serious drawbacks to the packing of an acceptable salt mackerel.

In the San Francisco market this fish is known as "mackerel," and ranks as a first-class food-fish. The supply is limited, and comes entirely from the southern part of the State. During the early part of June a few boxes of these fish were received by San Francisco dealers, but the bulk of the receipts comes later. The fish examined were of uniform size, having a length of about 16 inches.

THE SALMON INDUSTRY.

CALIFORNIA.

General importance.—Salmon are the most important fish of California, and their capture and utilization constitute one of the most prominent industries of the State. Among all the fishery products of the State, salmon are surpassed in value only by oysters, whales, and shrimps. All the species of salmon found on the west coast occur in the waters of the State in the proper seasons, but the most abundant, generally distributed, and important is the chinook or quinnat salmon (*Oncorhynchus chowicha*). While considerable quantities of salmon are taken each year in Eel River in Humboldt County, and in Smith and Klamath rivers in Del Norte County, the fishing-grounds which give to the salmon fishery the prominence it has attained are the Sacramento River, and Suisun, San Pablo, and San Francisco bays; of these the principal ground is the Sacramento River in Contra Costa and Solano counties.

Salmon in the Sacramento River.—The salmon taken in the important fisheries of the lower Sacramento River are either shipped fresh to market or are sold to the canneries located at Benicia, Black Diamond, and Chipps Island. In the quantity and value of the salmon output, the Sacramento ranks next to the Columbia among the rivers of this coast.

The spring run of chinook salmon in this stream usually begins about the middle of April and continues until the middle of May. In 1894, however, the run began earlier and kept up longer than usual; fish were landed at the canneries on April 4, and the supply lasted into June. As late as May 28 the run was very large, over 1,050 salmon being received at one cannery on that date as a result of only half a day's fishing. At the beginning of the season the run was light, and it was predicted that the catch would be smaller than last year, but afterwards the supply increased, and the close of the season witnessed a larger production than for five years.

The weekly close season from Saturday noon to Sunday midnight is generally observed and vigorously enforced, and is, without doubt, one of the most beneficial regulations affecting the fisheries of the State. The concentration of the fisheries in the proximity of the canneries permits a very large proportion of the fish that ascend the river on Saturday and Sunday to escape capture and molestation and to reach the headwaters of the Sacramento or its tributaries.

There seems no evidence of any improvement in the salmon fishery of the San Joaquin River. The physical conditions appear very unfavorable and distasteful to the migrating salmon. According to the reports of fishermen and members of the California Fish Commission, nearly all the fish which begin the ascent of the San Joaquin are diverted when they reach the Georgiana Slough, the uppermost path of communication between the waters of the Sacramento and San Joaquin rivers. They enter the slough and pass into the Sacramento, and seem to be attracted by the much cooler and muddier waters of that stream. This is in marked contrast with the behavior of the striped bass in the same waters.

In a subsequent chapter the quantities of salmon shipped to San Francisco dealers from the Sacramento River in 1893 and 1894 are shown. The following table gives the number of pounds of fish utilized at the canneries. It appears that the 2 canneries in operation in 1894 received 543,082 more pounds of salmon than the 3 canneries did in 1893, and that the increase over the receipts of the same 2 canneries was 1,255,582 pounds.

Statement of the number of pounds of salmon utilized for canning on the Sacramento River in 1893 and 1894.

Location of canneries.	Spring.		Fall.		Total.	
	1893.	1894.	1893.	1894.	1893.	1894.
Benicia	147,442	297,889	63,200	355,300	210,642	653,189
Black Diamond	292,500	.....	520,000	.....	812,500	.....
Chippis Island	138,125	573,300	335,060	713,520	473,785	1,286,820
Total	578,067	871,189	918,860	1,068,820	1,496,927	1,940,009

The salmon pack of the Sacramento River, as shown in the following table, was 23,336 cases in 1893 and 28,463 cases in 1894. The increase in the output of the two canneries that were in operation both years was 17,627 cases.

Statement of the number of cases of salmon packed on the Sacramento River in 1893 and 1894.

Location of canneries.	Spring.		Fall.		Total.	
	1893.	1894.	1893.	1894.	1893.	1894.
Benicia	2,204	4,068	1,253	5,175	3,547	9,843
Black Diamond	4,500	.....	8,000	.....	12,500	.....
Chippis Island	2,125	8,820	5,164	9,800	7,289	18,020
Total	8,919	13,488	14,417	14,975	23,336	28,463

Salmon trolling in Monterey Bay.—For many years the hand-line fishermen of Monterey Bay, who seek cultus-cod, bonito, rock-cod, etc., have from time to time had their hooks carried away by fish, sometimes supposed to be large bonito, which their lines were not strong enough to retain. Some years ago, when a large body of small mackerel suddenly appeared in the bay and were taken with hand lines, the fishermen, when hauling in the fish, would often have them seized by other fish and taken off, with parts of the line. Occasionally a salmon was caught, but it was not known that salmon would regularly take the hook or that they occurred there in sufficient numbers to warrant a special attempt to obtain them. In 1893, however, a troll-line fishery was established there by anglers which reached large proportions and resulted in the capture of a great many salmon. It was the first year that any formal attempt was made to take the fish in that way or place. The fishing was done principally from Santa Cruz and Capitola. It was carried on from sail and row boats, with stout lines and hooks, attached to fly rods or simply fished by hand. Sardines were used for bait.

The salmon were found in the bay from early in June to about September 1. Some very large catches were made. Mr. G. M. Ord, of Soquel, Cal., took 1,900 pounds in four days, using a nine-ounce fly rod, with sardines as bait. Another man took over 3,500 pounds during a brief visit to the bay.

The following interesting account of this fishery is extracted from an article contributed by Mr. J. Parker Whitney to the issue of "Forest and Stream" for July 29, 1893:

SALMON FISHING WITH FISH BAIT.

This is a comparatively new method of fishing, and one which salmon fishermen are almost entirely ignorant of. To those interested in the king of fishes, the salmon, the harbor of Monterey presents an opportunity of peculiar interest. Here the salmon is found in pursuit of its natural food, and exhibiting many features which give an insight into the ways which have been so mysterious before. Almost yearly the salmon come into the bay of Monterey, as well as that of Santa Cruz and

a few other places on the coast, where they sometimes remain for months, and pursue their feeding as other fish do, and where they are readily caught with fresh-fish bait. I have lately had the great pleasure of taking a few score, and for the benefit of those who, like myself, have been in the habit of taking these noble fish with the fly, I will give the result of my experience.

When the salmon strike in about the bay, and generally near the shore, which occurs here about the 10th of June, they do so in the pursuit of squid, sardines, anchovies, smelts, and other small fish, and their presence is first indicated to the fishermen by the occasional disturbance of the surface water by the small fish in their efforts to escape. This is a signal for the Italians, Portuguese, and other market fishermen to go out for them, which they do in both sail and row boats. These men all fish for the market and waste no time in sentiment. They are equipped with stout cotton lines sufficiently strong to pull in salmon hand over hand. A stout sea hook is used, with a sinker weighing half a pound. The line is about 200 feet in length, the sinker is attached a short distance above the hook, and the line is paid out about 100 feet from the boat, and in the slow sailing or rowing, which is about the same speed as followed in trolling for trout, the bait sinks down 20-odd feet. The sardine or small fish, if not too large, or over 6 inches in length, is put on whole, otherwise it is cut diagonally, making two baits.

The salmon seizes the bait and hook and is pulled in alongside the boat without ceremony, where it is either yanked in or gaffed. Fully half of the salmon hooked are lost by the careless manner of handling, and about two baits are stripped to a salmon hooked. About once in twenty or thirty times two salmon are brought in at one time. I have reason to believe that at times when salmon first come in, and in schools, that the fishermen catch doublets often in succession.

My first experience was in going out with two fishermen in their boat and in witnessing their method. The boat I was in secured three salmon by the hand lines; the other boats did better, some taking as high as eight or ten; about a hundred salmon were taken by the fifteen boats out that morning.

I could find no record of taking the salmon with rod excepting that of my friend Mr. A. L. Tubbs, of San Francisco, from whose information I was induced to look up the fishing. His rod fishing is the only one I have heard of as applied to the salmon in salt water, and I have seen no other during my fishing except that of Mr. Simpkins, of Boston, who accompanied me on one of my fishings and who succeeded in catching one of the largest salmon I have ever seen caught here, weighing 32 pounds. I equipped myself in San Francisco with the best I could get—two cheap bamboo trolling sea-bass rods of 14 ounces and 9 feet in length. My additions were light sea-bass linen lines No. 18, 600 feet long, and No. 4-0 Kirby hooks. The hooks I had soldered to a short link of strong brass wire, to which were attached three more additional brass-wire links, with swivels between, adding to the wire above the shank of the hook a small brass-wire projection without barb, to hold the bait-fish head in position, long half-pound lead sinkers with holes in each end. These, with a multiplying reel, completed my outfit.

The game commences when the salmon is brought toward the surface. Then the salmon will frequently strike off on the surface in a straight line several hundred feet. In two instances I have trembled for my line, being compelled, with all the strain I dared to put on, to allow the fish to take out within 50 or 100 feet of all I had, although the boat was being propelled as rapidly as two men could row toward the fish. But it has been rarely that I have paid out over 400 feet.

Not so often as in fresh water does the salmon leap out of water, and seldom more than two or three times.

My daily catch has averaged nearly eight fish and given most exciting sport. The careful weight of 69 salmon caught I find to be 1,133 pounds, or about 16 pounds each. The smallest was a grilse of 5 pounds and the largest of 30 pounds.

All my catches have been in the early morning, starting out at 4 o'clock and getting back to the Hotel Del Monte in each instance but one for lunch. The exception was an all-day fishing, when I secured 18 salmon, weighing 286 pounds.

As with trout, I have found the morning best, and after 10 o'clock the fishing falls off. Two or 3 miles of rowing has been required to reach the fishing-ground from Monterey pier, and the fishing-ground I have found so far to extend over an area of about 2 miles long by 1 mile wide, although I have no doubt that the salmon could have been found out 2 or 3 miles beyond that limit. I have caught, in addition to the salmon brought in, half a dozen rockfish, called bluefish by the fishermen, but not bluefish as known East, weighing about 5 pounds each; also two codfish of 5 or 6 pounds, and two flounders of 5 and 8 pounds. In a dead calm the fishing about ceases, as with trout in trolling; but

with a return of the breeze the fishing takes on again. The method of taking forcibly reminds me of the trout. Shyly at times, and again boldly, sometimes striking several times at the bait, and with following up and striking at intervals of a few seconds; at times biting off half the bait and in following up for the balance, and in one instance following up the bait with frequent half-decided action until the bait was within 10 feet of the boat and then fiercely seizing it while I had the line in my hand. It proved a close call in a double sense, as the fish was a heavy one of 25 pounds, and carried the line out of my hand and the sinker attached, which rested in the boat, and very nearly got away with my whole outfit. I fortunately still held my rod in hand, and although I paid out nearly the whole of my 600 feet of line, the fish was well hooked and in fifteen minutes was brought to gaff. In boldness and general action the salmon have reminded me constantly of trout, paying but little attention to the boat, occasionally passing in sight within a few feet and striking on the surface at an occasional small fish, and at times going entirely out of the water in pursuit.

For experiment I tried the spoon, but fancied I did not do as well as with bait, although I caught two salmon with it. I also tried the spoon with fish bait, catching one that way, but believe the fish bait alone to be the best. The salmon upon being opened seem to have more squid inside than other fish, although at times full of sardines, and oftener with anchovies. Sardines are, however, the best bait, and squid but indifferent, while I have had some success with smelts and young shad. At one time, out of bait, I used a strip of salmon belly, which did well enough to catch two salmon.

As I have my salmon rods for fly fishing I shall later on try a little surface work with the fly, but I do not anticipate much success; still I believe they will take under favorable circumstances, when they are as plentiful as I am informed by the fishermen they are outside the harbor at times in deeper water, when the fishermen have sometimes observed several salmon at a time, even up to a dozen in number, following the bait up almost to the boat's side.

The fishing in the harbor is in more or less turbid water, with a depth of from 6 to 10 fathoms; while outside of the bay, in deeper water, it is clearer and the salmon can be more distinctly observed. I am informed by the fishermen that at times the salmon are so plentiful a few miles beyond the harbor that they are enabled to fill their boats in a few hours. These occasions, however, are rare, and where the salmon are found plentiful one day they may not be found the next. It has been usual, however, for the salmon to remain about and in the harbor for several weeks each year, although they skip their annual visits occasionally. The small fish which the salmon follow into the harbor come in countless numbers, often in large, moving masses, and their presence is indicated to the fishermen by the hovering sea gulls, pelicans, and other predatory birds. These are seen busily at work on the salmon-grounds, and often indicate the most favorable places for fishing. While the salmon evidently come in schools at first, it would appear that they scatter more or less about, instead of remaining together; although they mass more or less when in the vicinity of large schools of small fish. The fishermen are more or less guides for each other, and they may be scattered over a square mile without doing much in catch. Presently one or two commence hauling in, which congregates all the others in the vicinity, and the fishing goes on merrily for awhile. Then a scattering takes place again, and a regathering afterwards. Still, I have found about as good success in passing up and down in certain localities as in following the fishing boats.

The market fishermen, as I have previously observed, lose fully half of the salmon they hook; it is a straight overhand pull, and no give except that which is compelled by want of strength. The line and hooks are strong, and the fishermen have no time to wait. If the salmon are plentiful they do not much mind the losses, which often occur from neglect in using the gaff. With the light rod, the fish, if hooked, is seldom lost. I brought in several with skin holds, which would not have been held for a moment in hand fishing. One salmon which I caught had been on one of the market fishermen's line and had a torn hook-mark in his mouth and a cruel gaff cut between his ventral and anal fins. The gaff cut was nearly 3 inches long, and had penetrated nearly to his other side, and was too serious to have ever healed up again. The fish was a large one, of about 21 pounds in weight, and in fine condition, although the gaff cut was evidently two or three days old. The wound had evidently made but a slight impression on the appetite of the fish, as it struck fiercely and fought hard. * * *

I found the salmon which exhibited the most gamy qualities to do their fighting near the surface, seemingly to disclaim any depth after once being brought up, and to often make an almost complete circuit of the boat. Certainly a more beautiful sight than a salmon exhibits, with his brilliant colors as he strokes along with his powerful tail near the surface in the clear water and bright light, never gladdens the heart of a fisherman. We all know the dangers to which the salmon is exposed in fresh

water, and from which but few survive, as it is doubtful if but very few, if any, ever return from the upper streams which they ascend after the spawning season, at least when such upper waters are far removed from the sea. If they have the exposures in the deeper waters of the sea which follow them in the shoal water of Monterey Bay, their lives are indeed beset with constant risk. I saw daily in the bay on the fishing-grounds the enemies and consumers of the salmon at their deadly work, in the form of seals, porpoises, sharks, and cowfish. One day when I was out, which was very foggy, I was startled by the uprising of a curiously peaked hump two boat lengths ahead. It seemed to me like a boat's end elevated with a black cloth over it, but a moment later revealed the half of an enormous bewhiskered sea lion, which, raising itself half out of the water, revealed a form which must have weighed at least a ton. In its mouth was a large salmon, which it had evidently just caught. The insatiable appetite of these monsters of the deep, of which hundreds abound in the vicinity, would indicate that they are not slow to avail themselves of the salmon invasion. Well, I thought, the part which man plays in the devastation of the salmon in the sea is but trifling compared with that which occurs from their natural enemies beneath the waters.

It is clear that the salmon of Monterey Bay are those which belong to the Sacramento or San Joaquin River group. Their average weight confirms this, and that they are not of the Columbia River. The distance from Monterey Bay to San Francisco Bay, into which the Sacramento and San Joaquin rivers pour, is about 90 miles. Monterey Bay and that of Santa Cruz, a few miles north, and at some of the sounds and bays north on the coast, are the only places known where the salmon is found engaged in taking his food, and where it can be caught with fresh-fish bait. It certainly presents a favorable opportunity for studying the salmon in its normal condition, in its prime, engaged in seeking its natural food. Here its manners and peculiarities can be examined with ease, and some knowledge obtained of the class of food upon which it best thrives. All this can be obtained and the salmon brought to gaff in his superior condition before the advanced condition of the organs of reproduction have reduced its delicious flavor or weakened the vigor of its efforts.

This year the fishery promises to be much more extensively followed than last year. Professional fishermen-owning boats and regular boatmen will resort to the bay from more or less remote places. Early in June some fish were taken, but a period of stormy weather drove them off. On June 13 some fishing was going on.

An interesting point connected with this subject is that these are undoubtedly the fish that constitute a part of the fall run of salmon in the Sacramento River. Last fall the Sacramento River fishermen took a number of salmon in their nets which had hooks in their mouths—clearly fish which had been snagged in Monterey Bay.

THE COLUMBIA RIVER.

Explanatory remarks.—The time was insufficient and the conditions not suitable for an examination of the salmon fisheries of the entire river. The extremely high water had seriously affected the fishing in the whole upper river, and a visit at that time would not have been satisfactory even if the indefinite suspension of railroad traffic and the uncertainty of water transportation had not rendered the contemplated visit to the Cascades and The Dalles impracticable.

The inquiry which gave promise of the most satisfactory results was the examination of the important fisheries and large canning interests of the lower river, which were easily accessible and afforded the opportunity of inspecting every prominent method of fishing in the river except that with wheels. It was therefore in Astoria, the great center of the salmon industry in the river, that most of the time available for the examination of the Columbia River basin was passed. Here and in Portland, where some time was also spent, it was possible to meet fishermen and cannerymen from all parts of the river.

The accompanying memoranda on the salmon industry simply represent mostly the personal inquiries and observations of the writer, and are far from being a complete account of the business. Many things were observed which, while of great interest

to the person who for the first time visits this region, would have too little general importance to deserve mention. In order to render the notes more complete, an account of the salmon industry for the year 1894 is presented, although the season was only half over at the time of the writer's visit. The information for the latter part of the season has been obtained chiefly by correspondence. The detailed tabular matter here offered is in all cases drawn from the books of canners or fishermen, and may be accepted as accurate.

The salmon fishery and canning industry in 1893.—The fishing season of 1893 on the Columbia River was noteworthy for two reasons—the loss of life among the fishermen of the lower river was never greater; the pack of chinook salmon was the smallest in twenty years, that is, since 1873; and the general pack was less than in any previous year since 1874, with the exception of 1887 and 1889.

Much of the loss of life among the gill-net fishermen in the past has been due to gross carelessness or foolhardiness on the part of the men in venturing too near the bar at the mouth of the river in the hope of taking the fish when they first leave the ocean. It is said, however, that the disastrous death rate in 1893 was in large part unavoidable, and was due to the occurrence of sudden gales, which took the boats unawares. In the early part of June gales resulted in the death of 34 men, and by the close of the season the loss of lives reached 54, about 40 of the men being married. The money losses in boats and gear aggregated nearly \$20,000.

In the early part of May the canners acceded to the demands of the gill-net fishermen's union for a price of 5 cents a pound for chinook salmon instead of the uniform rate of \$1 per fish which had formerly prevailed. Reference to tables of averages elsewhere given will show that the average weight of chinooks taken with gill nets in 1893 was 22.86 pounds, so that the prices received amounted to an advance over 1892 of 14 cents on each fish sold; on this basis the fishermen must have been benefited by the change to the amount of fully \$75,000.

Fishing with all forms of apparatus in the lower river was less satisfactory than in the previous year. The average catch of salmon by gill nets was more than 100 less to a boat than in 1892, the figures given being 450 against 565. The traps were scarcely half as successful as in the previous season, being injured by storms and freshets and being shunned to a considerable extent by the large runs of fish, owing, as some suppose, to a shallowing of the water by the accumulations of sand and sediment caused by the thousands of stakes. Seine fishing began later than usual and was unsuccessful generally. The run of chinooks in August was very large, and is said to have obviated what would otherwise have been a somewhat disastrous season to the packers. While May was the best month for gill nets and July for pound nets, the catch of both these forms of apparatus in August was large. The run during the whole of the open season in August was reported to be extraordinarily heavy, and when the season closed there was still an enormous body of fish passing up the river. The total pack to August 10 was reported to be about 365,000 cases, of which about 290,000 cases were chinooks. Compared with the pack of the year 1883, ten years previously, when only chinook salmon were canned, the decrease in chinooks was 58 per cent and in the total pack was 45 per cent.

The number of salmon canneries operated in the Columbia basin in 1893 was 24, of which 13 were in Oregon and 11 in Washington. They were located as follows:

Locality.	County.	Number.
Oregon:		
Astoria	Clatsop	8
Clifton	do	1
Dalles	Wasco	1
Maple Dell	Multnomah	1
Warrondale	do	1
Portland	do	1
Total		13
Washington:		
Bay View	Wahkiakum	1
Brookfield	do	1
Cathlamet	do	1
Chinook	Pacific	1
Eagle Cliff	Wahkiakum	1
Eureka	do	1
Ilwaco	Pacific	2
Knappton	do	1
Pillar Rock	Wahkiakum	1
Waterford	do	1
Total		11
Grand total		24

The reduced pack led some of the canners to resume the business when the close time was over and the fall fishing began on September 10. At that time there was a numerous run of salmon in the river. By some these were regarded as small chinook salmon, by others they were thought to be dog salmon. Judging from the size, 10 to 15 pounds on an average, it seems probable the fish were dog salmon (*Oncorhynchus keta*). If so, this was the first year any business was made of packing them on the Columbia, although they were rather extensively canned on some of the coast streams in 1892. The fish were known as "chums" in the lower river. The boats could go out from Astoria and return loaded in a few hours. The price at first was 5 cents per fish, but it quickly dropped to 2 cents per fish, and even then the demand was far below the supply. The canners could doubtless have packed three or five times as many as they did. They were restrained in packing these fish extensively by their poor quality when canned. When fresh the fish were fine-looking, with firm flesh and a good color to their meat. When canned, however, they bleached out and became white or straw color. They could only be sold as third or fourth class goods, bringing \$3.20 per case. The quantity canned was about 20,000 cases.

The unusual feature of the fall packing operations was the utilization of humpback salmon (*O. gorbuscha*). The canners paid 5 cents each for the fish. According to Mr. M. J. Kinney, between 2,500 and 5,000 cases were prepared. Some of the raw material came from Puget Sound. A few silver salmon (*O. kisutch*) were also canned.

Condition of the salmon industry in 1894.—The regular salmon-fishing season of 1894 began April 10 and ended August 10. During the months of May and June the success of this industry was seriously jeopardized by the occurrence of unprecedentedly high freshets, which constituted one of the principal features of the season. A later extraordinarily large run of salmon overbalanced the injurious effects of the floods.

During the height of the flood the operations of the gill-net fishermen were interrupted, but by the middle of June the gill nets began to take large numbers of fine chinooks, and are reported to have done well during the remaining part of the season. The run of fish continued large to the very end of the season. On August 7, three

days before the suspension of fishing, 45 tons of chinooks, equivalent to over 3,600 fish, were landed at one cannery in Astoria. Taking the season through, the year was the best one for gill nets in a long time. According to Mr. Kinney, many gill-net crews took 13 tons of fish, and one caught 17½ tons, equivalent to over 1,700 fish.

The catch of blueback salmon in traps had been unusually large up to the time of the writer's visit (June.22), and advices received after the suspension of the fishery reported a general continuance of the run. Some daily catches of single nets and sets of nets in June were larger than corresponding weekly lifts during the previous season. The season's run was said to have been larger than for five or six years. In the upper river, notwithstanding the destruction of wheels by high water, the catch of bluebacks was at times almost unprecedented. The yield of steelheads was also large.

The catch of chinook salmon in traps was, however, remarkably small. Up to June 22 some traps had taken only 200 pounds of chinooks, and during the whole season the quantities of chinooks obtained in this way were much below the average.

