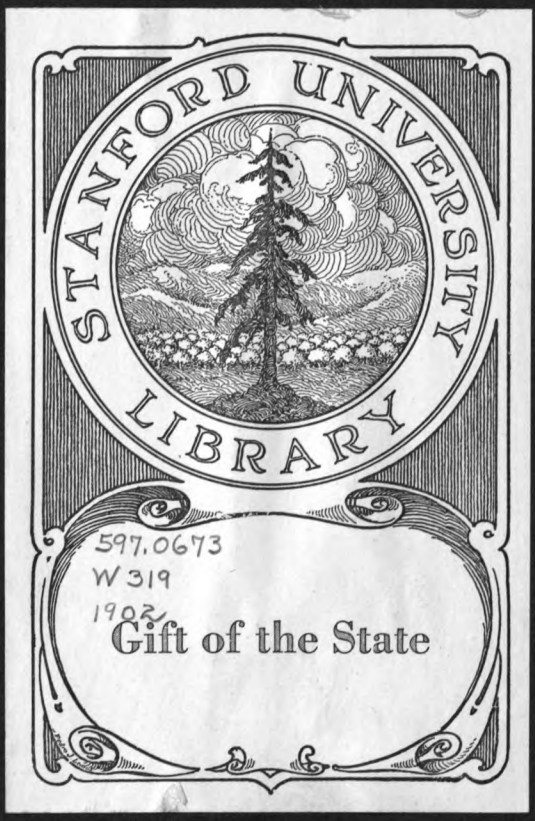
Washington (State) Dept. of fisheries and game.

13th annual report, 1902.



Regards of Rev Browne

STATE OF WASHINGTON.

DEPARTMENT OF FISHERIES AND GAME.

THIRTEENTH ANNUAL REPORT

OF THE

STATE FISH COMMISSIONER

TO THE

GOVERNOR OF THE STATE OF WASHINGTON.

T. R. KERSHAW, COMMISSIONER.
WHATCOM, WASH.

1902.

SEATTLE, WASH.:
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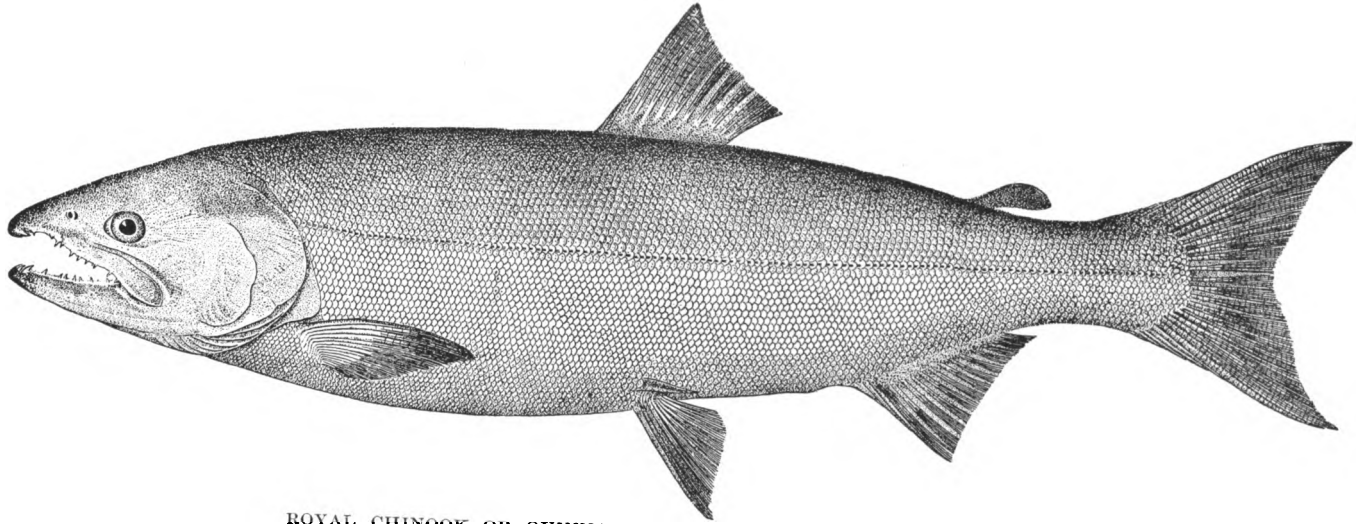

ROYAL CHINOOK OR QUINNAT SALMON, (*Oncorhynchus tschawytscha*).

STATE OF WASHINGTON.

DEPARTMENT OF FISHERIES AND GAME.

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WHATCOM, WASH., Dec. 1, 1902.

To His Excellency, Henry McBride, Governor of Washington:

Sir—In compliance with the provisions of the law requiring the same, I have the honor to submit herewith the thirteenth annual report of the Department of Fisheries and Game for the year ending November 30, 1902.

Respectfully submitted,

T. R. KERSHAW,
Fish Commissioner.

GENERAL REVIEW.

Pursuant to my appointment I took charge of the office on the third of March last, and in conjunction with the retiring commissioner, I checked over the accounts of the office and found everything in excellent condition. The books and records were well kept and all accounts showed a correct balance, and I wish at this time and in this public manner to acknowledge my appreciation of the many kindnesses shown me both prior to, and after taking possession of the office, by my predecessor, Mr. A. C. Little. He was at all times untiring in his efforts to render me all the assistance possible while I was familiarizing myself with the duties of the office. As soon as I became familiar with the detail work of the office and during the months of April and May I personally inspected all the state fish hatcheries as well as the experiment station at Dogfish bay, all of which will be more fully touched upon under their respective heads in subsequent pages of this report.