The prices agreed on by the canners and fishermen of the lower river were 5 cents a pound for chinooks, 4 cents a pound for bluebacks, and 2 cents a pound for steelheads. The condition of the industry on June 15 is thus described in a dispatch from Astoria, published in the *Oregonian*, of Portland, on June 16:

The run of salmon has improved greatly, and the catch of the gill-net men to-day was greater than for any day in the history of the canning business for many years past. During the warm and pleasant weather of the last ten days hundreds of boats could be seen out around the jetty. The success of the gill-net men does not, however, mean that their receipts are in excess of those of the corresponding time last year. As yet the traps have yielded but small returns, while seining is out of the question, owing to the high water. Cannery men claim that while the gill nets may take enough fish to pack 100,000 cases more than were packed last year from the same sources of supply, the shortage in receipts from seines, traps, and fish-wheels will reach fully 200,000 cases. This view of the situation is borne out by the fact that orders for over 50,000 cases are known to have been canceled during the past two weeks.

By the end of the month the estimated shortage was considerably reduced, and as the season wore on it became apparent that instead of a shortage there would be a larger pack than in 1893.

The canneries operating in the Columbia basin in 1894 numbered 24 and were located as follows:

Locality.	County.	Number.
Oregon:		
Astoria	Clatsop	9
Clifton	do	1
Dalles	Wasco	1
Maple Dell	Multnomah	1
Warrendale	do	1
Portland	do	1
Total		14
Washington:		
Bay View	Wahkiakum	1
Brookfield	do	1
Cathlamet	do	1
Chinook	Pacific	1
Eagle Cliff	Wahkiakum	1
Eureka	do	1
Ilwaco	Pacific	1
Knappton	do	1
Pillar Rock	Wahkiakum	1
Waterford	do	1
Total		10
Grand total		24

Detailed figures from separate canners have been obtained by correspondence, which place the pack at 461,400 cases, of which 183,400 cases were prepared at Astoria, 204,000 at other places in the lower river, and 74,000 cases at the Cascades and The Dalles. The proportion of the different species constituting the pack is estimated to be about as follows: Chinook, 69 per cent or 318,366 cases; bluebacks, 16 per cent or 73,824 cases, and steelheads, 15 per cent or 69,210 cases.

The foregoing figures apply only to the regular packing season, which terminated August 10. When the close-time expired on September 10, some of the canneries resumed operations and continued to pack until November 10. From information received from Mr. M. J. Kinney, it appears that about 70,000 cases, chiefly of silver-sides, were prepared in the fall. Mr. Kinney states that it would have been an easy matter to pack double that quantity had the fishing been carried on with sufficient energy.

Statistics of salmon pack from 1866 to 1894, inclusive.—From 1866, the year in which the salmon-canning industry on the Columbia River was established, to 1894, the quantity of salmon utilized for canning purposes was about 695,406,000 pounds, and the aggregate pack was about 10,633,800 cases, each holding 48 one-pound cans, or the equivalent. The value of the pack to the canners was about \$61,760,500. Up to and including 1887 practically the entire quantity of salmon utilized in canning consisted of chinook salmon. Since that year larger and larger quantities of steelhead, blueback, and other salmon have been used and the number of chinook salmon entering into the pack has been reduced in the same proportion.

The following table shows for each year the gross weight of salmon utilized for canning, the number of cases packed, the wholesale market value of the canned fish, and the average value per case. The growth, decline, and present condition of the industry are to be interpreted in the light of the statement in the preceding paragraph as to the utilization of the cheaper grades of salmon. The figures, as they stand, indicate a serious decline in the industry since the business reached its height in 1883 and 1884. The extent of the decline is made more apparent when the greatly augmented quantities of apparatus employed in recent years are taken into consideration. With the number of fishing appliances employed in 1894, a pack in that year a half larger than that in 1884 would really indicate a serious reduction in the supply of fish.

Summary of the salmon-canning industry of the Columbia River from its origin to the present time.

Year.	Gross weight of salmon utilized.	Number of cases packed.	Value.	Average value per case.	Year.	Gross weight of salmon utilized.	Number of cases packed.	Value.	Average value per case.
	<i>Pounds.</i>					<i>Pounds.</i>			
1866.....	260,000	4,000	\$64,000	\$16.00	1882.....	35,184,500	541,300	\$2,600,000	\$4.80
1867.....	1,170,000	18,000	288,000	16.00	1883.....	40,911,000	629,400	3,147,000	5.00
1868.....	1,820,000	28,000	392,000	14.00	1884.....	40,300,000	620,000	2,915,000	4.70
1869.....	6,500,000	100,000	1,350,000	13.50	1885.....	35,997,000	553,800	2,500,000	4.51
1870.....	9,750,000	150,000	1,800,000	12.00	1886.....	29,152,500	448,500	2,135,000	4.76
1871.....	13,000,000	200,000	2,100,000	10.50	1887.....	23,140,000	356,000	2,124,000	5.97
1872.....	16,250,000	250,000	2,325,000	9.30	1888.....	24,211,005	372,477	2,327,981	6.25
1873.....	16,250,000	250,000	2,250,000	9.00	1889.....	20,685,495	309,885	1,809,820	5.84
1874.....	22,750,000	350,000	2,625,000	7.50	1890.....	28,781,385	435,774	2,407,456	5.52
1875.....	24,375,000	375,000	2,250,000	6.00	1891.....	26,450,635	398,953	2,240,964	5.62
1876.....	29,250,000	450,000	2,475,000	5.50	1892.....	32,185,995	487,338	2,679,069	5.50
1877.....	24,700,000	380,000	2,052,000	5.40	1893.....	25,672,152	393,972	2,135,824	5.42
1878.....	29,900,000	460,000	2,300,000	5.00	1894*.....	30,452,400	461,400	2,422,350	5.25
1879.....	31,200,000	480,000	2,640,000	5.50					
1880.....	34,450,000	530,000	2,650,000	5.00	Total.	690,499,067	10,563,799	61,480,464	.....
1881.....	35,750,000	550,000	2,475,000	4.50					

*The figures given do not include the fall pack for 1894, amounting to about 70,000 cases.

Preservation and increase of the salmon supply.—It is not unnatural that the solicitude for the maintenance of the supply of salmon on the Columbia River should now be greater and more general than at any previous time in the history of the fishery. The catch of chinook salmon has recently shown an almost constant annual decrease, and the success of the industry is yearly becoming more jeopardized. People who within a short time scouted the idea of a permanent reduction in the number of chinook salmon entering the river, are now not averse to conceding the effects of overfishing, and there is probably no one pecuniarily interested in the industry who does not realize that the time has come for active measures to prevent a still more serious impairment of the abundance of salmon. Of course the supply of chinook salmon in the Columbia Basin is still enormous and the productive capacity of the river is wonderful. All reference, therefore, to a decreased abundance must be construed in the relative sense as compared with the conditions prevailing when the acme of the canning industry was attained in 1884 and 1885. The threatened exhaustion of the supply must also be considered with reference to the extent of the fishing now carried on, which is not only commensurate with the supply, but is overtaxing the capacity of the river. The facts must also be borne in mind that the annual reduction is hastened by the employment of larger and larger quantities of apparatus; that as the supply becomes smaller the diminution becomes more pronounced in geometrical ratio; and that the results of overtaxation of the resources of the river in a given season are not seen the next year or the next, but are to be gauged in the fourth or fifth year following.

Special inquiries were made by the writer among the salmon-canners, fishermen, and citizens as to the legislative or other action demanded by the present condition of affairs. The practical unanimity of opinion is remarkable in view of the supposed diverse interests represented by canners, gill-net fishermen, trap fishermen, seine fishermen, wheel fishermen, etc.

Foremost among the measures advocated for the improvement of the salmon industry is artificial propagation. The reliance placed in fish-culture is practically unanimous. Some believe that nothing else is necessary for the regeneration of the fishery than very extensive fish-cultural operations, but most persons in the salmon districts think that, for a time at least—until the fishery begins to improve—the propagation work should be supplemented by some prohibitive measures.

It being generally recognized that the decline in the abundance of chinook salmon is due to the fact that the length of the fishing season and the avidity with which the fishery is prosecuted prevent a sufficient number of salmon reaching the spawning-grounds to repair the annual destruction by man, the character of the protection which has been considered most necessary is a shortening of the fishing season, supplemented by a short weekly intermission in the fishing.

Under present regulations the regular salmon-fishing on the Columbia River begins April 11 and continues until August 10. In the opinion of the U. S. Commissioner of Fish and Fisheries, if the fish that are now taken in April and August were allowed to pass up unmolested, a very marked improvement in the abundance of salmon would in due time be witnessed, and this protection, with ample artificial propagation, would rapidly restore the productiveness of the river.

The Commissioner may be quoted on this point as follows:

The number of chinook salmon taken in April and August is relatively small and under conditions not so profitable, either to the canneries or the fishermen, as those carried on during the months of May, June, and July. The April run of this salmon, if allowed to pass without interruption to the headwaters of the Columbia and its tributaries, would spawn in those waters, and the present productive capacity of the river would be increased to such an extent as to much more than compensate for the restrictions imposed by the prohibition of the fishery operations during the month of April. The August run of chinook salmon consists of gravid fish near their spawning time. The flesh for this reason has undergone deterioration, and if canned constitutes an inferior product, the sale of which will discredit the reputation which the Columbia River salmon justly hold in public estimation. None of the August run of chinooks probably ascend the Columbia above The Dalles. They spawn in the tributary streams of the Lower Columbia and in the main stream between The Dalles and the mouth of the river.—(Report of the Commissioner of Fish and Fisheries on Investigations in the Columbia River in regard to the Salmon Fisheries. Washington, 1894. pp. 16, 17.)

As the Commissioner states, the packing of salmon in April is not generally regarded as profitable, owing to the irregularity with which the fish come and the relative scarcity, because of which much time is lost by the canning force. As to the August fish, they are usually so near the spawning period that the flesh is soft and often unfit for canning, and much waste results; the fish are also often scarce and the supply is insufficient to keep the canneries in operation. It sometimes happens, however, that the season is late and the August run consists of an abundance of fish in excellent condition for canning. In some seasons the fish are more abundant and in better condition in August than in any other month, and in 1893 the run of fish in the month in question contributed much to the financial success of the canners.

The sentiment of the canners in the lower river is strongly favorable to the restriction of the canning season to the three months of May, June, and July, and the suspension of fishing during the whole of April and August. A few canners favoring a shorter season would like the privilege of packing in August if they thought it desirable, and still fewer would prefer to operate their canneries in April.

That, as a whole, no conspicuous part of the pack is taken in April and August, and that making a close time of these months would not seriously impair the business of the canners, may be seen from the following summary based on the quantities of fish packed during each of the four years ending in 1892:

Percentage of weight of each kind of salmon packed on the Columbia River in each month in 1889, 1890, 1891, and 1892.

Years and species.	April.	May.	June.	July.	August.	Total.
1889.						
Chinook	12.47	21.81	23.61	42.11	.....	100.00
Blueback	15.78	32.93	35.49	15.80	.....	100.00
Steelhead	5.77	9.03	38.47	46.73	.....	100.00
1890.						
Chinook	3.66	26.50	28.29	39.99	1.56	100.00
Blueback	8.59	27.55	40.42	20.44	3.00	100.00
Steelhead	3.97	8.31	31.65	50.45	5.62	100.00
1891.						
Chinook	8.74	19.09	23.73	42.22	6.22	100.00
Blueback	9.05	28.70	43.50	16.83	1.92	100.00
Steelhead	2.72	6.99	27.67	51.44	11.18	100.00
1892.						
Chinook	6.05	20.61	26.33	37.76	9.25	100.00
Blueback	9.90	35.38	37.86	14.67	2.19	100.00
Steelhead	2.41	7.51	32.32	45.63	12.13	100.00

A fairly accurate gauge of the sentiment of those prominently interested in the industry of the river as to the measures favored for the preservation of the salmon supply may be obtained from the following tabulated statement, representing the results of interviews with canners, public men in salmon-fishing centers, and State fishery officers, chiefly in Astoria and Portland, the canners predominating:

Favoring extensive artificial propagation to exclusion of any restrictive measures	1
Favoring extensive artificial propagation and close time throughout month of April	* 3
Favoring extensive artificial propagation and close time throughout month of August	* 2
Favoring extensive artificial propagation and close time throughout the months of April and August	† 13
	19

In the case of the apparatus in the upper river, that is, in the section between the Cascades and Celilo, a close time extending to May 10 or 15 in spring and an extension of the open season to August 10 or 15 would be a proper modification of the close season advocated for the lower river, as the fish which entered the river during the last two weeks in April would be given opportunity to pass unmolested beyond the wheels. In lieu of such an arrangement, the establishment of a graduated close time for different parts of the river or of a moving zone of protected water has been suggested. Wheel fishermen would probably not object to such a plan. Those interviewed expressed themselves as favoring a close time till May 10 or 15, provided the course was considered advisable for the protection of the fish.

It may be stated that any suggestion of a shortening of the season on the Columbia River will probably be opposed by a large majority of the gill-net fishermen and many persons using other forms of apparatus, under the impression that a curtailment of the season would mean a reduction in their income, whereas the opposite result would probably ensue.

The prohibition of certain forms of nets has from time to time been suggested and advocated. In the lower river the use of wheels has by a few persons been opposed on the ground that the fish which have escaped the multitude of nets in the part of the river below the Cascades should be allowed to pass unmolested to the spawning-grounds. Those interested in the wheel fishing, on the other hand, say that the quantities of chinook salmon taken in wheels are insignificant as compared with those caught by other means in the lower river, and that if more salmon were allowed to pass as far as the wheels the supply would be much better maintained by natural means. It can not be said, however, that the desire to proscribe any special kind of fishing apparatus is very prevalent, and the entire canning interests would probably strenuously oppose any attempt to abolish traps, seines, or wheels, for the reason that these appliances are largely owned or controlled by them, and afford the principal means for successfully withstanding what are considered unjust demands of the Fishermen's Union, which advocates the use of no form of apparatus save the gill nets.

* All of these, while preferring to suspend fishing during only one of the months in question, would probably not be averse to having a close time in both, if deemed necessary or desirable by competent authority.

† One also favoring abolition of wheels.

Salmon in the Willamette and Clackamas rivers.—It is reported by fishermen and sportsmen that only the early run of chinook salmon goes up the Willamette River, as it is only in spring that there is sufficient current in that stream to attract fish ascending the Columbia; later, the water becomes sluggish, and the summer run of salmon passes by the mouth of the river.

In 1894, owing to an unusually large volume of water, many salmon are said to have gone over the falls of the Willamette at Oregon City, but it seems clear that in ordinary seasons, when there is no special increase in the amount of water at the falls, great difficulty must be experienced by the migrating fish in surmounting them. The construction of one or several fish-ladders at the falls is urgently needed, and is now more important than at any previous time.

It is gratifying to be able to record the fact that at the last session of the Oregon legislature provision was made for the construction of a fishway at the Willamette Falls. The plans for the location, building, and maintenance of the ladder are thus described in the *Oregonian* for August 10, 1894:

Governor Penoyer, State Treasurer Metschan, and Secretary of State McBride, constituting the State board which was authorized by the last legislature to locate a fishway over the Willamette Falls, will take the first step in that direction to-day. The governor, treasurer, and secretary, with State Fish Commissioner McGuire, Hon. George T. Myers, and several other gentlemen, will meet in Oregon City to-day, and proceed to the falls and select a location for the fishway.

For the construction of this fishway the legislature appropriated the sum of \$10,000, but it will cost much less. By the provisions of the law the fishway shall be constructed in the bed of the river on the west side of the main fall, by making excavations in the solid rock when the water is low, so that the slope will be more gradual, and when the water is higher the excavations will form a series of connecting pools, all constructed and arranged in such manner that salmon can freely ascend from below to above the falls by passing from pool to pool.

In order to have the fishway built in the manner provided, the board is empowered to remove all obstructions, whether natural or artificial, to its construction, or to the passage of fish over the falls. Obstructions to the passage of fish include fish-wheels, nets, lines, and other devices for catching fish stationed within 50 feet of the fishway. The maintenance of such obstructions is a misdemeanor, and is punishable by a fine or imprisonment, or both.

The board is authorized to make all necessary arrangements for the construction of the fishway, such as employing a superintendent and workmen, purchasing tools and supplies, and advertising for bids. All bidders must agree to keep the fishway in good order for two years after its completion.

The existence of a dam in the Clackamas River is generally recognized as one of the greatest evils now affecting the fisheries of the Columbia River basin. Not only is this obstruction annually destroying millions of undeposited ova and practically inhibiting natural reproduction in the headwaters of the river, but it is seriously impairing the operations of the hatching station of the U. S. Fish Commission located on that stream. The enactment of a law is earnestly desired requiring the owners of dams in all salmon streams to put in *and maintain* suitable fishways, which should be subject to the approval and regulation of the State fish commissioners. In the case of streams like the Clackamas, on which Government or State hatcheries are located, it would seem that the great interests at stake would warrant the absolute prohibition of dams or other obstructions, and, possibly, the proscription of all fishing.

According to Mr. Seaburg, of Ilwaco, Wash., one of the most extensive salmon-packers in the United States, in April and May, 1893, about 140 tons of chinook salmon were taken below the dam in the Clackamas River by means of gill nets and seines. The principal part of this relatively large catch was taken at the dam, where the fish congregated in their attempts to surmount that obstruction. In 1894 over 100 tons were taken in the same locality.

There is no doubt that the natural conditions in the Clackamas are extremely favorable for the breeding of salmon, and the foregoing statement of the catch in that stream in 1893 and 1894 clearly indicates that an enormous annual production of young salmon might be depended on if the fish were not subject to capture and obstruction. It is equally true that noninterference with the salmon which have escaped the traps, seines, and gill nets of the Columbia and reached the Clackamas would permit the hatching station there located to liberate enough young salmon each year to go far toward repairing the diminution in the supply caused by excessive fishing.

Mr. L. T. Barin, who has been fishing on the Columbia and its tributaries for more than thirty-four years, informed me that, as a result of his personal observations in every important branch of the Columbia, he has no hesitation in affirming that the Clackamas always was and still is the best tributary salmon stream in the whole basin.

The continuance of present conditions, however, can not fail to have a far-reaching effect on the abundance of salmon in the lower Columbia River, and an accelerated diminution of chinooks may be depended on as a direct result of the obliteration of the run into the headwaters of the Clackamas.

Notes on apparatus and the catch.—Under this head some general notes on the principal forms of apparatus and the catch in each may be presented, and some detailed statistics, showing the yield of certain nets in 1892 to 1894, may be introduced.

As is well known, gill nets take larger quantities of chinook salmon than all other nets combined. While the proportion of fish thus obtained naturally varies from year to year, the gill-net yield always so far overbalances the remaining catch that it affords an accurate basis for determining the abundance of the fish, while it is evident that any regulations intended to increase the supply of chinooks must have primary application to the gill-net fishery. The importance of the gill net as a factor in the taking of chinooks will be clearly seen from the following comparative statement of the number of these fish obtained on the Columbia River, with all forms of apparatus and with gill nets alone, during the period of five years beginning 1889:

Statement of the total number of chinook salmon taken on the Columbia River from 1889 to 1893, with the number and percentage of those caught with gill nets.

Year.	Total catch.	Gill-net catch.	
		Number.	Percentage.
1889.....	772, 425	478, 097	61.90
1890.....	942, 884	580, 871	61.61
1891.....	963, 779	657, 133	68.18
1892.....	916, 833	578, 912	63.14
1893.....	872, 317	544, 984	62.48
Total	4, 468, 238	2, 839, 997	63.56

The employment of small-meshed gill nets has of late been increasing, and in 1894 was more extensive than ever before. The regular mesh of salmon gill nets is $8\frac{1}{2}$ to $9\frac{1}{4}$ inches, while the smaller-meshed nets which have been coming into use have a 7-inch mesh.

The principal reason for the increase in the use of small-meshed nets has been the change in basis for selling the catch effected in 1893. Prior to that time the gill-net fishermen were paid so much per fish regardless of size, although two fish under a given weight (22 pounds) were required to count as one full-sized fish. The

practice of selling fish by weight caused no discrimination against the smaller fish, which now bring as much per pound as the larger ones, and led to the use of nets with smaller mesh with a view to increase the catch by taking the fish which might otherwise go through the nets without gilling.

The increase in the use of small-meshed gill nets may, to some extent, be gauged by the additional quantities of bluebacks and steelheads taken, and in future an augmented catch of these fish by gill nets may be expected.

The following detailed statements, showing for three years the daily catch of four gill-net fishermen fishing at the mouth of the Columbia River and landing their catch at Astoria, are interesting as indicating the daily fluctuations in the run of salmon and because they afford a basis for comparisons with other years. The figures were selected from the books of the salmon-canner to whom the fish were sold, for the special reason that the men fished more or less regularly each year and their work represents the capacity of the river. In 1892 the fish are designated by number; in the following years the figures represent pounds. The statement for 1894 comes up to June 20, the time of the writer's visit.

Statement of the daily gill-net catch of four fishermen fishing at the mouth of the Columbia River in 1892.

Date.	No. 1.			No. 2.			No. 3.			No. 4.			Total.		
	Chinooks.	Bluebacks.	Steelheads.	Chinooks.	Bluebacks.	Steelheads.	Chinooks.	Bluebacks.	Steelheads.	Chinooks.	Bluebacks.	Steelheads.	Chinooks.	Bluebacks.	Steelheads.
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Apr. 12	15						1						16		
16	17												17		
19	9												9		
20										7	1		7	1	
21	9						9						18		
23	9						5			5			19		
26				4			13			5			22		
27	15												15		
28				7			15			4			26		
29	2												2		
Total	70			11			43			21	1		151	1	
May 2							1			4			5		
3	14						5			3			22		
4										2			2		
5	13												13		
6							2						2		
7	5			1			1			9			16		
10	8						10			4			22		
11	7			4									11		
12							1			3			4		
13	3			3			11			3			20		
14	5						26	1		12		1	43	1	1
16	12												12		
17	13												13		
18							26			4			30		
19	9			7						12			28		
20	18						29						47		
21	8			6			31						45		
23	27												27		
24				16			18			19			53		
25	17						50			16	1		83	1	
26	28			21						7			56		
27	44			6			23			11			84		
28	8						24			27			59		
30	19			32			43			9			163		
31	24			15			12						51		
Total	282			111			313	1		145	1	1	851	2	1

Statement of the daily gill-net catch of four fishermen fishing at the mouth of the Columbia River in 1892—Continued.

Date.	No. 1.			No. 2.			No. 3.			No. 4.			Total.		
	Chinooks.	Bluebacks.	Steelheads.	Chinooks.	Bluebacks.	Steelheads.	Chinooks.	Bluebacks.	Steelheads.	Chinooks.	Bluebacks.	Steelheads.	Chinooks.	Bluebacks.	Steelheads.
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
June 1				15			24			18			57		
2	43			12			27			20	2		102		2
3							14			14			28		
4	8						15			9			32		
5															
6	32												32		
7	14						24		1				38		1
8							55						55		
9	15			26						32			73		
10							25			30	1		61		1
11	10			29			27			55			127		
13				66			17						83		
14	33						17			22	1		72		1
15	11						13			16	2		40		2
16				3									3		
17				4			15			6			25		
18	9		1	9			17			8			43		1
20	8			24		1	18		1				50		2
22	18		1	25		2	21		1	19	3		83		7
23				4		1	5		1	6			15		3
24	16	1	2	3		2	25			7	1		51	1	5
25	23	1	2	6						29	2		58	1	4
26															
27				28	1	3	57	1	9				85	2	12
28	14												14		
29										37			37		
30	26	2	2	17		1				26			69	2	3
Total	286	4	8	271	1	10	416	1	13	360	13		1,333	6	44
July 1	9						20		4				29		4
2				5			19		2	17			41		2
3	57		6	5			17			17			79		6
4	11			9			22			21	2		63		2
5	8			7		1				15			15		1
6							8		1	29	1		37		2
7	11			10									21		
8				6		1	41		1	31			78		2
9	28		17	4			41		2	43	1		116		20
11	4			69		2	7		1	11	2		91		5
12				5			44			14	1		63		1
13	20		1	32		2	78		2	16	1		140		6
14	11		2	2		1	0		1	15	1		34		5
15	3		3	5			43		4	37	4		88		11
16	3			3		1	5			19	2		30		3
18	36						7						43		
19	8			14			10		1	11			43		1
20	8						6		1	2			16		1
21	5			11			9		1	18			43		
22				6			6			27			39		
23	15		1				5			4			24		1
25	9			21									30		
26	7			2			15			31	1		55		1
27	6			1			15		1	6			28		1
28							14			2			16		
29	22			15		1	15		1	11			63		2
30	11			10			9			8			38		
31	55									57	1		112		1
Total	347		30	242		9	445		22	447	17		1,481		78
Aug. 1				4			25						29		
2	5						17			31			53		
3	9		1				10		1	23			42		2
4	2						7						9		
5	4						9			11			24		
6							3			2			5		
Total	20		1	4			71		1	67			162		2
Grand total	1,011	4	39	639	1	19	1,288	2	36	1,040	2	36	8,978	9	125

Statement of the daily gill-net catch of four fishermen fishing at the mouth of the Columbia River in 1893.

Date.	No. 1.		No. 2.		No. 3.		No. 4.		Total.	
	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Apr. 17.....	303								303	
18.....	80	80							80	10
22.....	72		69				82		223	
24.....	392		90				86		568	
25.....	107								107	
26.....	175								175	
27.....	187		131						318	
28.....	317						88		405	
29.....	287	10	168				358		813	10
Total.....	1,920	20	458				614		2,992	20
May 1.....	160				138		259		557	
2.....	279		106		221		355		961	
3.....	632				408		276		1,316	
4.....	141								141	
5.....	120	*5	27		319			20	466	25
6.....					141				141	
8.....	38				373				411	
9.....	266				122				388	
10.....	425				516		69	20	1,010	20
12.....	62		55		414		71		602	
13.....	105		311		408		455		1,279	
15.....	251		92	10	33		194		570	10
16.....	583		66		155		227		1,031	
17.....	390		180		335				905	
18.....	424		158		379		284		1,245	
19.....	472		152		369		152		1,142	
20.....	120		83		1,027		1,325		2,555	
22.....	173		48		738		355		1,314	
23.....	398		127		265		472		1,262	
24.....	518		418		256		124		1,316	
25.....			221		150		65		436	
26.....	238		313				17		568	
27.....	549		57				37		643	
29.....	914		106		1,914		117		3,051	
30.....	221		258				466		945	
31.....					167		244		411	
Total.....	7,479	5	2,778	10	8,845		5,564	40	24,666	55
June 1.....	56		156	10	222				434	10
2.....	1,036	10	164		569				1,769	10
3.....	721		92		408				1,221	
5.....			75						75	
6.....	214								214	
7.....	333		431						764	
8.....	382	20	179						561	20
9.....	160		278						447	
10.....			97						97	
12.....	431	10	140		50				621	10
13.....	299	10	82		24				405	10
14.....	229	10							229	10
15.....	373		53				82		508	
16.....	777	20	223		65		157		1,222	20
17.....	706	30	156		306	20	205	20	1,373	70
19.....	105	10	1,076		691	60	399	20	2,271	90
20.....	361	40	471		146		41		1,019	40
21.....			123	10	498				621	10
22.....			200		158		82		440	
23.....	57		63		87				237	
24.....	184	10	136		136		40		502	10
26.....	124		141		171	20	70		506	20
27.....	116	10	128		180	10	108	20	532	40
28.....	623		39		296		132		1,090	
29.....	111	10	65		894	10	175	20	1,245	40
30.....	154		52		85	10	281		572	10
Total.....	7,561	190	4,650	20	4,986	130	1,778	80	18,975	420

* Blueback.

Statement of the daily gill-net catch of four fishermen fishing at the mouth of the Columbia River in 1893—Continued.

Date.	No. 1.		No. 2.		No. 3.		No. 4.		Total.	
	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.
	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
July 1.....	248		53		156		335		792	
2.....	387		220		337		178		1,122	
4.....			60						60	
5.....					149				149	
6.....							20		20	
10.....	21		104		162		79		366	
11.....	55		121		390				566	
12.....	92		121		46		110		369	
13.....	128		110		189		142		569	
14.....	189		56		140		217		602	
15.....	276		323		68		183		850	
17.....	376		472		144		338		1,330	
18.....					141		80		221	
19.....	263		106		907				1,276	
20.....	250		00		127		58		495	
21.....	120		164		307		112		703	
22.....			27		295		136		458	
24.....	96		655		601		267		1,619	
25.....	92		214		168		50		524	
26.....	418		89		38		68		613	
27.....	447		74		71		46		638	
28.....	194				391		168		753	
29.....	679		85		946		408		2,118	
30.....										
31.....	298		160		1,315		589		2,302	
Total.....	4,629		3,274		7,088		3,584		18,575	
Aug. 1.....	462		292		285		246		1,225	
2.....	118		311		248		192		869	
3.....	40		458		364		87		929	
4.....	461		518		304		356		1,639	
5.....	280		67		258		78		689	
7.....	369		300		1,832		404		2,905	
8.....	665		600		672		490		2,427	
9.....	513				580		103		1,196	
10.....	85		292		74		115		566	
11.....	86		65				40		197	
Total.....	3,085		2,823		4,617		2,117		12,042	
Grand total.	24,674	215	13,983	30	25,636	130	13,657	120	77,850	495

Statement of the daily gill-net catch of four fishermen fishing at the mouth of the Columbia River in 1894 (to June 20).

Date.	No. 1.		No. 2.		No. 3.		No. 4.		Total.	
	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.
	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
Apr. 10.....	106								196	
12.....					185				185	
13.....	112								112	
14.....	252								252	
16.....					166				166	
17.....	352				102		37		491	
18.....			22		350				372	
19.....	297								297	
21.....	297		91		315				703	
23.....	554	10	55		547				1,156	10
24.....							107		107	
25.....	290				292				582	
26.....					57		153		210	
27.....					71				71	
28.....			61						61	
29.....									361	
Total.....	2,711	10	229		2,056		297		5,293	10

Statement of the daily gill-net catch of four fishermen fishing at the mouth of the Columbia River in 1894 (to June 20)—Continued.

Date.	No. 1.		No. 2.		No. 3.		No. 4.		Total.	
	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.	Chi-nooks.	Steel-heads.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
May 1.....	155		48		550		260		1,013	
2.....			89		248				337	
3.....			152				79		231	
4.....					182		119		301	
5.....	259		25		105		25		405	
7.....	604				285		18		907	
8.....			39						39	
9.....			180		278				458	
10.....	275		137		292		311		1,015	
11.....	636		70		608		237		1,549	
12.....	267		120		138		172		697	
15.....	188		49		130		86	5	453	5
16.....	245				533				778	
17.....			310		76				386	
18.....	312		249		62		218		841	
19.....	298		164		185		672		1,319	
20.....										
21.....	1,013		525		1,165		1,436	10	4,141	10
22.....	678		124						802	
23.....			297						297	
24.....	132		254		222		314		922	
25.....	480	22	495		581		400		2,022	22
26.....	197		150		144		125		625	
28.....			115		462		284		861	
29.....	227		485		105				907	
30.....	324								324	
31.....	444		411		620		535		2,010	
Total.....	6,725	22	4,497		7,059		5,359	15	23,640	37
June 1.....	350		345		340		459		1,494	
2.....	1,010				15				1,025	
3.....										
4.....					483		80		563	
5.....	403		305						708	
6.....					50				350	
7.....	344		626		290		633		1,893	
8.....	390				508		674		1,572	
9.....	249		113		142		49		553	
11.....	1,025		128		525		238		1,916	
12.....							345	9	345	9
13.....	285	12			99		1,248		1,632	12
14.....	308	29	939		547		65		1,919	29
15.....	1,711	31	425		184	12			2,320	43
16.....	159	32	510		887	22	180		1,736	60
18.....	1,260	10	737		355	6	800	20	3,248	36
19.....			261				234	11	435	11
20.....			841		304	14			1,145	14

* Blueback.

The great multiplication of pound nets in the lower Columbia, especially in Baker Bay and around Sand Island, is a feature of the salmon fisheries which impresses a visitor very forcibly. The nets form such a maze on the Washington side of the river that it seems impossible for salmon entering the river west of Sand Island to escape capture, and it would appear that access to so many nets is cut off by the lines of other nets that a large proportion of the traps would fail to pay expenses.

A Washington law requires that each trap set in the waters of the State shall be licensed. In 1893, 460 traps were licensed to fish in the Columbia River, of which 442 were in Baker Bay. In 1894 the number was 410, of which 387 were in the bay, as I am informed by Mr. James Crawford, the fish commissioner of Washington. Most of these are owned in Oregon and are properly credited to the fisheries of that State. The law also requires that a space of 800 feet be left between each line of traps and a space of at least 50 feet between the bowl of one net and the leader of the next.

The catch of chinooks in pound nets is larger than in any other apparatus except

gill nets, and the chinook is by far the most valuable species taken in the pounds. More bluebacks than chinooks, however, are secured in pound nets some seasons, the yield of the former usually being larger than in any other forms of nets except wheels. The catch of steelheads is always larger in pound nets than in other appliances.

The quantity of salmon taken with seines is less than with any other important form of apparatus. The number of seines used is relatively small, and the investment in this kind of fishing apparatus is insignificant compared with that in gill nets, pound nets, or wheels. In ordinary seasons more chinooks than any other species are caught in seines, although in seasons when there is a particularly heavy run of bluebacks in the river, as, for instance, in 1892, the catch of bluebacks is largest. The number of seines used on the Columbia is usually about forty, most of which are operated in the lower river near its mouth.

The following figures represent the results of a seine fishery in the lower Columbia in 1892, 1893, and 1894, the record for the last year being incomplete. In the first year the fishing season was from April 20 to August 11. In 1893 seining operations did not begin till June 30. The figures are given to show the variations in the catch of different species from month to month and the relative quantities of each taken by this means. The catch of this seine is larger than the average for the river, being 124,353 pounds in 1892 and 66,673 pounds in 1893.

Statement of the daily catch of chinook, steelhead, and blueback salmon in a seine fished at Brownsport Sands, opposite Pillar Rock, Columbia River; in 1892, 1893, and 1894 (to June 1).

Date.	1892.			1893.			1894.		
	Chinooks (pounds).	Blue-backs (pounds).	Steel-heads (pounds).	Chinooks (pounds).	Blue-backs (pounds).	Steel-heads (pounds).	Chinooks (pounds).	Blue-backs (pounds).	Steel-heads (pounds).
April 20.....	501	600							
22.....	452	285							
25.....	407	211				155	120	49	
26.....	340	104							
27.....						123	67	17	
28.....	670	279							
29.....	312	200							
30.....	788	394							
Total.....	3,470	2,073				278	187	66	
May 3.....	319	373				248	90	96	
4.....	894	671							
5.....	1,097	535				47			
6.....	791	115				295		96	
7.....	1,035	1,064							
8.....						78	121	8	
9.....	629	537				129	480	16	
10.....	1,144	1,052				165	616		
11.....	1,734	1,929				200	544	27	
12.....	1,413	1,704				137	516		
13.....	658	1,327							
14.....	1,197	2,711							
15.....						327		44	
16.....	623	244				196	1,052		
18.....	492	278				398	752	71	
19.....	378	218				411	270	15	
20.....	461	596							
21.....	1,138	597				180	94	17	
23.....	305	47				109		118	
24.....	730	38							
25.....	789	116							
27.....						290	94	35	
28.....	227	22							
Total.....	16,354	14,234				3,238	5,553	543	
June 7.....	160	36							
9.....	473	30	64						
10.....	1,010	62	54						
11.....	473	113	62						

Statement of the daily catch of chinook, steelhead, and blueback salmon in a seine, etc.—Continued.

Date.	1892.			1893.			1894.		
	Chinooks (pounds).	Blue- backs (pounds).	Steel- heads (pounds).	Chinooks (pounds).	Blue- backs (pounds).	Steel- heads (pounds).	Chinooks (pounds).	Blue- backs (pounds).	Steel- heads (pounds).
June 13.....	628	81	58						
14.....	563	100	35						
15.....	664	129	63						
17.....	912	166	126						
18.....	2,324	342	332						
20.....	699	610	77						
21.....	1,096	365	314						
23.....	657	452	266						
24.....	1,033	722	255						
25.....			81						
28.....	37	32	42						
29.....	138	72	85	298	193	175			
30.....				302	102	220			
Total.....	10,867	3,312	1,917	600	385	395			
July 1.....	458	41	234	270	203	152			
2.....	799	41	250						
3.....				563	134	184			
4.....	1,565	80	302	505	94	299			
5.....	464	67	208	752	83	421			
6.....	376		225	318	93	508			
7.....	280		287	389	37	533			
8.....	224		173	486	27	224			
10.....				628	103	146			
11.....	776		165	1,092	64	645			
12.....				850	118	521			
13.....	574		253	725	50	526			
14.....	465		199	609	96	570			
15.....	728		211	436	43	442			
16.....	1,504		773						
17.....				685	3	402			
18.....	863		212	787	5	303			
19.....	3,680		1,294	801	14	374			
20.....	2,542		1,278	850		311			
21.....	1,905		932	905		538			
22.....	1,586		1,213	1,376	35	414			
23.....	1,077		490						
24.....				4,168		1,057			
25.....				3,744		593			
26.....	1,706		1,367	2,007		931			
27.....				1,202		480			
28.....	487		587	2,169		374			
29.....	2,369		587	1,208	119	212			
30.....	7,410		2,212						
31.....				1,858		601			
Total.....	31,838	229	13,458	29,542	1,321	11,761			
Aug. 1.....				2,258	269	209			
2.....	3,777		742	2,920	220	366			
3.....	3,948		1,542	881	71	155			
4.....	2,635		1,389	814	100	315			
5.....	2,570		787	364	38	13			
6.....	2,194		1,437						
7.....				1,421	223	40			
8.....	1,952		1,120	3,058	261	304			
9.....				1,618	165	600			
10.....	1,325		239	1,080	248	699			
11.....	610		345	1,699*	389	1,235			
Total.....	19,011		7,590	16,743	* 1,990	3,936			
Grand total.	81,540	19,848	22,965	46,885	1,706	16,092	3,510	5,740	609

* The quantities shown in this column for August represent small chinook salmon, mostly under 4 pounds in weight, and are not included in the grand total.

The following table, relating to the year 1893, and applying to that part of the Columbia River adjacent to Astoria, shows by months the number of different kinds of salmon taken by certain gill nets, pound nets, and seines, respectively, the entire catch of which was landed at a cannery, from the books of which the figures were drawn. The fish here shown are the same as those whose average weights are recorded in another place in this report.

Table showing the monthly catch of chinook, blueback, and steelhead salmon in a certain number of gill nets, pound nets, and seines employed at the mouth of the Columbia River in 1893.

Months.	Gill nets. (April 17 to August 10.)					Pound nets. (April 17 to August 10.)				
	Number of nets used.	Number of fish taken.				Number of nets used.	Number of fish taken.			
		Chinooks.	Blue-backs.	Steel-heads.	Total.		Chinooks.	Blue-backs.	Steel-heads.	Total.
April	115	6,409	2	18	6,429	40	416	208	59	683
May	160	23,468	16	17	23,501	75	1,793	1,792	207	3,792
June	165	22,008	91	511	22,610	75	3,350	5,466	4,137	12,953
July	168	15,917	3	847	16,767	75	6,550	1,801	10,031	18,382
August	135	12,892	.....	647	13,539	75	3,109	.....	2,305	5,414
Total .....	.....	80,694	112	2,040	82,846	.....	15,218	9,167	16,739	41,224

Months.	Seines. (June 20 to August 10.)					Total number of fish taken.			
	Number of seines used.	Number of fish taken.				Chinooks.	Blue-backs.	Steel-heads.	Total.
		Chinooks.	Blue-backs.	Steel-heads.	Total.				
April .....	.....	.....	.....	.....	.....	6,825	210	77	7,112
May .....	.....	.....	.....	.....	.....	25,261	1,808	224	27,293
June	3	158	229	426	813	25,516	5,786	5,074	36,376
July	5	5,889	413	5,827	12,129	28,356	2,217	16,705	47,278
August	5	2,872	.....	1,555	4,427	18,873	.....	4,507	23,380
Total .....	.....	8,919	642	7,808	17,369	104,831	10,021	26,587	141,439

Detailed statistics for salmon wheels.—Through the courtesy of Mr. Frank M. Warren and Dr. John Williamson, of Portland, Oreg., the following detailed data are presented, showing, for a period of years, the daily catch of salmon by certain wheels operated at the Cascades of the Columbia, which is the lowermost part of the river where the use of wheels is possible. The number now operated there annually is about 35, and about 23 more are employed in the upper river at The Dalles and Celilo.

The following figures, which have been drawn from the records of Mr. Warren, the owner of the wheels, show, for a series of eleven years, terminating in 1894, the daily catch of each kind of salmon in one wheel fished on the Oregon side of the river and one on the Washington shore. The catch of the wheels in question was selected for detailed presentation because they were operated continuously during each season and the yield represents the productive capacity of that part of the river for wheel fishing. The uncertainties attending the prosecution of this fishery; the influence of the volume of water on the catch; and the daily, monthly, and annual fluctuations in the abundance of the different salmon are well exhibited in the tables. The data are also valuable for the comparisons that may be made. Separate figures are given for the salmon weighing 20 pounds or more and those weighing less than 20 pounds.

The aggregate catch of the two wheels in question during the years 1883 to 1894, inclusive, was 804,693 marketable salmon, as shown in the following summary. Of these, 163,526 were chinooks, 589,183 were bluebacks, and 51,984 were steelheads. The latter have only recently come into use, and the catch is not reported prior to 1887. The largest number of fish, namely, 134,144, was taken in 1886; the smallest number, 1,677, in 1894, while in 1889, owing to the low state of the water, the wheels could not be used. The catch of chinooks was larger in 1884 than in any other year; it will be recalled that the acme of the canning industry on the river was then attained. The blueback yield was largest in 1886. The biennial character of the run of this fish, of

which mention is elsewhere made, is well illustrated by these figures. On comparing 1884, 1886, 1888, 1890, and 1892 with 1883, 1885, 1887, 1891, and 1893, it appears the catch during the former series was 341,253 fish, and during the latter 246,881 fish.

Summary of the yearly catch of salmon in two wheels located, respectively, on the Oregon and Washington sides of the Columbia River, at the Cascades.

Years.	Chinooks.	Bluebacks.	Steelheads.*	Total.
	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>
1883.....	20,908	75,121		96,029
1884.....	27,902	83,219		111,121
1885.....	12,049	59,208		71,257
1886.....	13,641	120,503		134,144
1887.....	21,984	80,166	5,356	107,506
1888.....	11,996	40,978	6,105	59,079
1889.....				
1890.....	23,161	74,419	8,094	105,674
1891.....	4,089	10,448	1,557	16,094
1892.....	12,572	22,134	14,074	48,780
1893.....	14,670	21,938	16,724	53,332
1894.....	554	1,049	74	1,677
Total.....	163,526	589,183	51,984	804,693

* Not utilized prior to 1887. The fish caught were given away.

The following tables illustrate the monthly variations in the abundance of chinooks and bluebacks during each of the years mentioned. The largest catch of both fish is obtained in June; in April and August the yield is insignificant.

Statement of the number of chinook salmon taken monthly in two wheels located, respectively, on the Oregon and Washington sides of the Columbia River, at the Cascades, from 1883 to 1894, inclusive.

Years.	April.	May.	June.	July.	August.	Total.
1883.....		5,057	7,393	8,458		20,908
1884.....		3,787	15,393	8,722		27,902
1885.....		3,123	7,102	1,824		12,049
1886.....		410	11,427	1,804		13,641
1887.....		3,228	7,395	11,271	90	21,984
1888.....	12	2,666	6,593	2,725		11,996
1889.....						
1890.....		13,331	8,979	851		23,161
1891.....		1,072	2,878	139		4,089
1892.....		281	7,908	4,359	24	12,572
1893.....	8	1,487	8,710	3,912	553	14,670
1894.....	34	520				554
Total.....	54	34,962	83,778	44,065	667	163,526

Statement of the number of blueback salmon taken monthly in two wheels located, respectively, on the Oregon and Washington sides of the Columbia River, at the Cascades, from 1883 to 1894, inclusive.

Years.	April.	May.	June.	July.	August.	Total.
1883.....		5,108	59,621	10,392		75,121
1884.....		4,350	65,392	13,477		83,219
1885.....		5,296	42,717	11,195		59,208
1886.....		2,161	111,400	6,942		120,503
1887.....		5,283	38,544	36,336		80,166
1888.....	187	4,281	31,014	5,496		40,978
1889.....						
1890.....	88	12,176	54,670	7,485		74,419
1891.....		1,922	7,563	943		10,448
1892.....		6,203	11,334	4,591	6	22,134
1893.....	12	1,783	12,515	7,544	84	21,938
1894.....	10	1,039				1,049
Total.....	297	49,602	434,790	104,404	90	589,183

The maximum height of water shown in the tables was 30 feet 8 inches in 1894. Shortly after that point was reached the wheels were washed away, and the water

continued to rise till June 8, when it attained a height of 41 feet 9 inches. The lowest water record was 10 feet 6 inches at the beginning of the season of 1893. Very few fish comparatively are taken when the water is under 15 feet high. The poorest season, when the fishing was not suspended on account of too low water or too high water (as in 1889 and 1894), was in 1891. In that year the maximum height of water was only 19 feet 5 inches, and only during the first ten days in June was the water over 19 feet. In 1884, the best year for these wheels, the water was over 20 feet during the entire time from May 20 to July 8. In 1886, when the most bluebacks were taken, the water was 20 feet or over from May 27 to June 30.

The following tables give, in detail, the daily catch of the wheels referred to:

Statement of the daily catch of salmon in two wheels located, respectively, on the Oregon and Washington sides of the Columbia River at the Cascades, with a record of the height of water above low-water mark.

Date.	Height of water.	Oregon.					Washington.				
		Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.	Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.
1883.	<i>Ft. in.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>
May 14	19 0	45	6	85		136					
15	20 4	28	9	58		95					
16	21 3	11	2	23		36					
17	21 6	20	3	32		55					
18	21 8	52	2	45		99					
19	21 10	62	14	94		170	4		16		20
21	21 9	236	78	224		538	9		30		39
22	21 7	250	167	360		786	22	4	62		88
23	21 6	252	208	330		790	38	12	81		123
24	22 0	190	214	253		657	53	12	104		169
25	22 7	176	130	368		674	48	13	77		138
26	22 10	176	115	316		607	38	5	37		80
28	22 3	232	244	238		714	72	13	174		259
29	21 10	250	245	374		969	71	26	192		289
30	21 10	237	273	392		902	53	19	155		227
31	22 2	256	231	576		1,063	56	14	144		214
Total.		2,482	1,941	3,808		8,291	52	8	168		228
June 1	22 3	220	244	664		1,187	57	16	184		257
2	22 3	136	208	755		1,100	43	4	224		271
4	22 4	52	104	820		976	40	22	560		622
5	22 2	69	91	1,760		1,920	23	11	288		322
6	22 1	50	102	1,680		1,832	45	11	608		664
7	22 1	96	144	2,106		2,436	46	24	536		606
8	22 1	88	118	2,480		2,688	51	24	527		602
9	22 2	109	186	2,464		2,759	44	32	690		772
11	23 2	81	85	1,237		1,403	48	36	264		348
12	23 0	62	81	2,796		2,920	44	13	296		353
13	24 4	112	140	4,288		4,549	59	30	616		705
14	24 7	145	101	4,116		4,362					
18	23 9	131	131	2,296		2,558	56	24	503		583
19	23 8	78	205	4,036		4,319	76	30	648		754
20	23 11	146	210	4,166		4,522					
21	24 1	122	202	3,816		3,140					
22	24 2	167	212	2,204		2,613	24	6	296		326
23	24 3	176	143	1,896		2,215	68	16	368		442
25	24 0	56	159	1,264		1,479	60	12	408		486
26	23 11	121	110	3,216		3,453	90	26	336		452
27	23 10	64	55	840		959	67	17	328		412
28	23 10	55	82	1,024		1,161	80	18	384		482
29	23 10	73	82	984		1,130	72	13	272		357
30	23 9	113	77	924		1,114	70	21	296		396
Total.		2,541	3,268	50,983		56,792	1,178	406	8,638		10,222
July 2	23 9	172	90	784		1,055	72	8	168		248
3	23 9	162	133	752		1,047	100	19	100		285
4	23 6	285	279	832		1,396	88	18	208		314
5	23 3	325	384	880		1,589	55	14	136		205
6	22 11	353	337	903		1,593	32	5	104		141
7	22 6	366	335	832		1,533	16	9	80		105
9	21 11	113	210	368		691	28	19	64		111
10	21 6	225	292	560		1,077	30	20	56		106
11	21 1	256	204	504		964					
12	20 9	257	177	368		802	28	18	40		86
13	20 5	220	166	424		810	44	35	40		119
14	20 1	212	188	464		864	20	20	16		65
16	19 4	105	61	264		430	32	51	16		90

Statement of the daily catch of salmon in two wheels, etc.—Continued.