Office Force.

When I took charge of this department I found the office force consisted of a bookkeeper and stenographer, but as soon as I had become familiar with the work I let the bookkeeper go, and so far I have been able to keep up the records of the office with the assistance of one cerk, although it has necessitated many evtra hours of work both for myself and assistant. With provision for sufficient outside force I could spend more of my time in the office and my assistant and myself could easily keep up the work of this department within office hours.

Deputies.

The laws of 1901 provided for the appointment of three deputies and further provided that they should be paid for their salaries the sum of one hundred dollars per month, but the legislature

for some unknown reason only appropriated for the three deputies the sum of $4,000.00 for the two years. My predecessor therefore only appointed two deputies and when I came into office their appropriation had been exhausted and there were no deputies at work in this department, but the salary fund had been exhausted in the first ten months of the first fiscal year. This led to a great deal of annoyance and inconvenience, as the closed season was then on, and complaints from all over the state were continually coming in regarding the violation of the law. But with no funds at my command I was powerless to enforce the law, or to pacify those law-abiding citizens who had a right to complain. I shall, however, during the present fiscal year keep the two deputies in this department at the work the full twelve months, and trust to the wisdom of the incoming legislature to compensate them for their services for the full fiscal year.

Removal of Headquarters.

When I took charge of this office I found my predecessor had established permanent headquarters some five years ago at the city of Tacoma. On account of mailing facilities and the undeveloped condition of the fisheries industry on the lower Sound at that time, Tacoma was probably the most convenient place for the speedy dispatch of the business of this department at the time the office was located there, but within the last few years the fisheries industry on the lower Sound has grown with great rapidity, until today the Puget Sound district furnishes over 82 per cent of all of the capital employed in the state in the fishery industry; over 77 per cent of the number of persons employed; over 79 per cent of the earnings of labor employed; over 86 per cent of the value of the output of the state and over 85 per cent of the taxes received by this office. The Puget Sound district should therefore be credited with about 80 per cent of the fisheries industry of the entire state. In the year 1901 there was collected by this department in the way of taxes for the support of the fisheries industry, the sum of $55,-987.91; of this amount the Puget Sound district contributed the sum of $44,488.10, or over 75 per cent of the taxes for the entire state, and of the $44,488.10 paid into this department by the Puget Sound district, Whatcom county alone contributed over

$35,000 or about 79 per cent of the tax of the Puget Sound distract, and over 62 per cent of the amount derived from the fishery industries of the entire state.

You will notice therefore that the fishery interest of Whatcom county amounts to more than all the rest of the state, and in view of this condition I thought it would be to the best interest of the state, and that the industry would be better served with the office so moved to a more central locality. I therefore, on the 20th of September last, moved my headquarters to Whatcom and I find the change has been advisable. By being centrally located among the cannerymen and in the midst of the great fishing industry I can handle the ever-increasing business in this office with greater dispatch, with more convenience to the fishing interest and I believe with economy to the state.

FISHING INDUSTRY.

The fishing industry, while not reaching the magnitude from a commercial standpoint that it did last year, has on the whole had a profitable season. While the run of the Sockeye salmon fell far short of the expectation of the cannerymen, the pack was largely supplied by a good run of fall fish. The pack of the Puget Sound district will be small compared with last year, but the deficiency from a commercial standpoint will be largely supplied by a firmer market and increased prices. This has been one of the banner years in the Columbia river district. The early run of fish was the best it had been for years, and instead of slacking up between the early and late run as is usual on the river, the run continued in countless numbers until all available canneries and cold storage plants were crowded to their utmost capacity. So, taking the state as a whole, with increased demand and firmer prices, the present year has been a fairly successful one for cannerymen and cold storage plants, and on account of the large price offered for fish has been an exceptionally good one for fishermen. By the successful system of hatcheries the states of Oregon and Washington now maintain on the Columbia river, the permanency of the fishing industry of this state, in the Columbia river district is assured for all time to come; for it has been fully demonstrated the last two years that the art of artificial propagation has solved the prob-

lem of restocking the river with this most important product of our state's commerce. The exceedingly large run of fall fish in the waters of Puget Sound this season also shows the fruitful result of our system of hatcheries in the Puget Sound district. The most of the hatcheries in this district were erected in 1899 and this is the first year that any result could possibly be obtained from them. I believe that with the system of hatcheries now maintained in the state, not only the present supply of fish can always be maintained but with each succeeding year will come an increase. While we have done so much for the Royal Chinook on the Columbia river, and the poorer grades of fish on Puget Sound, it is to be regretted that so far we have found no way to propagate the most valuable of all varieties, the Nerka (Sockeye) fish, and unless some plan can soon be formulated whereby we can establish hatcheries for the propagation of this valuable fish the day is not far distant when they will become extinct.

FRASER RIVER HATCHERY.

Early after my installation in office I took up the subject of establishing a Sockeye hatchery on some tributary of the Fraser river in British territory. The Sockeye fish enter the waters of Puget Sound through the strait of Fuca, and passing through American waters ascend the Fraser river to their natural spawning grounds in British territory.