Date.	Height of water.	Oregon.					Washington.				
		Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.	Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.
		Number.	Number.	Number.	Number.	Number.	Number.	Number.	Number.	Number.	Number.
1883.	<i>Ft. in.</i>										
July 17	18 11	159	116	254	.....	529	77	76	16	.....	169
18	18 6	155	184	488	.....	827	66	89	16	.....	171
19	18 0	179	175	307	.....	661	60	60	24	.....	153
20	17 5	85	53	146	.....	284	46	53	8	.....	107
21	17 0	31	8	102	.....	141	22	43	8	.....	73
Total.	.....	3, 660	3, 401	9, 232	.....	16, 293	822	575	1, 160	.....	2, 557
Grand total.	.....	8, 683	8, 610	64, 083	.....	81, 376	2, 516	1, 099	11, 038	.....	14, 653
1884.											
May 12	.....	.....	.....	.....	.....	.....	52	2	49	.....	102
13	16 9	65	3	160	.....	228	91	8	56	.....	155
14	17 8	123	5	216	.....	344	32	2	16	.....	50
15	18 1	40	2	88	.....	130	.....	.....	.....	.....	.....
16	18 3	161	7	312	.....	480	24	2	32	.....	58
17	18 6	179	10	388	.....	577	32	2	24	.....	58
19	19 5	237	20	264	.....	521	76	4	88	.....	168
20	20 1	248	19	160	.....	427	72	2	80	.....	154
21	21 0	124	14	80	.....	218	41	3	72	.....	116
22	21 9	122	9	152	.....	283	32	1	72	.....	105
23	22 3	96	10	120	.....	226	52	.....	64	.....	117
24	22 5	247	17	232	.....	406	104	11	108	.....	223
26	22 9	241	40	264	.....	545	136	17	88	.....	241
27	23 2	154	25	136	.....	315	124	8	68	.....	200
28	23 9	186	34	216	.....	436	36	4	40	.....	80
29	24 5	96	15	138	.....	249	24	2	16	.....	42
30	24 10	72	9	160	.....	241	28	.....	48	.....	76
31	24 9	100	2	280	.....	382	28	2	64	.....	94
Total.	.....	2, 491	241	3, 360	.....	6, 098	984	71	984	.....	2, 039
June 2	24 0	221	23	344	.....	588	138	22	130	.....	296
3	24 2	423	77	744	.....	1, 244	220	32	256	.....	508
4	24 8	468	86	904	.....	1, 458	124	28	216	.....	368
5	25 4	180	70	432	.....	682	78	21	232	.....	331
6	25 10	173	66	704	.....	943	48	9	264	.....	321
7	26 3	202	95	752	.....	1, 049	56	11	136	.....	203
9	26 8	276	76	1, 184	.....	1, 536	100	21	200	.....	323
10	26 7	284	84	1, 640	.....	2, 008	136	42	228	.....	406
11	26 7	324	126	2, 768	.....	3, 218	120	37	496	.....	653
12	26 9	356	109	1, 776	.....	2, 241	156	70	624	.....	850
13	27 3	232	68	2, 096	.....	2, 396	84	25	400	.....	509
14	27 2	163	42	1, 788	.....	1, 993	4	.....	48	.....	52
16	26 11	210	52	2, 592	.....	2, 854	80	20	440	.....	540
17	26 9	343	122	3, 344	.....	3, 809	52	25	320	.....	397
18	26 6	466	231	3, 994	.....	4, 691	232	63	712	.....	1, 007
19	26 2	475	266	3, 680	.....	4, 421	296	161	1, 408	.....	1, 865
20	25 9	359	232	2, 752	.....	3, 343	248	60	1, 238	.....	1, 546
21	25 8	395	192	3, 440	.....	4, 027	142	64	576	.....	782
23	25 6	319	128	2, 984	.....	3, 431	136	38	656	.....	830
24	25 6	511	219	3, 632	.....	4, 362	196	67	1, 010	.....	1, 279
25	25 4	318	120	2, 080	.....	2, 524	72	4	416	.....	492
26	25 4	258	116	1, 560	.....	1, 934	152	47	1, 320	.....	1, 519
27	25 3	284	138	1, 992	.....	2, 414	104	18	592	.....	714
28	24 11	382	208	2, 936	.....	3, 526	164	36	960	.....	1, 160
30	24 2	261	182	1, 488	.....	1, 931	240	77	896	.....	1, 213
Total.	.....	7, 883	3, 134	51, 606	.....	62, 623	3, 378	998	13, 786	.....	18, 162
July 1	23 10	315	266	1, 266	.....	1, 847	168	62	544	.....	774
2	23 6	254	294	736	.....	1, 284	266	59	656	.....	981
3	23 1	474	331	984	.....	1, 789	228	62	762	.....	962
4	22 7	417	304	1, 248	.....	1, 969	240	85	678	.....	1, 043
5	22 1	514	280	960	.....	1, 754	228	37	736	.....	1, 001
7	20 11	459	225	1, 003	.....	1, 687	134	70	238	.....	442
8	20 4	484	169	882	.....	1, 535	92	61	200	.....	353
9	19 10	330	130	580	.....	1, 040	64	30	160	.....	254
10	19 2	307	109	561	.....	977	52	25	112	.....	189
11	18 9	261	103	485	.....	849	90	17	64	.....	171
12	18 4	126	49	245	.....	420	92	20	88	.....	200
14	17 4	32	15	99	.....	146	126	32	48	.....	206
15	17 0	8	2	46	.....	56	124	50	96	.....	270
Total.	.....	3, 981	2, 277	9, 095	.....	15, 353	1, 904	560	4, 382	.....	6, 846
Grand total.	.....	14, 355	5, 652	64, 067	.....	84, 074	6, 266	1, 629	19, 152	.....	27, 047

NOTES ON THE FISHERIES OF THE PACIFIC COAST.

Statement of the daily catch of salmon in two wheels, etc.—Continued.

Date.	Height of water.	Oregon.					Washington.				
		Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.	Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.
1885.	<i>Ft. in.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>
May											
11	16 6	12		191		203	19	2	50		77
12	16 6	9	1	136		146	40	5	124		169
13	16 7	7	2	144		153	24	3	84		111
14	16 9	12		96		108	28	2	88		118
15	17 4	11	1	168		180	23	2	64		89
16	18 1	36	4	376		416	16	2	56		74
18	18 9	70	9	344		423	33	3	76		112
19	18 9	28	6	216		250	17	2	44		63
20	18 8	119	16	432		567	38	5	116		159
21	18 6	155	23	624		802	98	12	152		262
22	18 7	106	28	656		790	92	18	144		254
23	18 9	122	18	480		620	72	24	108		204
25	18 7	40	6	128		174	100	24	104		228
26	18 3	56	9	136		201	112	14	184		310
27	17 11	8	1	76		85	68	12	260		340
28	17 8	4		64		68	37	9	152		198
29	17 5	4		32		36	44	6	124		174
30	17 3	2	2	72		76	64	7	108		179
Total.		801	129	4,371		5,298	2,044	152	925		3,121
June											
1	17 2	12	1	80		93	60	12	136		208
2	17 4	32	3	120		155	74	33	128		235
3	18 2	64	23	296		383	73	32	132		237
4	18 8	108	30	352		490	51	26	116		193
5	19 0	60	37	248		345	42	32	176		250
6	19 0	334	37	400		771	88	49	248		385
8	19 4	48	13	560		621	32	20	232		284
9	19 1	68	32	712		812	36	38	252		326
10	18 10	110	52	736		904	48	71	280		369
11	18 6	71	50	928		1,049	46	41	216		303
12	18 5	72	40	1,148		1,260	80	66	240		386
13	18 6	101	25	1,432		1,558	68	65	360		523
15	19 6	72	106	656		734	56	66	632		754
16	19 8	32	170	1,509		1,711	28	33	600		661
17	19 10	20	36	630		686	12	9	424		445
18	19 11	32	46	392		470	28	25	640		693
19	20 0	92	77	1,172		1,341	32	19	472		523
20	20 2	184	201	1,713		2,098	30	39	576		645
22	20 6	143	139	1,805		2,087	64	68	1,236		1,368
23	20 8	208	135	2,863		3,206	116	92	1,344		1,552
24	20 8	140	122	2,438		2,709	52	22	968		1,042
25	20 6	126	108	1,927		2,159	56	46	918		1,020
26	20 4	102	86	2,233		2,511	52	28	1,024		1,104
27	20 3	184	63	2,123		2,370	92	41	1,520		1,653
29	20 0	120	48	1,662		1,830	78	44	696		818
30	19 10	148	67	1,118		1,403	84	44	928		1,056
Total.		2,788	1,745	28,223		32,756	1,478	1,091	14,404		17,063
July											
1	19 8	112	32	836		979	88		098		737
2	19 7	132	55	1,008		1,195	98	42	448		588
3	19 5	124	76	686		886	40	18	472		530
4	19 3	108	86	637		831	20	7	608		635
6	18 9	84	48	768		900	32	16	456		504
7	18 4	72	75	811		958	40	20	608		668
8	18 2	51	34	748		833	22	20	352		394
9	17 9	32	16	534		582	32	15	436		483
10	17 3	24	16	314		384	20	6	302		427
11	16 10	16	6	236		258	32	7	208		247
Total.		755	444	6,607		7,806	433	192	4,588		5,213
Grand total.		4,344	2,315	39,201		45,860	3,955	1,435	20,007		25,397
1886.											
May											
12	12 4						12		53		65
13	12 8						8		40		48
14	12 9						8		24		32
15	12 6						8		12		20
20	13 0						4	2	15		21
21	14 2						20	2	69		91
22	16 2						16	4	64		84
24	18 6	16	3	167		186	4	1	88		93
25	18 11	12	4	145		161	16		24		40
26	19 5	12	2	183		197	50	4	111		165
27	20 6	16		128		144	40	2	51		93
28	21 6	28	5	199		232	28	3	95		126
29	22 9	28	6	326		360	16	2	40		58
31	23 11	20	4	303		327	4		24		28
Total.		132	24	1,451		1,607	234	20	710		964

Statement of the daily catch of salmon in two wheels, etc.—Continued.

Date.	Height of water.	Oregon.					Washington.				
		Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.	Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.
1886.	<i>Ft. in.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>
June 1	24 4	52	16	546	.....	614	20	12	44	.....	76
2	24 6	88	25	450	.....	563	47	10	96	.....	153
3	24 11	116	44	583	.....	743	70	18	152	.....	240
4	25 3	152	72	578	.....	802	138	34	216	.....	388
5	25 6	300	114	635	.....	1,049	126	34	216	.....	376
7	26 0	192	77	899	.....	1,168	60	14	192	.....	266
8	26 6	116	60	671	.....	847	44	14	280	.....	338
9	26 9	196	72	1,437	.....	1,705	48	35	144	.....	227
10	26 9	248	100	2,191	.....	2,539	136	71	860	.....	1,073
11	26 8	240	103	2,844	.....	3,187	56	22	480	.....	558
12	26 0	156	62	2,284	.....	2,502	52	24	572	.....	648
14	26 0	145	64	2,749	.....	2,958	80	25	1,312	.....	1,417
15	25 4	212	130	4,819	.....	5,161	72	45	1,530	.....	1,053
16	24 11	204	129	6,359	.....	6,692	116	38	2,304	.....	2,458
17	24 6	330	138	7,644	.....	8,112	.....	.....	.....	.....	.....
18	24 0	260	110	8,444	.....	8,814	.....	.....	.....	.....	.....
19	23 6	214	68	8,851	.....	9,133	.....	.....	.....	.....	.....
20	22 8	177	82	7,775	.....	8,034	116	51	1,072	.....	2,130
22	22 3	316	138	7,946	.....	8,400	92	48	1,848	.....	1,988
23	21 10	408	200	5,437	.....	6,045	84	33	1,508	.....	1,625
24	21 6	440	168	4,117	.....	4,725	126	113	888	.....	1,127
25	21 3	342	132	4,826	.....	5,309	106	73	1,432	.....	1,611
26	20 0	476	144	4,128	.....	4,748	88	56	732	.....	876
28	20 6	188	34	2,162	.....	2,384	80	50	1,008	.....	1,138
29	20 2	224	62	2,257	.....	2,543	88	59	912	.....	1,059
30	20 0	346	130	1,602	.....	2,078	52	39	456	.....	547
Total.	.....	6,138	2,474	92,234	.....	100,846	1,897	918	19,166	.....	21,981
July 1	19 11	232	100	927	.....	1,259	76	49	512	.....	637
2	19 9	284	72	837	.....	1,193	92	57	778	.....	927
3	19 5	228	66	547	.....	841	82	35	696	.....	813
5	18 11	60	26	253	.....	339	24	13	216	.....	253
6	18 9	4	6	187	.....	187	4	19	456	.....	519
7	18 4	20	9	221	.....	250	4	2	312	.....	318
8	18 2	48	6	171	.....	225	32	6	272	.....	310
9	17 9	12	17	125	.....	154	25	6	216	.....	247
10	17 3	.....	.....	.....	.....	.....	20	2	136	.....	158
12	16 5	.....	.....	.....	.....	.....	8	5	40	.....	53
13	16 2	.....	.....	.....	.....	.....	12	1	40	.....	53
Total.	.....	888	302	3,268	.....	4,458	419	195	3,674	.....	4,288
Grand total.	.....	7,158	2,800	96,953	.....	106,911	2,550	1,133	23,550	.....	27,233
1887.											
May 2	15 8	.....	.....	178	.....	178	.....	.....	.....	.....	.....
3	16 5	.....	.....	78	.....	78	.....	.....	54	.....	54
4	16 6	.....	.....	.....	.....	.....	.....	.....	72	.....	72
5	16 5	.....	.....	.....	.....	.....	3	.....	26	.....	26
7	16 6	.....	.....	.....	.....	.....	10	.....	64	.....	74
9	16 11	.....	.....	.....	.....	.....	108	.....	150	.....	258
10	17 0	20	.....	278	.....	298	73	.....	116	.....	189
11	16 9	12	.....	102	.....	114	38	1	58	.....	97
12	16 5	.....	.....	.....	.....	.....	80	1	76	.....	157
13	16 6	24	.....	80	.....	104	168	.....	130	.....	304
14	16 5	72	2	64	.....	138	250	2	176	.....	428
16	15 8	.....	.....	.....	.....	.....	518	2	200	.....	720
17	15 5	.....	.....	.....	.....	.....	110	1	120	.....	237
18	15 6	.....	.....	.....	.....	.....	116	2	232	.....	350
19	16 0	.....	.....	.....	.....	.....	184	2	272	.....	458
20	17 2	68	2	56	.....	126	208	2	416	.....	626
21	18 10	208	12	487	.....	707	158	7	112	.....	277
23	21 0	52	8	222	.....	282	4	.....	88	.....	92
24	21 5	68	10	184	.....	262	20	1	48	.....	69
25	21 6	80	10	213	.....	306	44	6	72	.....	122
26	21 10	120	14	236	.....	370	40	2	40	.....	82
27	22 11	111	20	159	.....	290	24	2	40	.....	66
28	23 11	48	4	246	.....	298	12	.....	24	.....	86
30	25 11	24	5	64	.....	69	8	.....	12	.....	20
31	27 3	12	2	24	.....	38	4	.....	8	.....	12
Total.	.....	922	89	2,071	.....	3,082	2,186	31	2,612	.....	4,820

Statement of the daily catch of salmon in two wheels, etc.—Continued.

Date.	Height of water.	Oregon.					Washington.				
		Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.	Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.
1887.	<i>Ft. in.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>
June 1	28 10	.....	1	56	.....	57	.....	.....	16	.....	18
6	30 7	6	.....	42	.....	48	2	.....	.....	.....	43
7	30 2	24	4	119	.....	147	10	1	32	.....	88
8	29 7	72	7	303	.....	382	20	4	64	.....	207
9	29 2	100	26	536	.....	662	48	7	152	.....	167
10	28 9	223	32	768	.....	1,023	43	12	112	.....	432
11	28 6	412	65	909	.....	1,476	172	36	224	.....	250
13	28 9	470	113	829	.....	1,412	88	26	136	.....	.....
14	29 1	224	62	696	.....	982	.....	.....	.....	.....	.....
15	29 4	440	87	1,436	.....	1,963	64	11	280	.....	355
16	29 8	296	86	1,456	.....	1,838	42	30	408	.....	480
17	30 2	348	120	1,948	.....	2,425	64	34	408	.....	506
18	31 11	84	34	600	.....	718	2	3	24	.....	29
20	32 10	.....	4	56	.....	60	.....	.....	58	.....	58
21	32 4	20	4	1,472	.....	1,496	.....	.....	.....	.....	.....
22	32 2	48	40	2,536	.....	2,624	.....	.....	.....	.....	.....
23	32 1	104	74	2,022	.....	2,200	84	32	672	.....	788
24	32 1	192	116	2,069	.....	2,377	36	23	448	.....	507
25	32 5	208	164	2,114	.....	2,486	80	37	920	.....	1,037
27	32 6	191	94	2,484	.....	2,769	12	10	256	.....	278
28	32 0	175	79	3,384	.....	3,638	36	4	280	.....	320
29	31 7	300	190	3,216	.....	3,706	80	35	632	.....	747
30	30 10	460	274	3,743	.....	4,477	70	55	528	.....	653
Total.	.....	4,397	1,685	32,884	.....	38,066	953	860	5,660	.....	6,973
July 1	30 2	464	196	4,215	.....	4,875	143	109	648	.....	900
2	29 6	428	188	4,272	.....	4,886	120	78	584	.....	780
4	29 0	312	98	3,196	.....	3,606	76	74	408	.....	558
5	28 10	332	119	3,028	.....	4,079	136	100	312	.....	548
6	28 8	314	100	2,640	.....	3,054	110	84	240	.....	434
7	28 5	348	110	2,177	.....	2,635	112	67	344	.....	523
8	28 2	264	108	1,498	.....	1,870	96	81	496	.....	673
9	28 1	228	83	1,028	.....	1,339	126	83	328	.....	613
10	27 10	.....	.....	.....	.....	.....	64	22	264	.....	434
11	27 8	298	86	682	.....	870	98	25	296	.....	551
12	27 4	164	30	577	.....	771	72	10	224	.....	414
13	26 9	60	20	224	.....	304	56	34	176	.....	304
14	26 3	152	26	640	.....	818	56	17	112	.....	329
15	25 9	116	16	568	.....	700	72	14	296	.....	550
16	25 1	80	12	480	.....	572	60	8	256	.....	524
18	23 10	108	54	784	.....	946	100	41	296	.....	861
19	23 2	72	30	264	.....	366	28	11	72	.....	187
20	22 8	272	65	224	.....	561	18	20	64	.....	234
21	21 11	344	76	216	.....	636	32	28	108	.....	652
22	21 6	516	98	496	.....	1,110	8	12	16	.....	164
23	21 1	380	130	536	.....	1,052	48	30	24	.....	462
25	20 3	276	52	384	.....	712	78	72	944	.....	1,094
26	19 11	212	26	320	.....	558	37	20	.....	.....	457
27	19 6	144	30	352	.....	526	36	16	.....	.....	308
28	19 2	220	44	464	.....	728	38	28	.....	.....	338
29	18 11	212	54	480	.....	746	28	21	.....	.....	313
30	18 8	204	36	480	.....	720	38	11	.....	.....	301
Total.	.....	6,430	1,841	30,775	.....	39,046	1,886	1,114	5,564	5,122	13,686
Aug. 1	18 0	.....	.....	.....	.....	.....	62	28	.....	234	324
Grand total.	.....	11,749	3,615	66,330	.....	81,694	5,087	1,533	13,830	5,356	25,812
1888.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Apr. 26	12 1	.....	.....	.....	.....	.....	.....	.....	44	.....	44
27	13 1	.....	.....	.....	.....	.....	.....	.....	68	.....	68
28	13 2	.....	.....	.....	.....	.....	.....	.....	56	.....	56
30	12 10	.....	.....	.....	.....	.....	12	.....	19	.....	31
Total.	.....	.....	.....	.....	.....	.....	12	.....	187	.....	199
May 1	12 7	.....	.....	.....	.....	.....	17	.....	24	.....	41
2	12 6	.....	.....	.....	.....	.....	28	1	56	.....	85
3	12 9	.....	.....	.....	.....	.....	44	.....	80	.....	124
4	13 6	.....	.....	.....	.....	.....	54	.....	132	.....	186
5	13 11	.....	.....	.....	.....	.....	20	.....	40	.....	60
7	14 4	.....	.....	.....	.....	.....	80	1	64	.....	145
8	14 9	.....	.....	.....	.....	.....	60	4	2	.....	66
9	15 0	.....	.....	.....	.....	.....	20	.....	32	.....	52

Statement of the daily catch of salmon in two wheels, etc.—Continued.

Date.	Height of water.	Oregon.					Washington.				
		Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.	Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.
1888.	<i>Ft. in.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>
May 10	15 3	16	2	72	.....	90	48	1	50	.....	105
11	15 9	26	.....	104	.....	130	36	2	40	.....	78
12	16 2	68	4	440	.....	512	32	.....	48	.....	80
14	16 2	84	.....	112	.....	196	53	2	96	.....	151
15	15 10	28	2	144	.....	174	62	.....	24	.....	86
16	16 0	44	2	96	.....	142	73	3	24	.....	100
17	16 5	96	4	180	.....	280	84	8	68	.....	160
18	17 1	36	4	32	.....	72	72	0	88	.....	169
19	17 9	64	12	216	.....	292	80	10	120	.....	210
21	17 6	64	4	184	.....	252	64	14	16	.....	94
22	17 4	48	8	168	.....	224	76	4	64	.....	144
23	17 1	80	6	168	.....	254	44	.....	24	.....	68
24	17 0	100	4	112	.....	216	165	12	90	.....	267
25	16 8	64	4	104	.....	172	96	5	64	.....	165
26	16 5	16	.....	48	.....	64	64	.....	48	.....	112
28	16 3	28	2	64	.....	94	64	1	84	.....	140
29	16 4	34	2	176	.....	212	51	2	48	.....	101
30	16 9	40	18	152	.....	210	28	3	16	.....	47
31	17 3	32	6	248	.....	286	17	.....	13	.....	30
Total	.....	968	84	2,820	.....	3,872	1,532	82	1,461	.....	3,075
June 1	17 9	48	20	272	.....	340	28	6	48	.....	82
2	18 5	76	32	440	.....	548	38	5	96	.....	139
3	18 5	.....	.....	312	.....	374	9	.....	64	.....	73
4	19 7	56	34	284	.....	374	6	.....	104	.....	110
5	20 3	36	20	216	.....	272	6	.....	216	.....	229
6	20 9	60	30	304	.....	394	11	2	308	.....	316
7	21 4	36	18	176	.....	230	6	2	210	.....	240
8	21 9	28	24	168	.....	220	15	9	210	.....	232
9	22 1	24	12	360	.....	396	14	2	210	.....	154
11	22 7	36	70	360	.....	466	10	.....	144	.....	196
12	22 9	172	120	552	.....	844	17	7	172	.....	700
13	22 10	108	70	328	.....	506	65	29	808	.....	701
14	22 11	136	70	752	.....	958	13	4	884	.....	401
15	23 10	28	28	120	.....	176	11	5	368	.....	384
16	23 3	24	4	204	.....	292	2	1	192	.....	195
18	23 6	64	52	368	.....	484	15	3	176	.....	205
19	23 7	96	112	672	.....	880	20	10	224	.....	265
20	23 6	224	174	632	.....	1,030	62	20	304	.....	380
21	23 4	308	210	992	.....	1,510	56	23	496	.....	591
22	23 1	238	117	1,562	.....	1,917	48	26	702	.....	896
23	23 11	320	100	1,574	.....	1,904	55	28	1,144	.....	1,280
25	22 1	164	34	1,336	.....	1,534	52	21	592	.....	713
26	21 7	240	26	2,360	.....	2,626	90	26	856	.....	1,096
27	21 3	280	38	2,368	.....	2,686	88	19	992	.....	1,391
28	20 10	228	26	1,600	.....	1,854	86	25	704	.....	1,219
29	20 7	384	24	1,472	.....	1,880	64	24	556	.....	1,156
30	20 4	384	20	968	.....	1,372	108	26	632	.....	1,446
Total	.....	3,798	1,485	20,500	.....	25,783	989	321	10,514	.....	14,005
July 2	19 7	304	8	432	.....	744	20	2	136	.....	550
3	19 3	348	14	536	.....	898	53	10	280	.....	959
4	18 10	316	12	704	.....	1,032	50	15	344	.....	897
5	18 7	272	8	512	.....	792	44	9	368	.....	813
6	18 5	288	10	416	.....	714	48	14	240	.....	844
7	18 1	152	6	368	.....	466	40	11	176	.....	523
9	17 5	304	4	344	.....	652	12	3	56	.....	267
10	17 1	104	2	232	.....	398	10	1	32	.....	227
11	16 7	4	.....	48	.....	52	18	1	48	.....	303
12	16 3	104	6	192	.....	302	6	1	24	.....	251
13	15 10	.....	.....	.....	.....	.....	8	1	16	.....	275
14	15 6	.....	.....	.....	.....	.....	4	.....	16	.....	132
16	14 10	.....	.....	.....	.....	.....	4	1	8	.....	69
17	14 6	.....	.....	.....	.....	.....	4	.....	8	.....	64
18	14 4	.....	.....	.....	.....	.....	8	.....	8	.....	40
19	14 4	.....	.....	.....	.....	.....	1	.....	0	.....	28
20	14 1	.....	.....	.....	.....	.....	.....	.....	0	.....	21
21	13 10	.....	.....	.....	.....	.....	.....	.....	0	.....	30
Total	.....	2,256	70	3,724	.....	6,050	339	69	1,772	.....	6,095
Grand total	.....	7,022	1,639	27,044	.....	35,705	2,863	472	13,694	.....	23,374

Statement of the daily catch of salmon in two wheels, etc.—Continued.

Table with columns for Date, Height of water, and catch statistics for Oregon and Washington. The table is organized into two main sections: Oregon and Washington, each with sub-columns for Small chinooks, Large chinooks, Blue-backs, Steel-heads, and Total. The 'Total' column for each section includes a 'Number' and a '89' value. The data spans from 1890 to July 23, with a grand total at the bottom.

Statement of the daily catch of salmon in two wheels, etc.—Continued.

Date.	Height of water.	Oregon.					Washington.				
		Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.	Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.
1891.	<i>Ft. in.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>
May 11	14 5						2	1	3		6
12	14 3						4		5		9
13	14 0						5		6		11
14	13 10						8		12		20
15	14 1						7		8		17
16	14 7						27	1	18	1	47
18	16 3	33	6	56		95	24	4	16		44
19	17 2	11	6	28		45	56	5	40		101
20	18 0	25	7	74		106	27	6	39		72
21	18 4	14	4	61	1	80	18	4	32	1	55
22	18 4	9	2	74		85	20	4	32		56
23	18 1	16	4	67		87	05	10	76		151
25	17 8	37	8	124	1	170	54	9	79	1	143
26	17 6	63	11	112		186	54	7	104	2	167
27	17 10	76	16	161	4	257	64	16	120		200
28	18 3	24	9	119		152	26	14	48		88
29	18 7	24	17	163		204	7	5	32	3	47
30	19 0	20	24	128	1	173	35	16	85		136
Total.		352	114	1,167	7	1,640	504	102	755	9	1,370
June 1	19 4	21	14	125	1	167	16	6	76	1	99
2	19 5	39	17	116		172	91	12	134	1	238
3	19 5	35	26	188		249	66	12	144	2	224
4	19 4	52	21	216	2	291	58	23	184	2	272
5	19 4	62	38	276	1	377	86	33	88	2	209
6	19 4	47	29	248		324	35	13	40		88
8	19 5	27	20	74	4	125	60	30	52		142
9	19 4	42	24	144		210	32	16	72		120
10	19 2	36	20	178	1	235	42	11	72	5	180
11	19 0	40	16	160	2	218	43	13	40	3	99
12	18 7	36	10	140	2	188	42	21	80	2	145
13	18 6	54	32	108	2	256	68	47	118	6	239
15	18 0	53	24	170	7	260	51	26	92	6	175
16	18 1	29	17	152	5	203	53	31	144	5	213
17	18 5	44	32	131	2	209	43	40	153	8	244
18	18 4	27	22	164	5	218	15	15	173	9	212
19	18 1	8	12	120	6	146	6	5	178	3	192
20	18 1	12	12	115	9	148	10	1	164	8	183
22	18 5	15	6	145	9	175	15	8	107	6	136
23	18 7	20	34	128	10	192	20	16	100	12	148
24	18 7	20	19	104	13	156	14	25	145		184
25	18 4	18	14	206	20	258	12	13	151	14	190
26	18 5	36	25	232	12	305	23	14	252	22	311
27	18 2	48	38	264	10	360	52	42	257	38	389
29	17 8	35	3	137	13	188	22	5	118	36	181
30	17 5	20	6	176	14	216	21	12	166	33	232
Total.		876	531	4,283	150	5,840	976	495	3,300	224	4,995
July 1	17 0	24	2	178	16	220	11	2	146	34	193
2	16 8	16	4	56	9	85	15	1	103	40	159
3	16 4	8	4	72	5	89	7		127	45	179
4	16 0			11	2	13	8	2	79	67	166
6	15 6						4		8		79
7	15 5						5		25	176	206
8	15 1								21	157	178
9	14 11						2		15	68	85
10	14 9						4		15	53	72
11	14 8						1		23	65	89
13	14 8						3		4	27	34
14	14 6								10	44	54
15	14 4								8	87	95
16	14 3						2	2	12	80	96
17	13 10						6	1	0	20	27
18	13 5						2		11	50	68
20	13 0						1		3	11	15
21	12 10								6	13	19
22	12 7								3	4	7
23	12 6						2		2	8	12
24	12 4								2	4	6
25	12 5									5	5
27	12 4								3		3
Total.		48	10	317	32	407	73	8	626	1,135	1,842
Grand total.		1,276	655	5,767	189	7,887	1,553	605	4,681	1,368	8,207

Statement of the daily catch of salmon in two wheels, etc.—Continued.

Date.	Height of water.	Oregon.					Washington.				
		Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.	Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.
1892.	Ft. in.	Number.	Number.	Number.	Number.	Number.	Number.	Number.	Number.	Number.	Number.
May											
14	11 7			40		49			19		19
16	12 3			07		07			84		84
17	12 5			151		151			128		128
18	12 8	2		248		250			176		176
19	13 0			320		320			99		99
20	13 7	8	1	698		705	4	1	144		148
21	14 5	8	5	1,328		1,341	4		360		364
23	15 10	48	3	304		355	18	2	128		148
24	16 11	52	12	490		560	8	3	80	1	92
25	18 6	30	4	336		370	3		40		43
26	20 0	24	8	312		334	2	1	04		67
27	20 9	4		40		44	2		112		114
28	21 7	1	1	96		97			160		160
30	22 11	8		56		64		2	40		42
31	23 9	4	2	56		62	7	1	33		41
Total.		189	35	4,536		4,760	48	9	1,667	1	1,725
June											
1	24 2	4	2	32		38	3	1	37	2	43
2	23 10	8	4	132		164	12	4	39		55
3	23 5	36	8	224		268	28	7	04		89
4	23 0	44	11	215		270	26		184	1	211
6	22 3	192	49	256		497	32	5	128		165
7	21 10	160	50	88		298	20	4	48		72
8	21 8	214	74	114		402	28	5	104	3	140
9	21 9	216	58	109		383	112	12	248	4	376
10	22 0	188	62	40	2	292	52	23	112	8	195
11	22 3	136	61	118		315	40	13	248	6	307
13	22 2	180	51	48	5	284	98	20	168	6	292
14	22 8	370	132	152	2	656	76	32	136	8	252
15	22 7	272	90	96	4	462	72	25	168	6	271
16	23 0	236	106	24	7	373	56	18	72		146
17	23 6	220	82	96	23	421	86	38	80	12	216
18	23 11	232	98	72	8	410	91	36	144	35	306
20	24 9	124	52	64	13	253	64	18	128	11	221
21	25 1	36	26	56	17	135	24	8	168	24	224
22	25 5	45	14	88	13	160	34	8	72	28	142
23	25 6	40	16	64	11	131	36	10	120	20	186
24	25 5	48	26	64	4	142	52	6	128	32	218
25	25 2	136	56	272	36	509	95	57	390	34	576
27	24 5	270	126	832	68	1,296	85	65	594	36	690
28	24 3	234	176	840	44	1,294	90	87	984	72	1,239
29	24 4	280	184	832	196	1,492	66	86	768	109	1,029
30	24 5	204	110	300	148	822	52	35	784	114	985
Total.		4,125	1,724	5,308	601	11,758	1,436	623	6,026	571	8,656
July											
1	24 7	216	118	268	224	826	55	41	616	180	892
2	24 9	32	20	32	44	128	38	20	424	180	602
4	24 9	108	58	216	200	582	66	33	336	298	733
5	24 8	124	96	120	184	524	70	51	344	248	713
6	24 6	116	82	136	216	550	59	25	261	208	556
7	24 4	60	47	96	168	371	32	12	144	187	375
8	24 2	72	46	204	197	519	25	11	224	235	495
9	23 10	128	78	136	310	658	52	50	232	228	562
11	23 2	52	96	98	320	560	20	21	80	200	321
12	22 7	84	102	96	308	590	4	8	32	61	108
13	22 2	53	110	64	288	515	12	23	72	288	395
14	21 8	76	58	71	300	505	4	14	64	452	534
15	21 9	52	126	40	380	598	16	77	16	522	631
16	20 8	32	144	32	376	584	8	59	26	670	769
18	19 7	56	62	9	420	547	20	23	5	568	616
19	18 11	60	52	16	420	548	16	24		448	488
20	18 5	44	60	14	384	502	16	31	15	528	590
21	17 11	14	36	8	196	254	8	3	6	324	341
22	17 5	40	46	5	356	447	10	7		292	309
23	16 11	52	32	13	291	388	12	5		230	247
25	16 2	32	20	2	96	160	20	3		220	243
26	15 7	43	21		72	134	12	3		148	163
27	15 2	36	26	2	70	134	5	2		72	79
28	14 8	28	14		48	90				28	28
29	14 3	24	6	3	32	65			8	58	66
30	13 10	28	6	2	19	55	8	7		50	65
Total.		1,662	1,556	1,683	5,925	10,826	588	553	2,908	6,932	10,981
Aug.											
1	13 2	8	1	2	7	18	5			11	16
2	12 9	4		3	24	31					
3	12 4	6		1	2	9					
Total.		18	1	6	33	58	5			11	16
Grand Total.		5,994	3,316	11,533	6,559	27,402	2,077	1,185	10,601	7,515	21,378

Statement of the daily catch of salmon in two wheels, etc.—Continued.

Date.	Height of water.	Oregon.					Washington.				
		Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.	Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.
1893. Apr. 27	<i>Ft. in.</i> 10 6	Number.	Number.	Number.	Number.	Number.	Number. 8	Number. 12	Number. 1	Number. 21	
May 1	12 6	1		14		15	5	2	10	1	18
2	12 8	2		15		17	19	10	3	4	36
3	13 1	3	1	16		20	6	3	28		37
4	13 4	1		24		25					
5	13 8	2	1	26		29					
6	14 1	2		36		38					
8	14 5	2	1	35		38	7	2	23	1	33
9	14 9	3	1	31		35	9	2	25	3	39
10	15 4	10	6	13		29	21	3	52		76
11	16 4	4	5	31		40			16	1	17
12	17 5	2	1	18		21	1		7		8
13	18 4	3	6	46		55	1	1	11		13
15	19 7	3	4	9		49	1	2	10		13
16	20 6	19	11	39		69	8	1	13		22
17	21 7	12	17	40	1	70	11	1	35		47
18	22 7	5	9	3		17	2		3	4	9
19	24 0	3		7		10					
20	25 8		1	2	2	5					
22	26 2	3		11		14	5		16		21
23	26 0	3		24		27					
24	25 8	2	1	21		24					45
25	25 3	6	2	56		64	27	7	35		81
26	25 0	17	10	40	5	70	58	8	46	1	153
27	24 9	52	23	80		155	149	32	160	4	345
29	24 0	144	50	112		306	74	6	50	3	133
30	24 0	110	52	73		235	113	15	116	6	250
31	23 11	140	31	88	4	263	60	12	101		173
Total.		560	233	937	10	1,740	582	112	846	29	1,560
June 1	24 6	162	28	126		316	76	16	141	6	239
2	24 7	166	46	96	1	309	136	34	246	3	419
3	24 10	240	95	68	2	405	90	32	308	2	432
5	24 10	322	72	59	9	462	71	14	52	6	143
6	24 6	264	75	80		419	124	40	108		332
7	24 11	184	62	368	6	620	114	38	127	4	283
8	25 1	124	50	144	7	325	97	49	126	6	278
9	25 10	96	26	144	4	270	88	37	94	6	225
10	26 7	72	14	264	4	354	101	48	279	9	437
12	27 3	32	12	138	7	189	17	4	52	5	78
13	27 8	20	5	96	6	127	33	13	106	1	153
14	28 1	16	4	96	4	120	35	6	99	2	142
15	28 2	8	6	80	2	96	10	1	39	1	51
16	27 10	8	3	79	5	95	8	1	36	3	48
17	27 3	28	6	160	6	200	49	19	129	5	202
19	26 5	104	52	80	2	238	108	57	88	3	256
20	26 3	126	72	65	3	266	134	125	173	13	445
21	26 5	148	92	136	7	383	195	180	498	12	885
22	26 0	118	52	96	8	272	84	123	439	16	662
23	25 6	80	45	80	8	213	48	54	309	18	429
24	24 11	60	34	176	12	282	48	46	369	19	482
26	24 1	224	108	264	23	610	149	94	319	16	578
27	23 10	272	172	400	28	872	334	236	1,038	49	1,657
28	23 6	163	96	335	34	628	153	102	1,116	49	1,420
29	23 5	160	68	322	44	614	102	90	1,076	48	1,316
30	23 7	132	66	304	88	590	92	47	832	57	1,028
Total.		3,327	1,381	4,256	320	9,284	2,466	1,566	8,250	359	12,620
July 1	23 5	120	88	288	111	607	150	59	1,088	140	1,435
3	22 9	84	42	136	132	394	49	23	232	65	369
4	22 4	72	32	208	132	444	113	53	571	89	829
5	22 2	66	43	216	160	485	108	52	884	98	1,142
6	22 3	68	24	198	156	446	78	57	649	118	902
7	22 0	68	16	202	120	406	140	30	399	328	897
8	21 11	56	17	184	204	461	203	70	445	499	1,217
10	21 2	54	18	152	348	572	45	15	75	329	464
11	20 11	34	24	84	351	493	56	33	122	622	833
12	20 10	40	20	92	254	406	56	10	99	499	664
13	21 1	52	24	104	368	548	33	7	72	538	650
14	21 6	76	40	103	360	579	39	16	90	650	785
15	21 7	80	49	72	400	601	31	23	64	851	1,069
17	21 1	28	18	42	189	277	19	16	27	878	440
18	21 0	28	18	56	252	354	34	18	39	462	553
19	20 11	32	14	56	241	343	16	11	2	390	419
20	20 10	24	6	38	247	315	15	5	29	357	406
21	20 10	36	16	35	240	327	20	10	23	408	461
22	20 8	30	19	30	248	327	25	8	26	612	671
24	20 4	27	16	31	188	262	19	11	18	252	300

Statement of the daily catch of salmon in two wheels, etc.—Continued.

Date.	Height of water.	Oregon.					Washington.				
		Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.	Small chinooks.	Large chinooks.	Blue-backs.	Steel-heads.	Total.
1893.	<i>Ft. in.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>
July 25	20 2	28	15	23	112	178	36	7	17	290	350
26	20 1	38	18	26	172	254	22	12	29	305	368
27	19 9	36	18	33	140	227	12	10	29	315	366
28	19 6	44	21	29	138	232	35	13	27	221	296
29	19 1	36	9	15	96	150	32	21	26	335	414
31	18 6	28	2	8	134	172	13	11	9	168	135
Total.	.....	1,285	627	2,461	5,493	9,866	1,399	601	5,083	9,359	16,442
Aug. 1	18 0	40	8	9	63	120	15	6	7	170	198
2	17 8	40	26	3	78	147	28	18	11	167	224
3	17 3	36	9	10	44	99	13	8	7	171	199
4	17 0	44	12	10	25	91	16	5	5	90	116
5	16 8	31	6	8	100	145	21	13	8	121	163
7	16 1	24	5	.....	16	45	7	.....	1	20	28
8	15 9	28	5	.....	6	30	3	1	.....	19	23
9	15 5	36	2	.....	4	42	6	1	.....	19	26
10	15 4	17	2	1	2	32	4	2	.....	34	40
11	15 0	4	.....	.....	.....	4	1	.....	4	4	9
Total.	.....	310	75	41	338	764	114	54	43	815	1,026
Grand total.	.....	5,482	2,316	7,695	6,161	21,654	4,599	2,273	14,243	10,563	31,678
1894.											
April 12	14 5	.....	.....	.....	.....	.....	1	1	.....	4	6
13	16 0	.....	.....	.....	.....	.....	.....	.....	.....	3	3
14	16 4	.....	.....	.....	.....	.....	2	.....	.....	2	4
17	16 3	.....	.....	.....	.....	.....	.....	.....	.....	2	2
18	15 6	.....	.....	.....	.....	.....	.....	.....	.....	3	3
20	14 6	2	.....	1	.....	3	.....	1	.....	5	6
21	14 5	.....	.....	.....	.....	.....	.....	1	.....	4	5
23	14 10	.....	2	.....	1	3	1	1	.....	3	5
24	18 0	.....	.....	.....	.....	.....	3	1	2	4	10
25	17 4	4	4	3	1	12	4	.....	2	.....	6
26	19 3	.....	.....	.....	.....	.....	.....	1	1	2	4
27	21 4	1	2	.....	.....	3	.....	.....	.....	.....	.....
28	21 0	.....	.....	.....	.....	.....	2	.....	1	.....	3
Total.	.....	7	8	4	2	21	13	6	6	32	57
May 2	21 10	.....	.....	.....	.....	.....	4	.....	1	3	8
3	21 10	1	4	3	2	10	.....	.....	.....	.....	.....
4	20 5	.....	.....	.....	.....	.....	19	1	15	1	36
5	20 0	5	2	4	.....	11	18	4	29	5	50
7	19 4	13	7	25	8	53	13	2	12	.....	27
8	10 10	12	6	24	.....	42	14	8	21	.....	43
9	20 5	4	15	30	.....	49	15	17	20	.....	52
10	20 6	4	4	32	.....	54	9	2	11	.....	22
11	20 8	8	8	56	2	74	13	6	29	2	50
12	20 8	12	10	90	1	113	39	7	68	1	115
14	20 6	16	12	106	2	136	16	5	32	1	54
15	20 11	.....	4	5	1	10	27	5	48	1	81
16	21 7	7	4	20	1	32	15	3	48	1	67
17	22 6	1	1	8	3	13	7	3	23	.....	33
18	23 1	3	3	10	.....	16	3	1	32	.....	36
19	23 4	.....	1	13	1	15	7	.....	37	1	45
21	24 0	.....	2	27	.....	29	6	4	30	.....	49
22	25 9	2	1	4	.....	7	5	4	22	.....	31
23	26 9	.....	.....	.....	.....	.....	4	1	16	.....	21
24	28 0	2	2	3	2	9	5	1	12	.....	18
25	29 3	1	.....	10	.....	11	4	5	16	.....	25
26	30 8	.....	.....	.....	.....	.....	4	3	38	1	46
Total.	.....	91	100	470	23	684	247	82	560	17	915
Grand total.	.....	98	108	474	25	705	260	88	575	40	972

On the salmon industry in 1876.—In the year 1876 Mr. M. J. Kinney, now the most extensive salmon-packer at Astoria, began the canning of salmon at that place. There were then only about 400 gill-net boats on the river, traps and wheels were not employed, and only chinook salmon were utilized for canning. The gill nets were then smaller than those now used, being only 300 fathoms long and 40 meshes deep. The season of 1876

was similar to 1894 in that there was a very heavy freshet, which for a time imperiled the fishery. The run was enormous. With the gear now employed and the factories now operated Mr. Kinney estimates that the output of the Columbia River in 1876 would have been 1,500,000 cases; there were enough fish in the river to pack that quantity.

The pack, as elsewhere given, amounted to 450,000 cases of chinooks, equivalent to over 1,200,000 fish, a larger pack and catch than had been made in any previous year, while in only nine of the subsequent eighteen years were the canning operations more extensive and in only eight were more chinooks packed, notwithstanding the advent of pound nets and wheels and the increase of 50 to 75 per cent in the number of gill nets employed. The boats fishing regularly for Mr. Kinney took an average of 4,300 chinook salmon each during the season. One boat landed 9,194 fish at the cannery, the catch being apportioned as follows among the different months: April, 1,020; May, 1,651; June, 2,631; July, 3,564; August, 328.

The daily catch of the foregoing boat and of ten other boats fishing for Mr. Kinney is shown in the following table. These boats, while representing more than the average production for the lower river, are not selected for this reason, but because of the fact that their operations covered the greater part, if not all, of the fishing season. The aggregate catch of these eleven boats was 55,832 chinook salmon. A similar average catch at the present time would mean an annual pack of over 2,000,000 cases of chinook salmon. These figures are interesting as showing the daily fluctuations in the abundance of fish as well as affording a basis for comparison with other years.

Table showing the daily catch of chinook salmon by eleven gill-net fishermen landing fish at the cannery of Mr. M. J. Kinney, at Astoria, Oreg., in 1876.

Date.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. 9.	No. 10.	No. 11.	Total.
Apr. 15-26.....	*1,000											1,000
27.....				15	9							24
28.....	20			20								40
29.....				25								25
30.....												
Total.....	1,020			60	9							1,089
May 1.....	82					30	21	31	20			184
2.....		28	20	18	38	55	13			17	24	222
3.....	61	42	28	32		61	13		55	26	18	336
4.....		30	47			53				34	48	212
5.....	59	30		75	46	21	54	25	58	30	29	427
6.....		25	56		53	16	56	48		26	40	320
7.....				45	60				51			156
8.....	106	51	71	19	68	42	54	61		50	02	584
9.....	36	45		41	95	51		25	37	31	34	395
10.....		52		51	26		39	58		22	52	300
11.....	110		44		61	60		27			07	369
12.....			13			23	77	67		52	31	263
13.....	84	26		43	51		42	15	36	23	47	389
14.....				18	42		24	48				132
15.....	135	51	65	46	27	38			43	66	25	496
16.....	94	25					57	50			63	280
17.....		33	31	49	08	19	93	92	50	61	34	530
18.....	127	58	78	65	60	40	65	47	57	64	71	732
19.....		56	52	24	101	77	57	49		49	42	507
20.....	146	91	58	16	110	113		73	60	36	64	767
21.....		60		47		128	58				59	352
22.....	107	17	43		76	22	64	101	108	79	34	651
23.....	25		48	29	68		29	46		64	34	343
24.....		74	54	20	12	36	77	47	47	23	65	455
25.....	99	60	59		66	72	65	87	78	29		615
26.....	29	35	27	10	51	45	50		80		27	354
27.....		34		27	45	31	109	56		34	47	383
28.....	22	62				50		84	85			393
29.....	86	54	62	26	60	41	63	74		40	34	549
30.....			47					100		76	27	250
31.....	223		37	58	66	88	101		38		32	643
Total.....	1,631	1,030	971	759	1,350	1,212	1,281	1,311	903	941	1,110	12,568

* No accurate record was kept for the first 12 days' fishing of this fisherman. He made some very large lifts before most of the other fishermen began operations, and his catch was estimated by Mr. Kinney at the number shown.

Table showing the daily catch of chinook salmon by eleven gill-net fishermen landing fish at the cannery of Mr. M. J. Kinney, at Astoria, Oreg., in 1876—Continued.