None of the streams emptying their waters into Puget Sound, except the Skagit, have been found to contain Sockeyes in sufficient numbers for propagation. The Fraser is their natural home where they ascend every year in countless number to reproduce their kind. It will therefore be necessary if we expect to keep up the supply of this valuable fish to formulate some plan whereby we can establish a system of hatcheries on the Fraser river. After considerable correpondence I made an engagement to meet prominent British Columbia officials last June in Victoria, where we discussed the project at some length, from a legal standpoint, and while I was received with extreme courtesy by Mr. John Pease Babcock, Commissioner of Provincial Fisheries, and the Hon. D. M. Eberts, Attorney General, and other officials of the British province, I am sorry to say that our conference resulted in no plan

SKOKOMISH HATCHERY.

that was satisfactory to this department. I did learn, however, in our conference that it was still an unsettled question whether the fisheries of British Columbia were under control of the Provincial or Dominion government. Acting upon this information I proceeded at once to New Westminster and took the matter up with Mr. C. B. Sword, Inspector of Dominion Fisheries. Here I was also cordially received by the officials of the Dominion government, but was respectfully referred to Prof. E. E. Prince, the head of the fisheries department of the Dominion government at Ottawa. Mr. Sword, however, transmitted my plan to Professor Prince, the reply to which conveyed some hope that something along these lines might be accomplished in the future. Acting upon this first ray of sunshine, I transmitted copies of all my correspondence on this subject to the state department at Washington, D. C., with a request that it be taken up with the proper authorities at Ottawa, in view of obtaining from the Dominion government the necessary concession for us to establish hatcheries on Canadian soil, where the matter is now pending. In the meantime the British Columbia cannerymen became interested in the enterprise, and made me a proposition on somewhat different lines, without having the concession granted direct to the state of Washington, it was more in the nature and on its face of a private enterprise, although the state would be in full control, and the Washington cannerymen receive the desired results. Mr. Henry Doyle, president of the British Columbia Cannerymen's Association, to whom this department is much indebted for the moral support he has given the enterprise, is now in Ottawa urging the Dominion authorities to give their consent to the stripping of fish on Canadian soil. I feel so much encouraged in this undertaking I hope for favorable result before the closing of the coming legislature, and if I obtain the concession for which I am working I would recommend a liberal appropriation for the enterprise. Feeling that I would eventually succeed in the undertaking, I instructed, last August, Mr. John Crawford, one of the best known fish culturists in the state, and a person of large experience in this line of work, to proceed to British Columbia and prospect the territory tributary to the Fraser river for a Sockeye hatchery; to select a location where not only the desired amount of spawn

could be obtained, but one that would furnish a good water system, convenient to timber and where labor could be obtained at moderate prices, and I herewith submit his report to me of his investigations:

HON. T. R. KERSHAW,
State Fish Commissioner,
Whatcom, Washington.

Sir—I have the honor to submit to you a report of my recent investigations of the Nerka (Sockeye) salmon on their spawning grounds in the different streams of British Columbia. In compliance with your order, I left Whatcom on the 19th of August, arriving at New Westminster the same evening. The next day I called at the office of the fisheries department and presented my letter of introduction to Mr. C. B. Sword, Inspector of Fisheries for the Dominion government.

Mr. Sword received me very kindly and promised all the assistance in his power, and I would like to state, that during my entire stay in British Columbia Mr. Sword and his able assistant, Mr. T. Robinson, did everything in their power to assist me in my investigation, and I am indebted to these gentlemen for a great many courtesies.

During my stay in New Westminster, from August 19th to August 24th, I looked up on the maps different streams frequented by the Sockeye salmon, and studied the route I would have to travel.

The maps of British Columbia were placed at my disposal, and all the information obtainable was given me by the officers of the fisheries department. Mr. Sword introduced me to Mr. Frank Devlin, the Indian agent at New Westminster, who furnished me with a map of the Lillooet district, and who also introduced me to the chief of the Pemberton Indians, at the same time telling the chief of my intended visit to the Pemberton Meadows.

Mr. Devlin instructed the chief to give me all the assistance in his power, and to see that I was given safe conduct through that part of the country. This service was invaluable, and I wish in this report to thank Mr. Devlin for his kindness in this matter.

On August 24th, I started for the Shuswap lake and arrived at Tappen siding on the Shuswap lake about 4 o'clock a. m. the next morning. At this point the Dominion government have a large hatchery.

The superintendent was absent at the time of my arrival, but the steam launch was there and the captain kindly conveyed me to Salmon Arm, near the Salmon river. This stream is used by the hatchery, and large quantities of spawn are taken from there every season. From Salmon Arm I went to Sicamous, near Mara lake, where I began my investigations. Mara lake is a body of water about 12 miles in length and will average about two miles in width. Having secured a boat, I

spent a couple of days examining this lake for hatchery purposes, but found that very few, if any, salmon spawned in this vicinity.

I next investigated the Spallumsheen river. This stream flows directly through Mara lake. Not finding any trace of the Sockeye in this stream, I proceeded to Enderby, a small town situated at the junction of the Spallumsheen and Shuswap rivers. There I ascertained that during the season of 1901, there were a great many Sockeyes in the Snuswap river. I ascended this stream for a distance of about eight miles, but found very few salmon. I talked with the Indians who were at work building a fish trap on the river, and from them I ascertained that every fourth year there was a good run of Sockeyes in this river, but during other years there were very few.

This is a good spring salmon (Quinnat) stream, however, and I saw quite a number that the Indians had caught. I made further investigations and found two good hatchery sites, but am satisfied that there are not enough Sockeye salmon to warrant the building of a hatchery at this place.

Before proceeding further with this report, I wish to state that there are about six good salmon streams that flow into the Shuswap lake. All but one of these are fished by the Dominion government for their hatchery at Tappen siding, the one exception being the Adams river. This stream empties into the Shuswap lake, near the southeast end, and the mouth of the river is about 65 miles from the Tappen siding hatchery.

The government had tried this river last year, but gave it up, as it was hard to control, and besides they could secure all the spawn they could handle at Scotch creek, a stream about five miles from the mouth of Adams river.

Having ascertained these facts, and having had considerable experience with swift streams, I decided to examine this river and Adams lake from whence it flows. I therefore left Enderby and went to Notch Hill, a railroad station near the Shuswap lake.

Having secured a camp outfit and provisions at Notch Hill, I hired a team and had my outfit moved to the lake. I crossed the lake to Scotch creek and procured a guide. From Scotch creek I went to the mouth of Adams river. We camped at the mouth of the river for a couple of days, examined the stream, and watched the Indians at work building a fish trap. We found quite a number of Sockeyes in the river, but not as many as I had expected. There I ascertained that the first run of Sockeyes passed up the river into Adams lake.

I therefore determined to explore the lake and the Tum-Tum river, which flows into it from the north. We secured a pack horse and started for Adams lake. The trail was very rough and we could hardly get through with a pack horse, but finally succeeded in reaching the lake near the head of the river. We pitched our tent here, and camped for the night. I found a large creek near this point and

determined to examine it next day. That night I set a net for Sockeyes. The next morning we took up the net, but found no salmon. I then proceeded up the creek and found ten Sockeyes spawning, also saw about fifty spawning at the lower end of the lake. The guide secured a canoe and we started for the head of the lake, a distance of fifty miles. We paddled all day against a heavy head wind and reached Skwa-am bay, where we saw about 100 Sockeyes. There is a small creek flowing into the lake at this place and we found an old Indian trap that had been used last season. We repaired this trap and left it in shape to catch fish. On the third day we arrived at the head of the lake and camped near the mouth of the Tum-Tum river. We tried to get up Tum-Tum river in the canoe, but found the mouth blocked with large log jams. The guide found the trail that led up the river, and we followed it for about eight miles. I found splendid spawning grounds and a good hatchery site, but very few salmon.

Adams lake is about fifty miles in length and about six miles wide at the widest part. The country surrounding is mountainous and but very few white men have ever been in this part of the country. There are a number of small streams flowing into the lake from the north.

We found six dead Sockeyes floating in the lake near the mouth of the river. They were not injured about the head or body, and on examining them I found them ripe and ready for spawning. I am at a loss to know what caused them to die.

While camped at the head of the lake, I examined the Mo-mich river, a small stream near the head of the lake. The Indians had informed me that the Sockeys spawned in this stream. We found no salmon there, but could see where a great many had spawned last season. The beach was full of spawning beds made last year. After examining another stream and finding no salmon I decided to return to the mouth of the Adams river. We broke camp and started to the foot of the lake, stopping at Skwa-am bay to see if there were any fish in the Indian trap. We found only a few and proceeded on our way. We came down the lake in two days' time. At the foot of the lake we found a few more Sockeyes spawning.

I had decided that there was no site on Adams lake suitable for our purpose, so proceeded at once to the mouth of Adams river. Arrived at the mouth of the river and went into camp. I stayed around the mouth of the river for a couple of days and although I saw quite a number of Sockeyes that the Indians nad caught, I came to the conclusion that there was no suitable hatchery site in this part of the country and decided to leave there and to go to Lillooet lake, one of the places I had decided to visit while at New Westminster. I wish to state that last season this part of the country was full of Sockeyes and that enough spawn could have been secured at the mouth of the Adams river to fill any hatchery.

It must be remembered, however, that last year's run of salmon was the largest in twenty years, and that almost every stream in this part of the country was full of Sockeyes.

What I wished to find, however, was a place that was good even in a poor season, and I decided that al location of this kind could not be found in the Shuswap country.

From the mouth of Adams river I went to Notch Hill, and proceeded direct to New Westminster and from there to Harrison Hot Springs on Harrison lake.

While in New Westminster, Mr. Sword made arrangements to have his steam launch meet me at Harrison Hot Springs. I accordingly met the launch at this point and was conveyed to Fort Douglas, a distance of forty-two miles. I stopped over a day at Silver creek, where the Dominion government was taking spawn for the Bon Acord hatchery. The day after I arrived at Fort Douglas I visited Big creek, a tributary to Harrison lake. This is a good Sockeye stream and I found quite a number of Sockeyes spawning there. I then visited Spring creek, about ten miles north of Fort Douglas (by the river), and found it a good spring salmon (Quinnat) stream, with some Sockeyes. I am of the opinion that a hatchery could be successfully operated at Fort Douglas by obtaining the spawn from Big and Spring creeks. However, as my instructions were to find, if possible, a site where from 25 to 50 million eggs could be taken, I was satisfied that this could not be done at Fort Douglas. I prospected the country in this vicinity for three days, and gathered a great deal of information from Mr. Purcell, the only white man in this part of the country, and on the fourth day I started for the Pemberton Meadows. I secured a guide, pack horse, and two ponies to ride. We rode thirty-five miles the first day, and camped near Lillooet lake that night.

We followed the Lillooet river nearly all of the way from Fort Douglas, passing the Indian village at Skukum Chuck (good water) on our way. This village is situated about twenty miles from Fort Douglas, and is one of the greatest fishing points for the Indians in British Columbia. Every year the Indians gather here to secure their salmon for the winter and thousands of Sockeyes are taken and dried every season. At the lower end of Lillooet lake I found an Indian who had a large boat and hired him to take us to the Pemberton Meadows. We started early in the morning and reached the upper end of Lillooet lake, a distance of nineteen miles, about four o'clock p. m. From here we ascended the upper Lillooet river to the Indian village at Pemberton Meadows, a distance of six miles. The chief of the Pemberton Indians met us and agreed to show us through that part of the country.