Date.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. 9.	No. 10.	No. 11.	Total.
June 1.....	43		80	78	90	82	48	123		112	121	778
2.....	117		65		100	24	107	82	123	73	108	799
3.....	114	113	78	67	92	51	11	72		117	45	760
5.....	208	126	26		217	222	174	133	111	75	188	1,430
6.....	172	119	52	110	188	142	74	104	137	67	106	1,277
7.....	141	56	93	87	145	74		97		89	130	912
8.....		121	109			124	72	53	154	51	71	755
9.....	138	108	63	87	106	56	83			73	105	819
10.....	84	52	39	18	13	40	79	91		58	72	545
11.....		31	36						21		62	150
12.....		122	25	63	70	139	59	85	173		23	759
13.....	170	61	72	72	89	42		829	200		117	829
14.....	171	63	54	72	74	103	51	81	181		107	957
15.....	184	103	92	110	82	68	114	72			114	939
16.....		67	100		74	13	164	89			80	587
17.....	77				62	77	44		82		103	445
19.....	82		82	64	62	64	81	19			85	539
20.....	106		103	44		68	80	29	69		105	604
21.....	43	66	33	58		53	80	50				383
22.....	153	81	87	88		48	44	21	70		75	667
23.....	63	47	47		132	80		79	35	28	45	556
24.....	80	55	37	157	78	62	135	19	81	43	65	812
25.....		73			124							197
26.....	64		24			77	18	92	55	70	79	479
27.....	128	82		94	55	100	140	62	74	25	101	861
28.....	19	25		94	25	100	125	88	42	53	95	666
29.....	148	96			12	30	53	186		49	80	954
30.....	126	61		110	107	65	125	116	72	72	103	957
Total.....	2,631	1,728	1,325	1,479	1,934	2,002	1,945	1,954	1,650	1,124	2,335	20,116
July 1.....	141	61	79	112	113	56	82	105	40	72	81	442
3.....	166	140	154	115	164	152	48	112		103	166	1,320
4.....	184	132	128	81	160	91	121	103	27	51	132	1,150
5.....	94	118	96	133	105		106	90	61		106	879
6.....	171	95	57	80	206	82	97	49		120	88	1,045
7.....	168	85	73	115	237	102	60	83		90	123	1,136
8.....	91	54	94	68	147	81	60	104		94	63	856
9.....		14										14
10.....	182	22	70	48	90	121	72	52	21	59	82	819
11.....	128	40	51	78	148	46	89			75	54	715
12.....	105	39	41	63	104	65	51	81		66	94	709
13.....	94		53	56	95	41	56	34	20	76	83	608
14.....	144	30	59	44	82	71	74	108	36	66	85	799
15.....	165	83	73		98		150	106	6	126	65	872
16.....	161	37	104	98	170					90	200	860
17.....	132	87	83	90	121		65	91			108	777
18.....	168	97	30	140	127		105	73		112	74	799
19.....	174	110	71		127			94	22	84	95	777
20.....	92	63	54	35	56		113	148	75	104	88	828
21.....	145	94	85	94	36		65	109	53	78	122	879
22.....	236	78	44	97			64	80		88	77	764
24.....	113	54	46	82	71		77	107	26	76	52	704
25.....	108	15	33	43			83	72	94	73	45	568
26.....	107	50	25	27	64		76	50	82	83	34	598
27.....	90	33	31	31	40		53	29	25	91	50	473
28.....	74	32	66				58		47	87	41	405
29.....	60	19	44	54	26		35	65	30	46	26	405
30.....	56		16					48	39			159
31.....	25		13		11		10	39	56	38	54	249
Total.....	3,574	1,688	1,711	1,674	2,551	908	1,879	2,026	780	1,548	2,288	20,607
Aug. 1.....	60		34	8				28	27	32	51	240
2.....	24		47		8			62	28	28	52	219
3.....	40		35		22			31		56		199
4.....			15		17			28		44	35	139
5.....	65		18		33			25		64	26	231
6.....	48		17		39						31	185
7.....	41		14		20			34		55	21	185
8.....	33		14		24			12		34	20	137
9.....	11		5		20							36
Total.....	328		190	8	183			220	55	313	206	1,512
Grand total.	9,184	4,455	4,206	3,980	6,027	4,122	5,105	5,511	3,377	3,926	5,939	55,832

Notes on the weight of salmon.—Owing to the practice of the canners of buying the salmon only by weight or by number, as may be determined on at the beginning of the season, it is not always easy to obtain accurate figures showing the average weights of salmon, except in small quantities and for isolated dates. The following tabulations and notes may therefore possess some elements of general interest and serve as a basis for comparisons.

In the case of chinook salmon it is found that the largest fish are taken in greatest numbers about June 10 or 20 of each year. The fish running at the beginning and at the end of the season represent the minimum average sizes, the decline in weight from the middle of June being in both directions. In 1894 there was a noteworthy run of very large fish in the lower river about the middle of June. One salmon weighing 74 pounds was landed at the cannery of J. O. Hanthorn & Co., Astoria, which was the largest seen in a number of years; its greatest girth was 45 inches and its length was 56 inches. Seven salmon, caught in gill nets and traps on June 20, and weighing 390 pounds in the aggregate, were found lying together at the cannery of Mr. M. J. Kinney, Astoria.

The average weight of the Columbia River chinook salmon is usually given as 22 to 25 pounds. The detailed data obtained by the writer give 22.76 pounds as the average weight of 104,831 chinook salmon caught in 1893 with gill nets, traps, and seines. The weights vary considerably with the apparatus employed and, as previously stated, with the season. Contrary to the usually accepted theory, the average weight of the fish taken in pound nets is but little less than those caught with gill nets; during the month of June the trap-caught fish are larger than those obtained with gill nets, and there are days in every month when the trap fish will average larger than the others.

The following table is a detailed presentation of the variations in the average weights of chinook salmon, depending on the month and apparatus in which caught. More than 100,000 fish are involved in the comparison, a number which is sufficiently large to warrant generalizations from the figures.

Statement showing by months the number, weight, and average weight of chinook salmon taken with gill nets, pound nets, and seines at the mouth of the Columbia River and landed at a salmon cannery at Astoria, Oreg., in 1893.

Months.	Caught by gill nets.			Caught by pound nets.			Caught by seines.			Total.		
	No. of fish.	Total weight (pounds).	Average weight.	No. of fish.	Total weight (pounds).	Average weight.	No. of fish.	Total weight (pounds).	Average weight.	No. of fish.	Total weight (pounds).	Average weight.
April	6,409	129,052	20.14	146	7,569	18.19	.....	.....	.....	6,825	136,621	20.02
May	23,468	528,498	22.52	1,793	39,922	22.26	.....	.....	.....	25,261	568,420	22.50
June	22,008	530,397	24.10	3,350	86,618	25.86	158	3,804	24.08	25,516	620,819	24.33
July	15,917	374,851	23.58	6,550	146,360	22.35	5,889	131,953	22.41	28,356	653,164	23.03
August	12,892	287,139	21.88	3,109	64,464	20.73	2,872	59,999	20.89	18,873	406,602	21.54
Total ...	80,694	1,844,937	22.86	15,218	344,933	22.67	8,919	195,756	21.95	104,831	2,385,626	22.76

Some daily comparisons of the weights of chinook salmon caught in gill nets and pound nets, respectively, are presented in the following statement. The figures relate to about three months of the fishing season of 1893. The fish shown were landed at a cannery in Astoria between April 17 and June 28. The smallest average for gill-net fish was 18.49 pounds, on May 6; the largest was 26.15 pounds, on June 3. The smallest average for trap fish was 15.95 pounds, on April 27; the largest was 28.66 pounds, on June 10.

Statement of the daily average weights of chinook salmon taken in gill nets and pound nets at the mouth of the Columbia River and landed at a cannery in Astoria, Oreg., between April 17 and June 28, 1893.

Date.	Gill nets.		Traps.		Date	Gill nets.		Traps.	
	No. of fish.	Average weights.	No. of fish.	Average weights.		No. of fish.	Average weights.	No. of fish.	Average weights.
		<i>Pounds.</i>		<i>Pounds.</i>			<i>Pounds.</i>		<i>Pounds.</i>
Apr. 17.....	316	21.17			May 24.....	1,235	23.44	25	23.68
18.....	585	21.60			25.....	1,090	25.54	9	23.33
19.....	244	20.68		17.5	26.....	789	23.80	34	23.90
20.....	67	23.14	16	23.44	27.....	858	24.53	34	25.14
21.....	122	21.66	5	20.00	29.....	944	24.16	74	25.48
24.....	409	21.13	46	19.04	30.....	1,358	24.07	66	26.15
25.....	657	20.54			31.....	738	25.60	43	25.41
26.....	610	20.47	115	18.46	June 1.....	1,112	25.58	90	26.75
27.....	401	21.70	66	15.95	2.....	1,332	24.35	83	24.02
28.....	335	20.78	57	18.00	3.....	2,030	26.15	118	24.08
29.....	650	21.12	82	18.60	5.....	848	25.38	117	26.53
May 1.....	278	* 21.60 ** 22.60	118	17.80	6.....	1,083	24.98	78	26.99
2.....	452	22.18	51	17.38	7.....	490	24.20	350	23.96
3.....	442	21.80	118	18.20	8.....	1,075	24.21	267	24.62
4.....	420	21.40	88	16.10	9.....	895	24.12	31	27.95
5.....	353	21.27	116	16.51	10.....	932	23.58	261	28.66
6.....	737	18.49	62	19.68	12.....	583	26.08	217	23.92
8.....	391	21.54	127	18.84	13.....	1,025	24.56	116	22.82
9.....	791	23.89	43	19.22	14.....	462	24.63	13	25.46
10.....	410	22.26			15.....	467	24.67	143	22.27
11.....	435	22.58	86	19.76	16.....	694	23.60	14	23.00
12.....	302	22.01	30	21.60	17.....	1,357	23.91	78	20.51
13.....	1,014	21.20	91	19.69	19.....	572	23.38	226	23.48
15.....	428	22.88	169	19.65	20.....	1,389	23.18	207	24.50
16.....	959	21.75	69	17.92	21.....	614	22.93	107	24.65
17.....	863	23.19	78	20.39	22.....	867	22.44	120	24.94
18.....	910	22.59	25	20.44	23.....	517	22.01	3	21.66
19.....	1,497	22.65	63	21.13	24.....	601	21.67	153	21.25
20.....	749	22.85	73	21.13	26.....	616	23.09	91	23.72
22.....	958	24.36	66	18.98	27.....	713	23.19	52	24.73
23.....	1,418	23.42	32	23.85	28.....	614	23.49	129	23.13
					Total	27,900		3,349	

* 8.75-inch mesh.

** 9.25-inch mesh.

† Salmon taken in small-meshed nets (7-inch) had an average weight of 11.70 pounds.

‡ Salmon taken in small-meshed nets (7-inch) had an average weight of 13.80 pounds.

Note.—During the week ending July 8, 2,488 gill-net fish had an average weight of 24.59 pounds and 1,191 pound-net fish an average weight of 25.59 pounds.

Average figures similar to those given for chinook salmon are available for blueback salmon. The weight of this fish is usually estimated by canners and fishermen at 5 pounds, which is very close to the actual figure. The following table, giving the catch of bluebacks in the same apparatus and by the same fishermen that took the chinook salmon previously referred to, shows that the average weight of 9,921 bluebacks was 4.96 pounds. The largest fish were taken with gill nets, and in May; the smallest with seines, and in April.

Statement showing by months the number, weight, and average weight of blueback salmon taken with gill nets, pound nets, and seines, at the mouth of the Columbia River and landed at a salmon cannery at Astoria, Oreg., in 1893.

Months.	Caught by gill nets.			Caught by pound nets.			Caught by seines.			Total.		
	No. of fish.	Total weight (pounds).	Average weight.	No. of fish.	Total weight (pounds).	Average weight.	No. of fish.	Total weight (pounds).	Average weight.	No. of fish.	Total weight (pounds).	Average weight.
April.....	2	10	5.00	208	535	2.57				210	545	2.60
May.....	16	91	5.69	1,792	10,391	5.80				1,808	10,482	5.80
June.....	91	452	4.97	5,466	26,385	4.83	229	1,102	4.81	5,786	27,939	4.83
July.....	3	15	5.00	1,801	8,179	4.54	413	2,039	4.94	2,217	10,233	4.62
August.....												
Total ..	112	568	5.07	9,107	45,490	4.96	642	3,141	4.89	9,921	49,199	4.96

The only other member of the salmon family that is a regular factor in the salmon industry of the lower Columbia is the steelhead. Ten pounds is usually assigned as the average weight of the fish. From the following table, showing the weights in similar form to that exhibited for the chinook and the blueback, it appears that 26,587 steelheads taken in 1893 had an average weight of 10.33 pounds. The fish are largest in August and smallest in April, while those taken in gill nets are heavier than those obtained in pound nets or seines, the seine fish being lightest.

Statement showing by months the number, weight, and average weight of steelhead salmon taken with gill nets, pound nets, and seines, at the mouth of the Columbia River, and landed at a salmon cannery at Astoria, Oreg., in 1893.

Months.	Caught by gill nets.			Caught by pound nets.			Caught by seines.			Total.		
	No. of fish.	Total weight (pounds).	Average weight.	No. of fish.	Total weight (pounds).	Average weight.	No. of fish.	Total weight (pounds).	Average weight.	No. of fish.	Total weight (pounds).	Average weight.
April.....	18	167	9.28	59	569	9.64	.....	.....	.....	77	736	9.56
May.....	17	176	10.35	207	2,097	10.13	.....	.....	.....	224	2,273	10.15
June.....	511	5,049	9.88	4,137	42,907	10.37	426	4,294	10.08	5,074	52,250	10.30
July.....	847	11,594	13.69	10,031	101,858	10.15	5,827	58,486	10.04	16,705	171,938	10.29
August.....	647	8,735	13.50	2,305	23,105	10.02	1,555	15,609	10.04	4,507	47,449	10.53
Total..	2,040	25,721	12.61	16,739	170,536	10.19	7,808	78,389	10.04	26,587	274,646	10.33

Destruction of salmon in the headwaters.—By some reputable persons considerable stress is laid on the injurious influence on the abundance of chinook salmon in the Columbia River of the destruction of fish in the headwaters. Mr. W. H. Barker, of the firm of George & Barker, of Astoria; Mr. J. O. Hanthorn, of the firm of J. O. Hanthorn & Co., of Astoria, and other canners, as well as regular fishermen and sportsmen, attribute the present relative scarcity partly to the sacrifice in the upper waters, by white men and Indians, of large quantities of salmon that have run the gauntlet of the lower river and deserve protection when they have reached their spawning-grounds. The fish are taken with great facility in the shallow streams constituting spawning-beds, and the quantities killed some seasons are said to have been enormous. The fish taken in such situations are hardly fit for food, being "logy," diseased, and emaciated. At times they have been used on the land by wagon loads. The improvident red man often cuts out the eggs and dries them, discarding all the remainder of the fish.

Mr. Barker has observed obstructions placed across narrow streams up which fish were running in September, October, and November, and has known many hundreds of pounds of ripe fish to be shipped from a single point in Idaho to places in Iowa, Missouri, and other States.

Mr. Hanthorn has known good spawning-grounds to be destroyed by irrigation ditches, the building of which has so reduced the supply of water in the streams that the salmon have ceased to resort to them. The irrigation work is also said to keep otherwise clear streams muddy or "roily," and thus impair their usefulness as spawning-beds.

According to the statements of reliable people on the lower river, blueback salmon have had their spawning-grounds restricted by the erection of dams at the outlet of certain lakes in the headwaters of the Columbia. Favorite breeding-grounds for the small species are now utilized for irrigation purposes, and are said to be dammed against the entrance of fish.

Destruction of small salmon.—The statement has from time to time been made in public print, and the opinion prevails among some persons interested in the fisheries of the Columbia River, that to the destruction of young chinook salmon is to be attributed at least a part of the decline which the industry has undergone. It may be said, however, that most persons attach very little importance to the taking of small fish; and the special committee of the Oregon legislature appointed to investigate the fisheries of the State seemed inclined to favor rather than oppose the capture of the small fish found in the Columbia, on the ground that they were stunted fish, the multiplication of which tended to impair the quality of the race. The prevalence of the opinion that all the chinook salmon constituting the runs up to August 1, or even later, will naturally die after the completion of the spawning process, is sufficient to outweigh any compunctions that may be entertained as to the sacrifice of small fish.

In proportion to the extent of the fishery, the catch of chinook salmon too small for canning is generally unimportant. During some seasons there is a larger run of small fish than during others, and then considerable quantities may be destroyed. Mr. M. J. Kinney, of Astoria, is authority for the statement that at a seine fishery above Astoria a great many small chinooks were sacrificed in 1893. Perhaps a third of the catch of 50,000 pounds consisted of fish under 4 or 5 pounds in weight. Some were brought to Mr. Kinney, who dumped them overboard and refused to take more, as did other canners. Fish of this size are too small to can. Reference to a table (p. 252) giving the daily catch of salmon at a seine fishery at Brownsport Sands, near Pillar Rock, Washington, shows that in the month of August, 1893, 1,990 pounds of chinook salmon, having an average weight of only $3\frac{1}{2}$ pounds each (some weighing only $1\frac{1}{2}$ pounds), were caught and thrown away because there was no sale. Seines nearer the mouth of the river are reported not to take a great many small fish, and pound nets in the same situation are said to catch very few ordinarily, although some of these small chinooks are thus taken each season. On June 20, at Astoria, a few were seen weighing only 2 pounds; these had been obtained in pound nets.

According to the statements of canners, fishermen, and all other persons connected with the salmon fishery who have had opportunity to make observations, the small chinook salmon in question are all males which, though undeveloped as to size, are sexually mature. This opinion is based on the following facts and hypotheses: (1) That only fish capable of undergoing the reproductive act enter the river; (2) that male fish of this small size are known to have had ripe milt and to have undergone the spawning process; (3) that no female salmon under 7 pounds in weight has ever been taken in the river.

The following remarks on this subject emanate from a report made to the Oregon legislature by a special committee appointed to investigate the fisheries of the State:

Parties engaged in either of the different modes of fishing named generally insist that that particular mode of fishing is least injurious to the fish interest of the State; and a great deal of complaint has been made and many objections have been urged against fishing with traps, wheels, seines, and similar appliances. The main objection urged against the modes of fishing just enumerated is that they are detrimental to the fish interest of the State in this way, that they destroy very small fish (salmon), and by the destruction of the small fish cause a general falling off in the supply of salmon; and it is urged that this mode of fishing is so destructive that it will ultimately cause the annihilation of the salmon industry of the Columbia. We have, therefore, undertaken to make a thorough investigation of that subject, and have done so to the best of our ability, to such an extent that we feel confident that we have arrived at the proper solution of the question.

The small fish, or salmon, that are caught with the last-named appliances, and which it is claimed are destroyed by such modes of fishing, consist principally of small chinook salmon, and weigh from

3 or 4 to 7 or 8 pounds. They run at the same time and with the large, or what we term the royal chinook salmon. The other small fish caught are blueback and a very few small steelheads. The bluebacks of the sizes caught are what we consider the average of the run, and of the small steelheads that are caught there are too few to be worthy of consideration.

There seems to exist quite a diversity of opinion with regard to the small salmon referred to, some persons asserting that they are small chinook, while others insist, on account of the paleness of the flesh, that they are another and different species, or white salmon. The last claim is made mainly by persons interested in those modes of fishing by which small fish are taken. After a thorough investigation we feel that we can positively assert that those small salmon so taken, not including bluebacks and steelheads, are small chinook salmon, and we shall here give our reasons for coming to that conclusion.

During our investigation up and down the Columbia we carefully compared those small salmon with the large salmon, and we found that in every respect, except color of flesh, they had the same distinguishing characteristics that the large salmon have. We also had hundreds of those small salmon opened, and every one of them proved to be a male salmon. The smallest female salmon found by us during all our investigation was one caught near Astoria, which weighed $9\frac{1}{2}$ pounds.

The chairman of this committee has had the opportunity of examining into that question for many years. He has examined hundreds—he could safely say thousands—of those small salmon, and all that he has ever examined were male except one, and that one weighed $8\frac{1}{2}$ pounds, that being the smallest female salmon ever seen by him, the next smallest being the one seen by the committee, and weighing $9\frac{1}{2}$ pounds.

Since 1887, Senator L. T. Barin, the chairman of the committee whose report has been quoted, has been offering \$25 for any female chinook salmon weighing 7 pounds or less, caught in the nets of the Columbia River fishermen.

Senator Barin has made some interesting observations, which probably throw light on the stunted-fish problem, and has communicated the same to me. Some years ago, on an island at the mouth of the Willamette River, he ascertained that some blind sloughs, inhabited by catfish, contained numbers of small chinook salmon. The sloughs had not been overflowed for two years, to the positive knowledge of Mr. Barin, and the fish must, therefore, have been retained for at least that length of time. They were much stunted in growth, owing, as the observer supposes, to deficiency of food. He thinks that every year larger or smaller numbers of parrs are left in blind sloughs adjacent to the rivers, and are liberated in a dwarfed condition, after one or two seasons, by the recurrence of freshets similar to those which caused their retention. In Mr. Barin's opinion all apparently stunted salmon taken in the river are fish which have been left in sloughs without sufficient food and other suitable conditions. An unexplained fact, however, is that all the small fish appear to be males.

Quality of fall chinook salmon.—The canners lay great stress on the poor quality of fall chinook salmon and the little value they possess for canning. The fish which run in September and October are healthy-looking and have little superficial difference from the spring and summer fish. They are apt to have a somewhat paler flesh, however, and the meat is destitute of oil, which is essential to first-quality fish.

While the ordinary fish will sell for \$5.25 per case of 48 one-pound cans, these fish can never be sold as No. 1 fish, and have to be diverted to an inferior trade, not even ranking with good second-class fish. The demand is limited, and their sale tends to reduce the reputation of the Columbia River salmon. The differences between the early and late fish when canned are very marked, and may be appreciated even by a novice. Natural oil of a rich yellow color will be found in a can of fish taken before September, while no oil worthy of mention will be found in the late fish. There is no difference in the size or appearance of the fish, and often little or no difference in the color of the fish before or after cooking.

The opinion is quite prevalent among the canners and fishermen that the fish belong to a different race from the spring and summer fish, being similar to the fall run in the other rivers of the west coast, in all of which the fall run consists of lean fish. The opinion also prevails that the fish hatched from eggs of the fall run will return to the river in the fall and be the undesirable fish, and the hope is general that no attempts will be made to propagate the late fish, but that the efforts of fish-culturists will be centered on the spring and summer broods, which alone are suitable for canning.

Salmon taking food in fresh water.—The opinion and observation of fishermen and dealers coincide in attributing to the chinook salmon the habit of wholly abstaining from food after entering the river.

According to the statements of fishermen there is only one locality in that part of the basin of the Columbia River where commercial fishing is carried on where the chinook salmon regularly take the baited hook; this is at the falls of the Willamette River, at Oregon City, where anglers use fresh-salmon spawn with great success.

Food consisting of partly digested small fish has repeatedly been observed in the stomachs of salmon taken at or near the mouth of the river. Unmutilated smelts have sometimes been seen to fall from the mouths of chinook salmon when the latter were thrown in a scow or boat. In all such instances, however, the inference is clear that the food was ingested before the fish left the ocean.

During the month of June the angling at the falls of the Willamette River was considered unusually fine, and large numbers of chinook salmon were taken. On June 19 the *Portland Oregonian* contained the following note on the subject:

The salmon fishing at the falls of the Willamette still continues good, and some fine catches have been made within the past few days. Mr. L. T. Barin caught 21 on Saturday and Al Johnson and Henry Gordon caught over 30. Several others caught from 10 to 20, and in all nearly 100 young chinook were taken in one day, weighing from 2 to 10 pounds, and averaging about 5 pounds. For a country where it is said salmon would not take a hook this is pretty good fishing.

On June 23 the writer made a visit to Oregon City, and found that a large number of fish were then below the falls. The best fishing is from a rocky island lying at the extreme left of the falls, at the only point where it is possible for the fish to ascend. In the course of an hour about 15 chinook salmon, mostly of small size, were taken by a dozen anglers. Most of the fish here caught are under 10 pounds in weight, but a few weighing from 15 to 25 pounds are also secured.