We camped that night at the Indian village and the next morning started for the fishing grounds of the Pemberton Indians at Poole creek. During the past twenty-five years I have visited a great many

spawning streams and have seen a great many salmon, but I never saw such an ideal stream for a hatchery as Poole creek (sometimes called Clear creek). The Indians had caught and dried thousands, but the amount they had taken, compared with the salmon in the stream, was but a "drop in the bucket." Here I had found the *exact* spot I was looking for. I am satisfied that the main run of the Sockeye salmon that ascend the Fraser river go through the Harrison river, Harrison lake, Lillooet river, Lillooet lake, upper Lillooet river and spawn in Poole creek. The stream was fairly alive with Sockeyes in all stages, some spawning, some spawned out and dying, while fresh ones were just coming in the creek. This creek empties into the upper Lillooet river about a mile from the Indian village. One Indian speared seventy Sockeyes in two hours, the first day I was there. I traveled upon the stream for a couple of miles and found the creek full of Sockeyes. I would state that this part of the country, with the exception of the meadows, is rough and mountainous and with very little timber of any value in sight. However, I had noticed that the Indians had built very substantial houses and barns of cedar, some were built of split cedar and some of hewed cedar logs. I explained the object of my visit to the chief, who seemed delighted with the prospect of a hatchery in the vicinity, and he agreed to show me the cedar timber, and to also show me small streams that could be used for hatchery purposes.

The next morning we secured a couple of horses and the chief and myself started up Poole creek. Fortunately I spoke the Chinook language, as the chief spoke no English. Being able to talk and understand the Chinook language was a great help to me throughout the entire trip.

We first examined the country for a good hatchery site, and selected a place near the junction of Owl and Poole creeks, Owl creek to furnish water for the hatchery.

We then proceeded further up Poole creek, a point about three miles from the proposed hatchery site and about five miles from the Indian village. Here we found cedar in abundance.

We traveled on about two miles further up the creek to look at the salmon, and it was a sight I will not forget very soon. The entire distance from the mouth of the creek to where we stopped was just one large school of fish.

The chief informed me that I would find the same thing for three miles further, making a distance of ten miles of spawning Sockeyes, and this it will be remembered is during an off year. The chief told me that last year it was impossible to see the bottom of the creek on account of there being so many salmon. In my opinion this will make the greatest salmon hatchery site on earth. The cedar for the buildings is easy to get at, and there is a good road from the timber to the hatchery site. The Indians are good workers and labor could be

obtained right here. I found several whip-saws among the Indians. The freight can be shipped up the Fraser river, and if shipped in the spring, can be unloaded at Fort Douglas, and from there packed to Lillooet lake and thence by canoe to Pemberton Meadows, and packed from there to the hatchery site. Once established I do not think it a very expensive proposition. My estimates show that about $12,000 would build and equip this hatchery and about $8,000 a year would maintain it, and I am satisfied that if it is properly managed it will excel any salmon hatchery in the world. Having finished my work here, I proceeded direct to Whatcom, stopping at New Westminster on my way home to thank the Canadian officials for the many courtesies shown me during my stay in British Columbia.

We experienced rough weather on Harrison lake on our return, being seventeen hours in an open boat with heavy rain and head winds. However, I returned thoroughly satisfied, as my trip had been successful far beyond my expectations.

Respectfully submitted,

JOHN CRAWFORD.

DAKOTA CREEK.

Being mindful of the fact that the Sockeye pack has been in the past over 80 per cent. of the entire pack of the state, and that the Puget Sound canneryman has carried the burden of the expense of restocking the Columbia river with merchantable fish, it is just to the operators in the Puget Sound district that every effort should be made, and the ingenuity of this department taxed to its utmost to keep up the run of Sockeye fish in the waters of Puget Sound. I therefore visited, last October, Dakota creek, a small stream in the northerly part of Whatcom county, emptying its waters into Boundary bay, with a view of establishing an experimental Sockeye hatchery on the headwaters of this stream. I entered the mouth of the creek at Boundary bay in a row boat, and followed the stream up to its source, a distance of about eight miles. The water at high tide set up the stream about four miles, where I encountered pure spring water in the upper portion of the stream. While the bottom of the creek was, particularly at the lower end, not all that could be desired, the other features were good, and I believe spawn could be easily taken, and fry successfully hatched and liberated in this tributary of Puget Sound. It would cost but little to rack the mouth of the stream, when fish could be collected direct from the traps and towed at high tide