Fishing is done with jointed rods, fitted with 50 to 100 yards of stout line, one or two hooks, and a light sinker. The current is very swift and strong, and the line is cast up under the falls and permitted to drift downstream. From 10 to 25 yards of line are usually paid out. The only bait used is fresh salmon spawn. This is cut into pieces of the size of a cubic inch, and is placed on the hook as securely as its consistency will permit. The vivid red color which the spawn naturally has gives place to a pale pinkish or white color after immersion in the water.

Periodicity of run of bluebacks.—A study of the statistics of the salmon fishery of the Columbia River collected by the U. S. Commission of Fish and Fisheries during the past five or six years discloses an interesting feature of the run of blueback salmon. The figures show that the fish are much more abundant in the alternate years. Many of the salmon-canners and fishermen have overlooked this fact, which, when the matter has been brought to their attention, has been clearly demonstrated by reference to their records. So far as generalizations may be made from the data at hand, the

relative abundance of bluebacks during any given season may be with certainty predicted. In this respect the blueback resembles the humpback (*O. gorbuscha*).

The greatest abundance of the blueback salmon in the Columbia River corresponds with the even years. The catch in those seasons so far exceeds that during the odd years as to clearly establish the contention of a biennial run. The following statistical data, based on the book records of canners and others, show that in 1890 and 1892 the catch of bluebacks was more than three times larger than in 1889 and 1891. Complete figures are not available for the years 1893 and 1894, but the information at hand indicates, and the testimony of the canners and fishermen bears out the statement, that in the former year the run was small, and in the latter was larger than for five or six years, and probably larger than ever before known.

Statement of the number of blueback salmon caught on the Columbia River from 1889 to 1892, inclusive.

Years.	Number of fish caught.
1889.....	324, 532
1890.....	994, 471
1891.....	287, 826
1892.....	1, 064, 358

As a matter of related interest it may be mentioned that the run of bluebacks in the Fraser River is similar to that in the Columbia in its periodicity, the difference being that the fish are most abundant in the odd years. An examination of the official reports of the Canadian Department of Marine and Fisheries shows a well-established biennial feature of the run. In the year 1893 the run was extraordinarily large, corresponding with the very small catch in the Columbia, and immediately preceding the phenomenally large run in the Columbia in 1894. Whether there is anything more than a mere coincidence in this alternation in the abundance of the fish in these two great rivers remains to be determined. It is not impossible, however, that the fish entering these streams belong to the same general body, and that a large run in one river is more or less at the expense of the other.

Condition of the water as affecting the catch.—As in the case of all river fisheries, there is in the Columbia a certain relation between the abundance of fish at a given time and the resulting catch on one hand and the condition of the water on the other. The following notes are a meager contribution to the subject of the dependence of the catch on the water. The unprecedentedly high water which prevailed in the Columbia basin in May and June, 1894, interfered to some extent with fishing with all forms of apparatus, although the damage done was much less than was at first anticipated and reported. The most serious injury resulting from the freshets was done to the wheels located at the Cascades and The Dalles, where the rise of the water was greatest. Owing to the expensive character of the wheels the financial losses were very heavy. Of 19 scow and 8 stationary wheels in operation at the Cascades at the time the freshets began, 7 of the former and 4 of the latter were either entirely lost or seriously damaged.

Up to June 20, 1894, the reported shortage in the salmon pack of the Columbia River was due almost entirely to the loss of time and apparatus occasioned by the floods. With the subsidence of the high water the run of bluebacks and chinooks became so numerous, and the catch of bluebacks in wheels and pound nets and of

chinooks in gill nets was so large, that the shortage was overcome, and the aggregate season's pack was much larger than last year.

Trap fishing in Baker Bay and the lower river was somewhat interfered with by the large amount of driftwood brought down by the freshet. Many of the traps, especially those on the edge of the channel, became clogged or were torn by brush, logs, etc. A few stakes were also washed out by the high water. Swift currents and floating débris also interfered with the setting of gill nets and the hauling of seines.

As is well known, the wheels require a certain amount of high water in order to do well. At the Cascades it is found that the largest quantities of fish are taken when the height of the river is 20 to 25 feet above mean low water. Several explanations of this circumstance are offered. Some hold that more fish are prompted to enter the river when an unusually large volume of fresh water is being poured into the ocean. Mr. Frank M. Warren, who operates wheels extensively and has had much experience in the matter, attributes the larger catch during high water to the fact that the nets in the lower river can not take so many fish and that a larger number are able to reach the wheels. During the prevalence of high water the gill nets in the lower river do not so effectually sweep the bottom, and new channels are made on the sides of the river, up which the fish may pass unmolested. For detailed data showing the relation between the height of water and the catch in wheels, reference is made to the table giving the yield of certain wheels at the Cascades.

The clearness or muddiness of the water has an important bearing on the success of the fishing operations of trap and gill net fishermen. Trap nets always do best when the water is clear, and gill nets take the most fish when the water is muddy. It therefore usually happens that when traps are making large catches the gill nets are likely to have poor luck. The explanation of these phenomena seems to be as follows: In muddy water the salmon swim into the gill nets before becoming aware of the existence or nature of the obstruction; on the other hand the leader of a pound net, with its fine meshes often occluded by grass and other drift material, acts as a solid barrier, and when the salmon swim against it they quickly withdraw and move in other directions. When the water is clear, the fish readily see the gill nets at some distance and do not attempt to go through them, but swim along the side of the nets and go round the ends. In the case of the leaders of traps, the fish act the same way and are led into the nets, the tendency of the salmon being to go into the heart rather than toward the free ends of the leader, for the reason that the water becomes deeper in the direction of the pocket.

STURGEON AND THE STURGEON FISHERY.

CALIFORNIA.

The white sturgeon (*Acipenser transmontanus*) is one of the most prominent food-fishes of the State, its edible qualities and economic value being of high rank. The capture of sturgeon for market is practically restricted to San Francisco Bay and the lower reaches of the Sacramento and San Joaquin rivers. The fish is taken with large-meshed gill nets, in salmon nets, and with set or troll lines provided with unbaited, barbless hooks. The principal part of the yield is obtained with set lines. In 1893, for the first time, a license was required for the use of sturgeon set lines. A license fee of \$10 was charged to each fisherman.

Up to the middle of June, 60 licenses had been granted to fishermen, distributed as follows in four counties:

Fishing center.	County.	No. of fishermen licensed.
Martinez.....	Contra Costa.....	8
Black Diamond.....	do.....	5
Seal Island.....	do.....	2
Marsh Landing.....	do.....	2
Antioch.....	do.....	5
Jersey Landing.....	do.....	2
Bouldin Island.....	San Joaquin.....	3
Benicia.....	Solano.....	2
Benicia Flats.....	do.....	1
Roe Island.....	do.....	2
Long Island.....	do.....	2
Cut Off.....	do.....	5
Suisun Creek.....	do.....	6
Montezuma.....	do.....	3
Broad Slough.....	do.....	3
Dutton's.....	do.....	3
Lakeville.....	Sonoma.....	4
Petaluma Creek.....	do.....	2

The law by virtue of which these licenses are issued (section 636 of the penal code) has a limited value so far as the protection of sturgeon is concerned. Its utility arises from the fact that it enables the State fish commissioners to regulate the size of the hooks used, to keep a check on this method of fishing, and to secure a small fund with which to carry out the patrol of the State waters. The commissioners have no discretion in issuing licenses, and can not regulate the methods, the fishing season, or the quantity of set lines employed by individual fishermen.

The method of taking sturgeon with set lines is generally and justly considered very destructive and cruel. It probably originated in China and was for many years extensively practiced by the Chinese fishermen of California. Recently, however, the use of set lines by the Chinese has been interdicted.

One of the features of the method which makes it especially harmful is the destruction of immature fish. Very large quantities of sturgeon only 15 or 18 inches long are often seen in the markets. The sacrifice of small sturgeon is said, however, to be unavoidable, as the fish that are snagged by the hooks are injured so severely that even if liberated alive most of them would soon die.

Regarding the abundance of sturgeon, it may be stated that while fishermen and dealers acknowledge that the supply is much less than it was prior to ten years ago, still the catch during the past four or five years seems to have been about uniform and appears to be undergoing no reduction.

Sturgeon are usually received at the stalls of the wholesale dealers in a round condition. The fishermen are paid, however, only for the decapitated and eviscerated carcass and for the roe. The latter is made into caviar by some of the dealers. The proportion of the weight of roe and waste parts to the total weight may be judged from the following figures applying to a large female sturgeon examined in the San Francisco market June 11, 1894:

	Pounds.
Total weight.....	243
Weight of roe.....	51
Weight of head and viscera.....	62
Weight of dressed carcass.....	130

Nearly the entire catch of sturgeon is consigned to San Francisco, in the markets of which city the fish is constantly found. It is there known by the trade names of "sturgeon," "bass," "white salmon," and "tenderloin solè." In restaurants and hotels sturgeon is commonly served as "tenderloin sole," which represents the choicest cut of the fish.

Small numbers of the green sturgeon (*A. medirostris*) are caught and find a market in San Francisco. The prejudice against this fish is too strong, however, to permit the sale of many, and the price received is less than half that commanded by the white sturgeon.

THE COLUMBIA RIVER.

The sturgeon utilized in the Columbia is the white sturgeon, the same species which is taken in California. The green sturgeon is also found there, but, as in California, is only sparingly eaten, and in most places is totally discarded. The white sturgeon is found in the river every month in the year, but it is most numerous in July and August, when the sardines are running, and in January and February, when the smelt are found in abundance. The sturgeon feeds on these fish. Writing of the sturgeon of the west coast at a time when its commercial importance in the Columbia River had not brought it into the prominence it has since had, Dr. Jordan said:

It reaches a length of 8 or 10 feet or more, and is said to attain a weight of 400 to 500 pounds. We have seen none of over 150 pounds weight.

The average gross weight of sturgeon taken in the regular sturgeon fishery of the Columbia is about 150 pounds. Fish weighing 500 pounds and even more are not rare. In 1892 one weighing 800 pounds was taken off Oak Point, and in the previous year one weighing 848 pounds was caught near Kalama, this being probably the largest sturgeon ever taken on the west coast.

The history of the sturgeon fishery of the Columbia River is that of most other streams in which the sturgeon has been assiduously sought. For many years no attention was paid to the fish and its value was not recognized. It was generally regarded as a nuisance by the salmon fishermen, who emphatically expressed their contempt for such a fish whenever it was caught in the salmon nets by quickly knocking it in the head and throwing it away. The institution of a regular fishery for sturgeon dates from 1888. During that year some fishing camps were experimentally located on the river, and the abundance of fish led to the establishment of a permanent business, contingent on the presence of fish.

Practically the entire catch has been taken with set lines armed with unbaited, barbed hooks.

Most of the fishing has been done in that part of the river below Kalama, although it is also carried on as far up as the Cascades. The fishing season extends from the close of the salmon-packing, about August 10, to the opening of the salmon season, about April 10. The sturgeon fishery thus occupies the attention of the fishermen at a time when other fishing has been suspended. The inquiries conducted in 1889 and 1892 by Mr. W. A. Wilcox, of this Commission, showed that in the first year of this fishery (1888) nearly 1,000,000 pounds of dressed fresh and pickled sturgeon, valued at \$15,000 to the fishermen, were shipped from points on the river. The business steadily increased until, by 1892, over 2,900,000 pounds of dressed fish were sold, which, together with various secondary products (caviar, isinglass, and "bone"), had a value of over \$41,000.

The sturgeon meat is practically all shipped east, the bulk of it going to Sandusky, Ohio. The carcasses are cut into pieces of convenient size, which are frozen solid and then loaded into refrigerator cars for transportation. Up to the time of Mr. Wilcox's visit in 1892 the sturgeon had been found in ample abundance for the purposes of the firms engaged, but at that time the fishermen were beginning to experience some difficulty in taking as many fish as formerly. They were obliged to move from one fishing-ground to another more frequently than had previously been necessary and they were compelled to use larger quantities of apparatus in order to keep up the catch. In the season of 1893-94 there was a very perceptible decrease in the supply and the fishery was generally regarded as being on the decline. Under date of February 15, 1894, Mr. C. B. Trescott, who is extensively engaged in sturgeon fishing and shipping, wrote to the Fish Commission as follows, regarding the condition of this industry on the Columbia River:

Sturgeon fishing has completely failed on the Columbia. There has been no fish caught since last November to amount to anything. At present the entire catch on the river does not amount to over 1 ton of dressed fish a day, and is growing less. We do not expect to be able to fish longer than the 15th of March, and what few we get now do not pay for handling. At present we do not have much faith in the sturgeon business on the Columbia. Usually we have a good run of fish in January or February, but there are no fish this year and there is every indication of the fish being caught out. We have thought that we would have our usual run of sturgeon on the Columbia in January and February. The sturgeon season will begin again on the 15th of August, and if we do not have our usual run of fish then it will prove that the sturgeon fishing is done for here. There is every indication of the sturgeon business having seen its best days on this coast. The total catch for this season has not been 25 per cent of the catch last season, and what fish were caught were caught in August, September, and October.

The suggestive remarks of Mr. Trescott are in accord with what might have been expected as a result of the useless waste of enormous numbers of small fish taken in wheels, pound nets, and other nets, supplemented in the past five years by the very active use of set lines, by which very large quantities of spawning fish have been sacrificed. Regarding the destruction of sturgeon in wheels in 1888 it was said:

The wheels often take in a day many tons of sturgeon less than 50 pounds in weight. Such are not marketable and are now thrown into the river. Their utilization would be a blessing to the fisherman, for they now help to contaminate the water.—(Report on the Fisheries of the Pacific Coast. U. S. Fish Commission Report, 1888.)

In an interview with Mr. M. J. Kinney, of Astoria, he made the following remarks concerning sturgeon in the lower river:

In 1893 there was a good supply of sturgeon. The fish sold for 2 cents a pound. The fishermen as a whole did not do well, however, although the price received was double that of the previous year. In 1879 the sturgeon were so thick in Baker Bay that we did not consider it safe, early in the season, to put our gill nets out. The fish were so numerous and large that they were able to destroy a great amount of netting. For years every sturgeon taken was mutilated or killed with an ax and thrown back into the water. The shores of the river would be lined with dead sturgeon, and numbers could always be seen floating down the river. It is quite different now.

The destruction of small unmarketable sturgeon in trap nets must be extremely large in the course of a season. The salmon fishermen pay little attention to the sturgeon and have no interest in the preservation of the supply. A salmon trap near Sand Island, lifted on June 23, was observed to contain over 50 sturgeon, none over 2 feet long, and some only 10 or 12 inches long, all of which were dumped into the boat and consequently destroyed. On this occasion only a few salmon were caught, which were gaffed out of the net, and it would have been an easy matter to permit the small sturgeon to escape.

When the large number of salmon traps in the lower Columbia is recalled, and when the larger or smaller quantities of sturgeon caught at nearly every lift are taken into consideration, it may be readily understood that the annual loss must be enormous and must have had an appreciable influence on the abundance and catch. It is difficult to avoid the conclusion that the present scarcity of sturgeon of marketable size in the Columbia River must be at least partly attributable to the destruction of small fish in the manner stated, which has been becoming greater each year with the increase in the traps.

LAMPREYS.

Inquiries regarding the results of the attempted acclimatization of the eel (*Anguilla chrysypa*) on this coast are apt to elicit misleading information unless great care is exercised. In the San Francisco markets one learns that eels are not infrequently exposed for sale, and that both salt-water and river fishermen catch them occasionally, but an examination of the reported eels usually shows them to be lampreys.*

The only "eel" of the west coast that attracts the notice of fishermen is the three-toothed lamprey (*Entosphenus tridentatus*), which ranges from Monterey to Canada, and ascends all the major streams. It is especially abundant in the Columbia basin. The San Francisco market steamers fishing paranzellas off Drake Bay are said to take these "eels" at almost every haul. The lamprey has no commercial value except in the region of the Columbia River and its tributaries. Here it has the habit of ascending the streams in large bodies and of clinging to the rocks at falls, where they are entirely oblivious to the presence of man and may be easily picked off by hand. They are considered excellent bait for sturgeon, and several hundred barrels were formerly salted annually for that purpose.

The largest runs of lampreys are often coincident with those of salmon.

At the falls of the Willamette River, near Oregon City, Oreg., on June 23, the rocks at the particular part of the falls where salmon ascend were at times completely covered with lampreys. In places where the force of the current was least they were several layers deep, and at a short distance the rocks appeared to be covered with a profuse growth of kelp or other water plants. A lamprey dislodged by the force of the current or by an angling rod would often carry half a dozen others with it to the bottom of the falls. At the sides of the falls, numbers of lampreys had drawn themselves entirely out of the water to avoid the current or remained hanging from the rocks with only their tails in the water. In the turbid water beneath the falls hundreds of lampreys could be seen trying to get a position on the rocks, some being those which had been swept from the rocks above, others being new arrivals from the salt water. This noteworthy run had been in progress for about a week, and was synchronous with the movement of chinook salmon elsewhere alluded to.

It appeared to me that only a very small part of the run could ever surmount these falls, over which, as has been stated, salmon must have passed with the greatest difficulty. The bodies of most of them showed the effects of the rough usage received; the posterior part of some was worn off fully one-fourth the total body length by being whipped against the surface of the rocks while the head remained fixed; and numbers were seen to lose their hold, fall back in the water, and float away apparently dead, emaciated, and covered with bruises and fungus.

* A few true eels have been taken in California, but they are now very rare and seldom seen.

THE SPINY LOBSTER OR CRAWFISH (*Panulirus interruptus*).

This valuable crustacean is regularly exposed for sale in the markets of San Francisco and other cities of the Pacific coast. Its distribution, however, is restricted, as it is not abundant and not taken in noticeable quantities north of Santa Barbara County. South of that limit it is extremely numerous and exists in sufficient abundance to supply all present demands.

With commendable foresight the California fish commissioners have thought the time might come when unrestricted capture of the "crawfish" would greatly reduce the production, and have taken measures to avert, as long as may be, a diminution in the supply. While no laws applicable to the entire State have thus far been enacted, several counties have, at the solicitation of the fish commissioners, passed local ordinances. The following action by Los Angeles County has also been taken by San Diego and Ventura counties; other counties interested will soon adopt similar regulations:

Every person who, in the county of Los Angeles, State of California, shall take, catch, or kill, or sells, exposes or offers for sale, or has in his possession, any lobster or crawfish between the 15th day of May and the 15th day of July of each year, shall be guilty of a misdemeanor.

Every person who, in the county of Los Angeles, State of California, shall at any time buy, sell, barter, exchange, offer or expose for sale, or have in his possession, any lobster or crawfish of less than 1 pound in weight, shall be guilty of a misdemeanor.

The purport of the first of these provisions is to secure the protection of the spiny lobster during the period when the eggs carried by the female reach maturity and hatch. All the female lobsters examined by the writer in May and June had eggs attached, and it is evident that the close season stipulated in the ordinance quoted is the proper one. The eggs are of a brilliant brick-dust red color, and are much smaller than the eggs of the true lobster (*Astacus americanus*) of the east coast, their diameter being between one-third and one-half that of the latter.

The spiny lobster is caught in a kind of dip net, or drop net, similar to the apparatus employed for taking crabs. It is baited with fish or meat, lowered into the water from a boat, and raised at intervals. Regular lobster pots are also employed at various places.

Spiny lobsters are shipped to market alive in sacks holding from 50 to 75 pounds, and are displayed on the counters of the dealers, like lobsters on the east coast. Considerable numbers are also at times boiled by the dealers and sold in that condition. When cooked, the spiny lobster acquires the intense red color which in the true lobster is so familiar.

Some of the spiny lobsters exposed for sale are very large, and others are relatively quite small. Examples observed by the writer on June 1, in San Francisco, weighed as much as 8½ pounds, and those weighing 10 pounds can not be rare. Six-pound and 7-pound individuals are common. The average weight of those sold in San Francisco is between 2 and 4 pounds.

The spiny lobster appears to be a more active, if not a more intelligent, animal than the true lobster. It easily moves through the water with greater speed than the eastern lobster, and it also seems endowed with a faculty for escaping capture that the Atlantic representative does not possess. Experiments made with the typical pot, which is so efficacious in the taking of the lobster, have demonstrated that the spiny lobster is often able to escape from that form of trap. The California Fish Company, of Los Angeles and San Pedro, had a large number of lobster pots made with vertical and oblique entrances for the capture of spiny lobsters to be used for canning purposes at its factory in San Pedro, but, according to the reports of the company, little success

attended their use. It was stated that the "crawfish" would enter the pots, eat the bait, and then depart.

In the absence of other similar crustaceans, the spiny lobster occupies an important place among the aquatic food animals of the west coast. It is, however, much inferior to the eastern lobster, the flesh being coarser and less tender.

TERRAPIN AND TERRAPIN-FISHING.

The question is often asked by eastern fishermen and dealers whether the diamond-back terrapin is found on the Pacific coast, and, if not, whether there is an acceptable substitute therefor.

The diamond-back terrapin (*Malaclemmys palustris*) does not exist on the west coast, and the genus is not there represented. The California terrapin (*Chelopus marmoratus*), the only member of the order which has as yet attained commercial prominence on the coast, is much inferior to the diamond-back in food value. It inhabits the rivers and fresh-water ponds west of the Sierras, and its range extends from Monterey to the Canadian border. It prefers warm, sluggish water, and is especially abundant in California.

The nets used in this fishery are simple, inexpensive fyke nets, although they are not designated as such anywhere in the State, being called "turtle nets" and "turtle traps." The prohibition by the State of the use of set nets of any kind makes this fishery illegal, but the law was enacted for the purpose of preventing the capture of shad, striped bass, and other desirable fresh-water fish on the spawning-grounds or in an immature condition, and was not intended to limit the turtle fishery. So long, therefore, as these nets take only terrapin and catfish, carp, chubs, and other similar species generally regarded as nuisances, the legal question is waived.

A fyke examined by me at Sherman Island in the San Joaquin River on June 10, 1894, may be described as follows: The framework consisted of 3 light iron hoops of uniform size, 20 inches in diameter. A short funnel, with a horizontal, elliptical opening about 6 inches wide, extended from the first hoop, the aperture being rather nearer the top than the bottom of the netting. It was held in position by means of cords running to the second hoop. The size of the mesh is about 2-inch stretch. The net is kept in position by means of stakes, to which the first hoop and pot are tied, and also by a stake placed on each side of each hoop piercing the netting and driven into the bottom. The bait is suspended by a cord from the top of the second hoop. A piece of rope attached to either side of the lower part of the first hoop facilitates the lifting of the net. Value about \$1 or \$2.

The terrapin are very numerous in the marshy lands of the Sacramento-San Joaquin delta and around San Francisco Bay. As many as 16 to 20 turtles are sometimes caught in a trap at one lift. Their size is, however, small as compared with the diamond-back terrapin of the east coast, and examples over 5 inches in length are not common, although the species is said to attain a length of 8 inches. They are generally called "turtles" by the fishermen.

Much of the terrapin fishing in California is semiprofessional or incidental to salmon-fishing, although a few persons devote considerable time to the business, and may be classed as regular "turtle" fishermen. The greater part of the catch is marketed in San Francisco, where the terrapin are exposed for sale throughout the year. The annual sales in that city are about 1,500 dozen, with an average value of \$4 per dozen.

The conditions seem excellent for the successful introduction of the diamond-back terrapin to the west coast. The extensive salt marshes around San Francisco Bay and in other places would doubtless supply a suitable habitat for the animal, whose high food value would in time bring it into active demand and stimulate cultivation and a profitable trade.

THE MARKET FISH AND THE FISH TRADE OF SAN FRANCISCO.

There are few cities in the United States in which such a large variety of fresh fish is found in the markets or in which the supply is so constant as in San Francisco. Not only is there a varied fish fauna in the immediate vicinity of the city that is utilized by a large resident fishing population, but the fresh and salt waters of the three coast States contribute their rich resources to the city's supply. Over 100 species may be seen in the markets during a season, and perhaps half that number may be found at almost any time. The quantity of fresh fish landed and sold in San Francisco, as determined by the agents of the Fish Commission, is from 9,000,000 to 12,000,000 pounds annually, worth to dealers from \$600,000 to \$800,000.