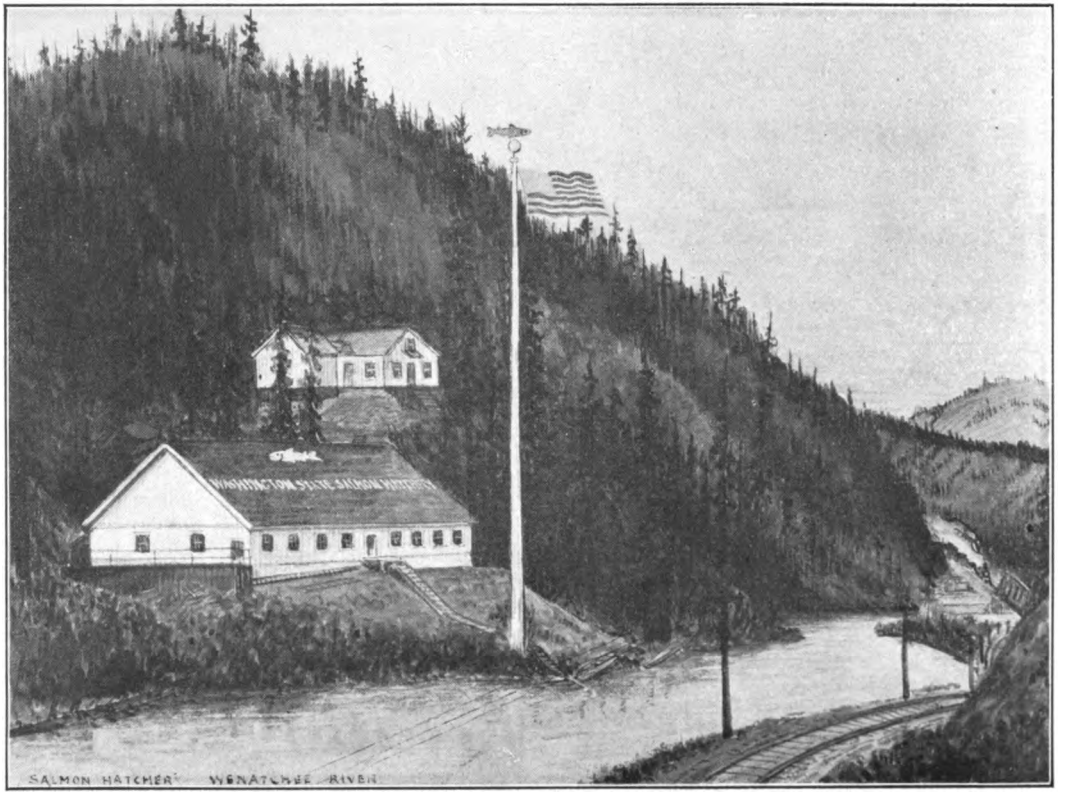
to the racks and placed in the stream to ascend to its source at the dictates of nature. This is the way our Chinook hatchery is operated at Bakers bay, and it seems to be the favorite plan of propagating salmon on the Atlantic coast, and I see no reason why it would not be successful here. I would strongly recommend an appropriation of $2,000 to carry out the experiment, conditioned, however, that the mills in Blaine cease depositing sawdust and other mill refuse in Boundary bay.

NOOKSACK RIVER.

There is another plan in my mind that may result in solving the problem of the propagation of Sockeye fish. On Kendall creek, one of the tributaries of the Nooksack river, about thirty miles from the city of Whatcom, we have erected and have in operation one of the best equipped hatcheries in the state; it has always been a success for the propagation of fall fish; the stream is supplied with pure water from numerous lakes, and its swift current and gravelly bottom make it an ideal home for this particular variety of fish. And further, the fact that the sockeye occasionally ascends the river in small numbers, leads me to believe that at one time this was one of their natural spawning grounds. I should feel confident of good results if I built a rack across the Nooksack river, and towed my fish direct from the traps and deposited them in the river, where they would eventually be caught at our Kendall creek hatchery in their natural spawning condition. I estimate the probable cost for the necessary rack along this river would be in the neighborhood of $1,000, and urgently recommend an appropriation for that purpose.

BAKER LAKE HATCHERY.

This hatchery was built by the state in the year 1896, and was successfully operated by the state until the season of 1899, when it was sold by the state to the United States government. Since that time it has been under the control of the United States Fish Commissioner, and operated as a government plant. This is by far one of the most important plants in the state for the fishing industry, it being located on Baker Lake, at the head waters of the Skagit river, the only stream emptying its waters into Puget



WENATCHEE HATCHERY.

Sound, that the sockeye fish is known to ascend in sufficient numbers for spawning purposes. Without any criticisms against the government or on the part of the very honorable gentlemen who have had charge of this plant since the United States government assumed control of it, I cannot help but believe that the state made a serious mistake when it allowed this hatchery to pass beyond its control. It being of so much importance to the fishery industry, probably more so than all the rest of the hatcheries on the Sound, that the state naturally would take an especial interest in its development and success, while the department that now operates it has no particular interest in its success further than they have in a general way in the successful operation of all plants. Again, the country in which it is located is isolated and far removed from civilization, no convenience for school, church or society, with cold and disagreeable winters to contend with and no attractions in summer save those supplied by nature, and while I do not wish to be unjust to anyone, it is a bare possibility that people who have all these disadvantages and elements to contend with may welcome the day when they are removed to some other locality. Being employes of government hatcheries, and under the civil service rule confident of their positions, they do not have the inclination to exert themselves to bringing an undeveloped plant to its high state of cultivation that state officials would have who know that upon the successful operation of their plants depend their positions and their salary. If the state was today the operator and owner of this hatchery, with our improved hatchery facilities, and advanced method of artificial propagation, I am confident we could turn out annually 20,000,000 young salmon which, in due coure of time, would find their way back to the waters of Puget Sound to add their share towards building up a great fishing industry that means so much to this state and is yearly advertising it throughout the civilized world. I strongly recommend that negotiations at once be opened between the state and the United States government, with a view of repurchasing this site, and that the legislature enact such laws as are necessary, together with an appropriation sufficient to carry out these views.

SALARY OF FISH COMMISSIONER.

In connection with this subject, I desire to quote from the 1899 report of my predecessor, Mr. A. C. Little, in which he says:

"In connection with the amount of work required of the fisheries department of this state, we would respectfully call attention to the fact that the salary of the Fish Commissioner of Oregon is $2,500 per year, while that of the commissioner of this state is $2,000. No one aware of the facts in the case will for a moment contend that the fisheries department of the State of Washington is not of more than twice the importance of that of Oregon, and considerably more than double the amount of work is required for the enforcement of the general fishing laws on account of our state having two large districts instead of one, as in Oregon; the industry, in the district of Puget Sound, in our state, being larger than the whole State of Oregon, and demanding more attention.

"Also, in respect to the amount of money collected and disbursed, more than three times the labor is required. We also have more than five times the number of fish hatcheries in the state, there again requiring more than five times the amount of supervision and responsibility. We wish to further state that the legislature of Oregon, at the last session, provided their commissioner with twice the amount of deputy service and $500 a year expense money, in excess of that appropriated for the Washington department.

"To state the matter briefly, the Fish Commissioner of Washington has more than twice the responsibility than has the same official in Oregon, and certainly three times the amount of labor to perform in order to properly do the work required of his department."

LIBERAL APPROPRIATION.

As great as are the general resources of this state, none excel the fisheries from a commercial standpoint. Taking the four leading industries of the state—coal, lumber, wheat and fisheries—the fisheries product of the state in 1901 exceeded the coal output by over $3,300,000; the lumber output, both foreign and domestic, including shingles and lath, by over $1,200,000, and was a little in excess of our great wheat crop. I therefore deem it essential,

and good business judgment, that the legislature should make liberal appropriation, not only for the maintenance of the state's greatest commerce, but that it may be increased in each succeeding year.

FIRE INSURANCE OF HATCHERIES.

One of the most important questions that this department has to present to the coming legislature is the question of some permanent protection of our hatchery property against loss by fire. Our buildings are all located in remote parts of the country, some of them far removed from civilization and beyond all reach of any fire protection, and generally constructed in the midst of thick foliage, where forest fires are most likely to rage with most disastrous results. I am aware that heretofore it has been the policy of the state to carry its own insurance, and this is perhaps the part of wisdom on public institutions that are constructed largely of stone and brick, situated within the fire limits of cities where they have the benefit of fully equipped fire brigades; but how differently situated is our hatchery property. In case of fire we are powerless to resist it, and can only stand back and witness the completion of its destructive work; and, again, it might be a great setback to our great industrial enterprise. Suppose, for instance, that our Kalama hatchery, one of the most important on the Columbia river, should burn directly after the close of the legislature, it would cause a loss to the state of this important output for two seasons, or until after the convening of the next legislature. I would therefore urgently recommend the enactment of some law that will authorize this department to insure its hatchery property, or for the state to set aside a certain per cent. of our revenue, to be known as the "Fire Insurance Fund," that can be made available at any time in case the state should be so unfortunate as to meet with an accident of this character.

PATROL BOAT.

One of the most important wants for this department is a patrol boat for the Columbia river. On account of the many sloughs and estuaries on this river, the collecting of licenses and the apprehension of violators of the law is very difficult. The

chartering of boats in this district is very expensive, and at the time we need one the most it is very difficult to obtain. The last legislature appropriated for chartering boat in this district the sum of $1,500 for the two years, and this amount only served as a pretense towards enforcing the law in that locality, while $2,000 would purchase a boat suitable for our work on the Columbia river, and $900 a year would be sufficient to maintain it, and this amount would be fully made up to the state in two years by additional license fees and fines from the offenders of the law. The patrol boat that was purchased for the Puget Sound district by authority of the last legislature has been a great convenience to this department in the dispatch of its business, and has more than paid its operating expenses. The very knowledge that the state is possessed of patrol boats is an incentive to persons who would violate the law to take out licenses.

TROUT HATCHERIES.

The state having in the last few years spent large sums of money in building up the fishing industry, making it one of the permanent resources of our state, consideration is now due to other elements of our state who do not believe life is made up entirely from a commercial standpoint, and that there should be established a trout hatchery and our depleted streams should be restocked with game fish for the benefit of those who desire and need recreation from the cares of business during the summer months. And the great pressure that is brought to bear on this department for such an enterprise comes from a large per cent. of the intelligent people who go to make up this great commonwealth of ours. Surely a state that has been blessed by mountain streams and inland lakes enclosed by nature's grandest beauty, should not be derelict in an enterprise of this character. We have several inland lakes within the boundaries of our state that are suitable for this desired purpose, and the money that would be spent in an enterprise of this character would be soon returned to the people by the ever-increasing tourists seeking our state for recreation and pastime.

KALAMA HATCHERY.

EASTERN OYSTERS.

As great as in our fishing interest, the oyster industry, if carefully fostered and protected, will in a few years be the leading industry of the state.

Never before has such an interest been taken in the oyster industry on the Pacific Coast as at present. This is shown not only by the amount of money that is being invested and by the formation of stock companies to engage in this business, but by the increasing number of applications made to this department for information regarding this industry. This is sought not only by residents of the state, but a number of letters have been received from various sections in the East from parties seeking a safe investment for capital.

While much is being done with the native oyster, a still greater interest is being shown in the experiments with the Eastern oyster, not only at our experimental station, but at various other places on the Sound and on Willapa harbor. Many carloads of young seed oysters have been shipped from the East and planted in these waters. The success attending these experiments is beyond the hopes of the most sanguine, for it has been found that these oysters grow and develop so rapidly that they are fully equal both in size and flavor to the best oysters grown on the Atlantic Coast.