Among the fishes which are handled in largest quantities in San Francisco are the salmon, flounders, herring, shad, smelt, sturgeon, suckers, anchovies, cultus-cod, viviparous perch, and rock-cod, of each of which more than 100,000 pounds are annually sold.

During the latter part of May and the first of June, when I visited the wholesale markets regularly, the following fishes were observed. The scientific names are necessary for their proper identification; the common names given are those heard in San Francisco. A few data collected concerning these are added.

FISHES.

- Acipenser medirostris.** *Green Sturgeon.* Rarely exposed for sale. Brings about half the price of the white sturgeon.
- Acipenser transmontanus.** *Sturgeon; White Sturgeon.* Of constant occurrence in the market. A great many small fish under 2 feet in length received. The bulk of the supply is from the Sacramento River region.
- Ameiurus albidus.** *Catfish.*
- Ameiurus nebulosus.** *Catfish.* These exotics are almost invariably sent to the market in a dressed condition; it is only in that state that they meet with any sale. The dealers do not encourage the shipment of catfish by the fishermen, and the quantities sold are disproportionate to the abundance of the fish.
- Ptychocheilus oregonensis.** *Pike.* This large representative of the minnow family is sent to the San Francisco market chiefly from the Sacramento and San Joaquin rivers. The fish is large enough to be taken in salmon gill nets, but it has such little market value that it receives scant attention from the salmon fishermen. Fish weighing 4 to 7 pounds were seen. The price is only 2 or 3 cents a pound, and the demand is chiefly among the Chinese.
- Cyprinus carpio.** *Carp.* The carp does not rank high as a food-fish in San Francisco, although considerable quantities are annually sold. The local Chinese fishermen catch a part of the supply, the remainder coming from the Sacramento and San Joaquin rivers. The receipts give no idea of the abundance of the fish, and doubtless the catch could be easily increased fifty times were it required by the trade. The average price of the carp is about 2 cents a pound.
- Clupea sagax.** *Sardine.* Very few sardines were seen, and, as elsewhere stated in this report, the fish is much less abundant in San Francisco Bay than it was comparatively few years ago.

Clupea sapidissima. Shad. Very numerous at all times. Found in the markets every month in greater or less abundance. The supply greatly exceeds the demand, and the price is so low that the shad becomes available even for the impecunious Chinaman. The dealers are obliged to restrict the receipts, otherwise the markets would be continually overrun. The prices paid by the dealers vary from one-half a cent to 4 cents a pound, the average being 2 cents. As fine shad as are ever seen in the markets of the Eastern States, weighing from 4 to 7 pounds, may now often be bought at retail in San Francisco for 10 to 15 cents. The supply comes chiefly from local fishermen in San Francisco Bay and from the Sacramento River.

Stolephorus ringens. Anchovy. This was perhaps the most abundant fish in the markets during the period of my visit.

Oncorhynchus chouicha. Chinook salmon. The sales of fresh salmon in San Francisco amount to over 3,000,000 pounds annually, the larger part of which quantity consists of chinook salmon and comes from the waters of California. The fish are most common in the markets during April, May, and August, but are exposed in all the other months, except September, during which month there is a close season, when the salmon receipts are from points outside the State. The following statement of the quantities of salmon handled by the San Francisco dealers in each month in 1893 and 1894 (to June 30) has been prepared from the records of the dealers, and has been furnished by the California Fish Commission, through Mr. John P. Babcock, chief deputy:

Statement of the receipts of California fresh salmon by the San Francisco dealers.

Months.	1893.	1894.
	<i>Pounds.</i>	<i>Pounds.</i>
January	137,460	128,556
February	93,263	103,801
March	139,401	163,131
April	874,478	211,552
May	325,170	242,126
June	70,216	138,075
July	149,217	.....
August	575,609	.....
September .....	.....	.....
October	249,753	.....
November	183,789	.....
December	155,090	.....
Unclassified*	135,455	84,084
Total	2,588,001	1,071,925

* Salmon handled by minor dealers, whose monthly receipts can not be shown separately.

Data are available showing for much the larger part of the salmon receipts the sources whence they came. The Sacramento basin furnishes more than two-thirds the quantity handled. Eel River, in Humboldt County, and the ocean adjacent to Point Reyes also supply a considerable proportion. The monthly receipts, specified by localities, are shown in the following table:

Statement for a part of the fresh-salmon receipts in San Francisco, showing in pounds the localities from which the fish came.

Months.	1893.					1894.				
	Sacramento River.	Humboldt County.	Ocean.	All other rivers.	Total.	Sacramento River.	Humboldt County.	Ocean.	All other rivers.	Total.
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
January	20,768	110,574	.....	5,058	136,400	28,530	96,485	.....	5,753	125,015
February	55,308	83,616	.....	1,189	90,111	38,398	50,557	.....	.....	94,708
March	117,334	6,150	.....	6,202	129,776	129,191	11,265	.....	13,031	153,487
April	346,053	.....	.....	1,895	347,948	175,651	.....	.....	3,009	178,720
May	309,064	.....	.....	672	310,636	310,636	.....	.....	.....	205,930
June	44,196	.....	16,666	.....	60,862	120,146	.....	.....	.....	126,277
July	17,382	.....	105,521	.....	122,903	.....	.....	1,589	.....	.....
August	515,701	.....	29,072	.....	544,773	.....	.....	6,131	.....	.....
September .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
October	182,139	40,873	.....	.....	223,012	.....	.....	.....	.....	.....
November	39,628	143,049	.....	.....	182,677	.....	.....	.....	.....	.....
December	47,946	99,303	.....	.....	147,249	.....	.....	.....	.....	.....
Total	1,096,417	433,565	151,931	14,434	2,296,347	695,057	158,307	7,720	21,853	883,537

- Salmo gairdneri.** *Steelhead.*
- Salmo mykiss.** *Lake Trout.* A few seen which had been shipped from Oregon.
- Salmo mykiss henshawi.** *Lake Tahoe Trout.* Very common.
- Atherinopsis californiensis.** *Smelt.* During my visit this smelt was more or less abundant. It is popular and brings a good price. The specimens examined were in a spawning condition.
- Sphyræna argentea.** *Barracuda.* Reaches San Francisco from points south of that city, the bulk of the supply coming from the extreme southern part of the State.
- Scomber colias.** *Mackerel.* This fish, the bull's-eye or chub mackerel of the east coast, has great food value in San Francisco and always meets with ready sale. No large quantities were seen, but several boxes full were observed on a number of occasions between June 6 and 13. The fish weighs about 3 pounds, and sells in the markets at 10 to 20 cents a pound.
- Sarda chilensis.** *Bonito.* Weighs 10 to 15 pounds. Comes chiefly from the south.
- Trachurus picturatus.** *Horse-mackerel.* Not uncommon.
- Orcynus alalonga.** *Tunny.* A few observed that weighed 20 or 25 pounds.
- Archoplites interruptus.** *Perch.* One of the best fresh-water food-fishes of the coast. Its abundance has greatly decreased of late, and the price keeps correspondingly high, averaging more than double that of the chinook salmon. The greater part of the supply comes from the Sacramento River.
- Roccus lineatus.** *Striped Bass.* The most common name by which this fish is known on the east coast, viz, rockfish or rock, is fortunately never used in California, the designation rockfish being reserved for various species of *Sebastichthys*. The striped bass is found in the city markets at all seasons; in fact, there is not a day in the year when it may not be looked for. The average weight is 10 pounds, although a great many smaller fish are sold. In 1890 the board of supervisors of San Francisco County passed an ordinance making it unlawful to buy, sell, or have in possession any striped bass weighing less than 8 pounds. In 1891 the ordinance was amended reducing the minimum weight to 3 pounds.
- Seriphus politus.** *Kingfish.* A few seen every day, but no large quantities observed. The bulk of the receipts comes later in the summer.
- Embiotocidæ.** *Perch; Salt-water Perch.* Numerous species of this interesting family were seen in the markets daily, the most abundant being *Ditrema jacksoni*, the black surf-fish, and *Hysterocephalus traski*, the "perch" of the fresh-water streams of this region. The boxes in which these fish are kept in the markets and the stalls on which they are exposed were littered with the young.
- Hexagrammus decagrammus.** *Sea Trout; Rock Trout.* Common.
- Ophiodon elongatus.** *Codfish.* Even at this late day there are many San Franciscans who believe the true cod is found in the waters immediately adjacent to the Golden Gate, and this fish, the cultus-cod, is sold by no other name than codfish in the markets of California. Indeed, I was approached by at least one dealer who wished me to state that the fish he had on his stall was a genuine cod. The fish is found in San Francisco Bay and in the adjacent sea at all times. Examples weighing 10 to 20 pounds were observed.
- Sebastichthys, species.** *Rockfish; Rock-cod.* The members of this genus are among the most abundant and important fish found in the markets. The annual sales are considerably over 1,000,000 pounds, the ruling market price being from 6 to 10 cents a pound. Several species of rockfish, in varying quantities, but usually abundant, were noticed every day. Those positively identified were the red rockfish (*S. ruber*), the most abundant species, the black rockfish (*S. mystinus*), the orange rockfish (*S. pinniger*), and the yellow-tailed rockfish (*S. flavidus*).
- Microgadus proximus.** *Tomcod.* The diminutiveness of the tomcod would naturally be expected to place it at a great disadvantage among the many large fishes of this coast having recognized food value. On the contrary, however, the sales are quite large and the prices are good, although much less than a few years ago.
- Hippoglossus hippoglossus.** *Halibut.* A few are taken by the San Francisco market fishermen, but the supply is always small and uncertain, and the price commanded by the fish is very high, running from 10 to 25 cents a pound. This condition of affairs offers a good opportunity for the establishment of a halibut fishery out of San Francisco, and it seems probable that a very remunerative fishery might in time be built up. In the early part of June, 1894, a vessel reached San Francisco from the banks off the northern coast with 75,000 pounds of fresh halibut.

The result of this venture is thus described in the *Examiner* of June 10:

"The fish war which has been agitating the local fishermen for the past ten days is now over for the present. Capt. D. Johnson, of the schooner *Elwood*, who came down from the northern waters with a cargo of halibut, has sold out, and it will be five or six weeks before he will be back with another load. When the *Elwood's* cargo arrived halibut was retailing at 25 cents a pound, and it was scarce at that. Captain Johnson offered to sell all his fish to the Fishermen's Union at a very small price, but they would not accept it, and the captain opened up a fish market on the deck of the schooner, selling retail at 5 cents a pound. He kept two men busy cutting up the fish for customers, and in five days the whole cargo of 75,000 pounds was sold. When the Italian fishermen heard the *Elwood* was coming with a cargo of halibut they informed the customs officials that the schooner was coming down the coast with opium. That information was sent to the sound, and when the *Elwood* was passing Cape Flattery a revenue cutter overhauled her, but only fish and ice were found on board. When the vessel tied up at the dock the health inspectors were informed that she had a cargo of rotten fish, and an inspector was sent to her at once, but he bought the largest fish he could find and took it home for his own table. None of the fish-dealers dared handle the halibut for fear of being boycotted by the local men, and Captain Johnson was forced to open a market or throw the fish overboard.

"As soon as he began to sell the local men got into their boats and every net, in San Francisco was set for fish. They hoped to make a good catch and glut the market, but luck was against them and they returned almost empty. There was consequently a big demand for halibut, and now the schooner is cleared of her cargo. The local fishermen say that another cargo shall not be sold in San Francisco."

Paralichthys californicus. *Halibut.* Commonly sold under the name of halibut.

Psettichthys melanostictus. *Sole.* Only a few seen.

Pleuronectes stellatus. *Flounder.* This was the most abundant and constant flounder in the markets. Enormous quantities were observed only 6 or 7 inches long. The largest weighed about 15 pounds. Much the largest part of the flatfishes which reach the San Francisco markets is caught by steam vessels fishing with paranzellas off the mouth of Drake Bay.

In addition to fish proper, a very extensive trade is done in other fishery products in the San Francisco markets. In fact, the value of the mollusks, crustaceans, and reptiles which enter into the fish trade of the city is greater than that of the fish. The following products, which constitute all the principal economic aquatic objects additional to fish, were observed in the markets in greater or less abundance:

MOLLUSKS.

Ommastrephes tryoni. *Squid.* Consumed chiefly by the Chinese, although also eaten by natives of southern Europe. On one occasion a Portuguese woman was seen to take a small fresh squid from a counter, bite off its head, and devour it with apparent gusto!

Octopus punctatus. *Octopus; Devil-fish.* Usually exposed for sale by suspending from hooks in the stalls or at the doors of markets. Eaten by Chinese.

Ostrea rufa. *Native Oyster; California Oyster.* Sells for \$3 to \$4 per bushel. The flavor is "coppery," and the oyster can not be relished by one not accustomed to it.

Ostrea virginica. *Eastern Oyster.* The annual sales are over 100,000 bushels, valued at about \$4 per bushel. The supply comes from San Francisco Bay, and depends wholly on seed and plants brought from the East.

Tapes staminea. *Hard Clam.*

Mya arenaria. *Soft Clam.*

Modiola capax. *Mussel.*

CRUSTACEANS.

Cancer magister. This was the only crab seen in the markets. It weighs from 1 to 4 pounds, the average being 1½ or 2 pounds. Next to oysters, it is the most valuable of the invertebrate products. The annual sales amount to 1,200,000 to 2,000,000 crabs, having a value of 5 to 7 cents each. The supply is largely from San Francisco Bay.

Panulirus interruptus. *Crawfish; Lobster.* Reference to the spiny lobster will be found in a separate chapter. The name crawfish, by which this is often called, is an unfortunate misnomer.

Crangon franciscorum. *Shrimp.* The sales of shrimp in San Francisco are very large, and have increased of late years. At the present time the shrimp is, next to the crab, the most valuable crustacean entering into the city's supply of water food, and is exceeded in value only by oysters, soft clams, and crabs. In 1888 Mr. Wilcox found that 290,000 pounds of fresh shrimp, worth \$23,200, or 8 cents a pound, were sold in the markets; in 1893 Mr. Alexander ascertained that the receipts amounted to 825,000 pounds, valued at \$41,250, or 5 cents a pound. As is well known, the shrimp fishery is in the hands of the Chinese, who, in addition to selling large numbers in a fresh condition, dry and ship to China much larger quantities.

REPTILES.

Rana pretiosa. *Bullfrog.* This animal is figuring more conspicuously in the San Francisco markets each year, and already has great commercial value. The ruling price is \$3 to \$4 per dozen, and the annual sales amount to between 5,000 and 10,000 dozen.

Chelopus marmoratus. *Terrapin.* Between 1,000 and 2,000 dozen are sold annually in San Francisco, at \$3 to \$5 per dozen. The supply comes chiefly from the marshy regions at the mouth of the Sacramento River.

Chelonia virgata. *Sea Turtle; Green Turtle.* Reaches the San Francisco markets from the southern coast and Lower California.

THE PACIFIC WHALE FISHERY.

The principal whaling port in the United States is now San Francisco. Besides having a numerous home fleet, that city is the rendezvous of a large number of New Bedford vessels. The growth of the whaling industry on the west coast has been due to the scarcity of whales in the Atlantic and their abundance in the North Pacific and Arctic oceans. The present importance of the whale fishery carried on from San Francisco is largely due to the extensive use of steam vessels, which are considered essential for the proper prosecution of the business in the more northern latitudes.

The year 1893 was the most successful one in the history of the Pacific whale fishery. The San Francisco fleet killed and utilized over 350 whales, of which 294 were bowheads, a much larger number than had been obtained in any previous year. The quantity of bone represented by this catch was 404,600 pounds, valued at \$1,246,168; and 6,740 barrels of oil, worth \$93,160, were extracted.

The fleet consisted of 46 vessels, of which 20 were sailing craft and 26 were steamers. Eleven of the sailing vessels took 16 bowhead whales and 9 took none, the season for this class of vessels thus being a failure.

The year was remarkable for the remote grounds frequented by the steamers, and the abundance of whales there found. While none of the sailing vessels ventured east of Point Barrow, owing to the ice and fog, a large part of the steam fleet did so, going as far as Herschel Island, Cape Bathurst, and Banks Island. Four steamers, which had wintered at the north of the Mackenzie River, took 94 whales off Cape Bathurst, where they went in July. Returning to the vicinity of Herschel Island, they were joined by 9 steamers from the west, and this fleet of 13 vessels took 164 whales by the middle of September, 1893. Ten vessels that went to Okhotsk Sea and Bristol Bay captured 15 whales, 2 obtaining nothing.

The present aspects of whaling in the Pacific are thus referred to by the San Francisco *Call*:

The whale is destined to disappear from the North Pacific much more speedily than he was driven from the eastern approaches to the Arctic. The whale fleet sailing out of the port of San Francisco has this year caught in Arctic regions no less than 353 whales. The product of this season's catch would have been represented by about \$2,000,000 had prices remained as they were about three years ago. When one small steamer takes 62 whales in a single season, and a still smaller one kills 64, there

is a striking illustration of what steam is doing for the extermination of the whale in the Pacific. There will be no restriction. The whale fishery by sailing vessels has for some time been unprofitable. What the sailing craft would not do in a lifetime of years the steam whaler will pretty effectually accomplish in a very few years.

MINOR NOTES.

A LARGE SKATE.

At Astoria, on June 20, two salmon gill-net fishermen brought in a very large skate, which had become entangled in their net at the mouth of the river. It was landed at a cannery, and was said by a number of people who saw it to have been the largest skate ever landed in Astoria. Its greatest width was 5 feet, its total length was a little over 6 feet, and its weight was 150 pounds. A Chinese salmon-dresser was engaged to open the fish; its alimentary tract was found to contain a number of crabs (*Cancer magister*), some of which were almost whole. The Chinese cannery hands watched the evisceration of the skate very intently, and when the opportunity came hastily made off with the intestines, which are, by them, considered a great delicacy. From a sketch made of this skate and an examination of the teeth the specimen has since been identified as the big skate (*Raia cooperi* Girard). It is the largest representative of the genus on the Pacific coast, and is said by Jordan & Gilbert to have an egg case nearly a foot in length. According to those authorities, it is abundant from Monterey to Sitka.

FISH IN LOS ANGELES MARKET.

At Los Angeles, on June 5, the following meager representatives of the rich fish fauna of the coast of Los Angeles County were seen in the market, which is supplied by the fishermen of San Pedro:

- Seriola dorsalis.** *Yellow-tail.* One fish weighing 25 pounds.
Orcynus alalonga. *Albacore.* One weighing 25 pounds.
Sarda chilensis. *Bonito.* Two having weight of 8 pounds each.
Halichoeres semicinctus. *Kelpfish.* Several weighing about a pound each.
Sebastichthys, species. *Rockfish.* A number of these fish, belonging to several species, were on sale.
Leptocottus armatus. *Sculpin.* A few.
Paralichthys californicus. *Halibut.* Several.
Oncorhynchus chouicha. *Salmon.* A few from San Francisco.
Microgadus proximus. *Tomcod.* Common.

Some anchovies (*Stolephorus ringens*) prepared as "Russian sardines" were also seen.

FRESH-WATER CRAWFISH.

The business of taking crawfish for market is of very recent origin, and their utilization is as yet limited. Several species of the genus *Potamobius* are found in the west coast States, but they are taken only in a few localities. They may be seen exposed for sale in San Francisco and Portland. They are especially numerous in the sloughs of the Columbia and Willamette rivers, from which the greater part of the supply is now drawn, although they occur in great abundance in suitable situations throughout this region. On June 18 several hundred remarkably large and fine-looking crawfish were seen at a fish-stand in Portland. Some were somewhat over 6 inches in body length.

The *Oregonian* of June 19 stated in regard to the crawfish trade of that city:

The first shipment of big crawfish from down the river was received here yesterday, and some of them were whoppers, at least 6 inches in length. They look more like young lobsters than ordinary crawfish. There is quite a demand for these crustaceans, now that the Americans have begun to learn what the French and Germans have long known—that they are delicacies. There is no end of them in the Columbia and Willamette, where they grow to large size, and smaller ones are found in nearly every stream in the State. Quite a business is done by several persons in shipping cooked and spiced crawfish to San Francisco, where there is a great demand for them, and they are now found regularly on the bill of fare at a number of restaurants. It is not likely that there will ever be so many millions of dollars in the crawfish fishery as in the salmon, or even in the sturgeon and shad, but it can be made to yield a profit to many fishermen.

Mr. A. B. Alexander, of the Fish Commission steamer *Albatross*, found that in 1893 the quantity of crawfish received by Portland dealers was 25,000 dozen, with a value to the fishermen of \$3,000, or 1 cent each.

FISHES OF MONTEREY BAY AND VICINITY.

The mounted collection of fishes of Mr. B. C. Winston, of Pacific Grove, has already been referred to. The collection is interesting in that it is a fair representation of the fish fauna of a definite part of the coast, being made up from specimens drawn almost exclusively from the immediate vicinity of Monterey; that is, from Monterey Bay and the adjacent ocean. Mr. Winston has courteously supplied a list of the fishes, which discloses some interesting species and seems worthy of presentation.

- | | |
|---|---|
| <i>Polistotrema stouti</i> . Hagfish. | <i>Sebastes paucispinis</i> . Bocaccio |
| <i>Heptranchias maculatus</i> . Seven-gilled shark. | <i>Sebastichthys flavidus</i> . Yellow-tailed rockfish. |
| <i>Catulus uter</i> . Puffy shark. | <i>miniatus</i> . Rasher. |
| <i>Triakis semifasciatus</i> . Leopard shark. | <i>ruber</i> . Red rockfish. Very rare. |
| <i>Carcharinus glaucus</i> . Blue shark. | <i>constellatus</i> . Spotted corsair. |
| <i>Alopias vulpes</i> . Thresher shark. | <i>maliger</i> . |
| <i>Lamna cornubica</i> . Mackerel shark. | <i>nebulosus</i> . Garrupa. |
| <i>Squalus acanthias</i> . Dog shark. | <i>serriceps</i> . Treefish. Not common. |
| <i>Rhinobatus productus</i> . Shovel-nose shark. | <i>nigrocinctus</i> . Black-banded rockfish. |
| <i>Raia inornata</i> . Skate. | One specimen. |
| <i>Raia stellulata</i> . Skate. | <i>goodii</i> . |
| <i>Myliobatis californicus</i> . Stingray. | <i>Sebastolobus alascanus</i> . Alaska rock-cod. Very |
| <i>Alepidosaurus borealis</i> . Lance-fish. Rare. | rare. Two specimens. |
| <i>Synodus lucioceps</i> . Lizard-fish. | <i>Icelinus quadriseriatus</i> . Sculpin. |
| <i>Exocoetus californicus</i> . Flying-fish. | <i>Enophrys bison</i> . Scorpion-fish. |
| <i>Siphostoma californiense</i> . Pipefish. | <i>Nautichthys oculo-fasciatus</i> . Sculpin. Four speci- |
| <i>Hippocampus ingens</i> . Sea-horse. Rare. | mens. |
| <i>Sphyræna argentea</i> . Barracuda. | <i>Rhamphocottus richardsoni</i> . Ramfish. |
| <i>Scomber colias</i> . Mackerel. | <i>Porichthys margaritatus</i> . Midshipman. |
| <i>Sarda chilensis</i> . Skipjack. | <i>Neoclinus satiricus</i> . Batfish. Rare. |
| <i>Trachurus picturatus</i> . Horse mackerel. | <i>Clinus evides</i> . Blenny. |
| <i>Seriola dorsalis</i> . Yellow-tail. | <i>Xiphister mucosus</i> . Blenny. |
| <i>Girella nigricans</i> . Kingfish. | <i>Cebedichthys marmoratus</i> . Crested blenny. |
| <i>Ditrema laterale</i> . Blue perch. | <i>Anarrichthys ocellatus</i> . Wolf-fish. |
| — — Surf-fish. | <i>Microgadus proximus</i> . Tomcod. |
| <i>Caulolatilus princeps</i> . Whitefish. | <i>Hippoglossus hippoglossus</i> . Halibut. |
| <i>Hexagrammus decagrammus</i> . Sea trout. | <i>Lepidopsetta bilineata</i> . Sole. |
| <i>Ophiodon elongatus</i> . California cod. | <i>Pleuronectes stellatus</i> . Rough-jacket flounder. |
| <i>Anoplopoma fimbria</i> . Black cod. | |