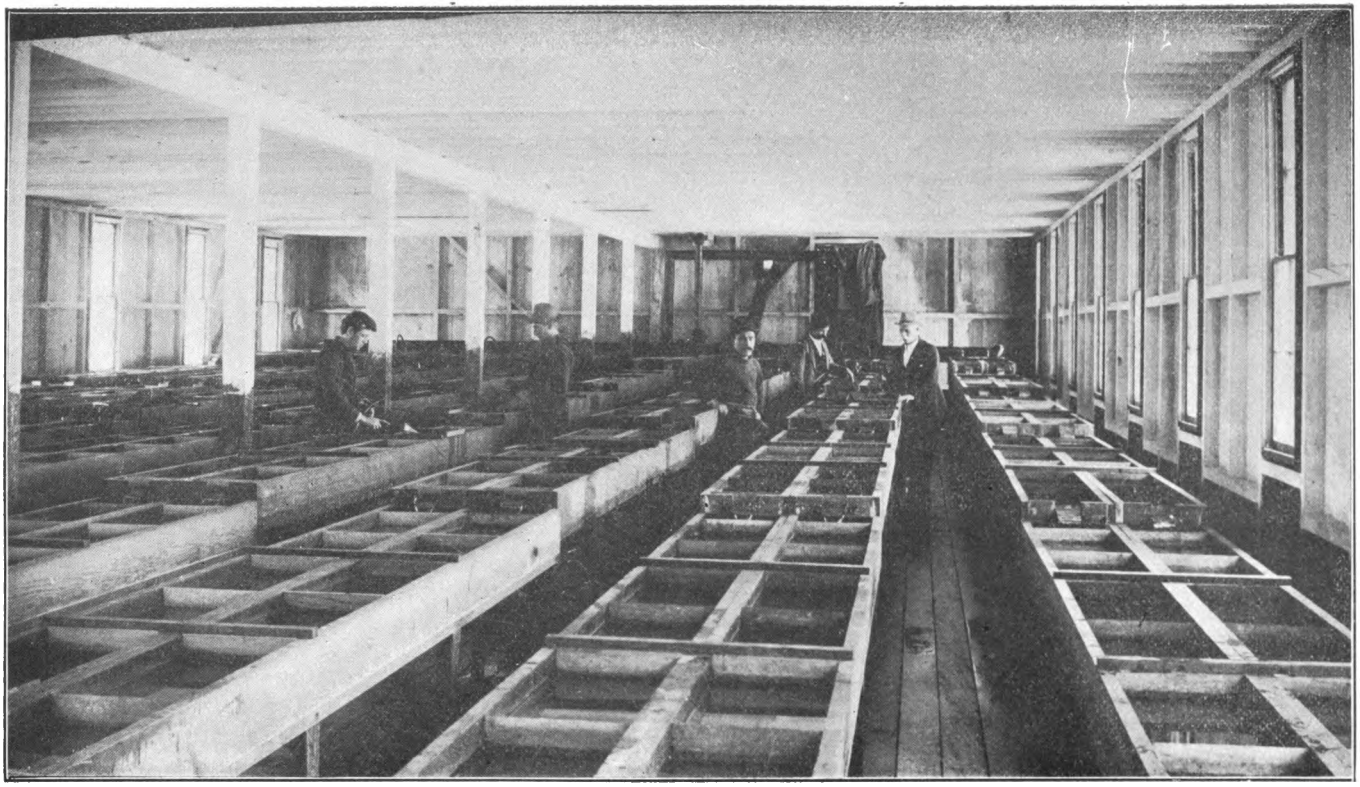
Methods of Handling.

Most of these young oysters are shipped from the East when they are about eight or nine months old, ranging in size at this time from one-quarter to one and one-half inches. They are closely and firmly attached to some collector, usually old oyster shells or cockle shells that have been sown on the beds the previous summer during the spawning season. They are dredged or tonged from the beds and as soon as possible packed closely in barrels and shipped in refrigerator cars. If kept at the proper temperature, they will live for several days or even weeks. It usually takes them ten to fourteen days to reach the Coast. Having reached their destination, they are scattered broadcast over the beds, where they are allowed to lay for a few months, when they are taken up and broken loose from the collectors and again scattered over

the beds. Here they are cared for and protected for three or four years, or until they have attained a marketable size. Occasionally two or even three-year-old oysters are shipped instead of the one-year-old. As the shells are larger and firmer, there is very little loss in shipping; as they are already separate from the collectors, they do not have to be rehandled after being planted and, of course, it does not take as long a time for them to reach a marketable size. There are usually 2,000 or 3,000 two-year-old oysters to the barrel, costing, according to quality, from three to five dollars per barrel.

One Must Understand the Business.

This, or something like it is, briefly, the method adopted by those who are already engaged in the Eastern oyster industry in this state. The success attending these experiments depends entirely upon the good judgment, energy and experience of the parties conducting them. We would not expect a farmer who had no experience or little knowledge of business methods to take charge of a large mercantile house and make a success of its management, nor would we except a man to make a successful agriculturalist or horticulturist until he had spent at least a few years on the farm studying the soil and crops and the best methods of handling them. It is quite likely, however, that thousands of dollars will be lost within the next few years because so many cannot be made to realize that it requires some knowledge of the oyster and its habits to make a successful oysterculturist. Under the very erroneous idea that any kind of beach or mudflat that is left bare by the tide will make good oyster land, hundreds of acres of tide lands have been bought up for oyster land that are entirely unsuited for this purpose. The question that most frequently comes to us is, "What kind of land is good for oyster land?" To this we can give no direct answer. So much depends not only upon the character of the ground itself, but upon the location and surroundings. The tides, currents and the directions from which the winter storms come all have to be taken into consideration and studied before one could tell whether a certain tract would make a good oyster bed or not.



INTERIOR VIEW OF KALAMA HATCHERY.

Cost of Seed.

With proper management we believe that the oyster business is safe and profitable. The number of seed oysters in a barrel of one-year-old seed will average about 12,000 or 16,000. The greatest loss occurs during shipment and during the time they are being separated from the collectors, but with proper care and handling the loss should not be over 15 to 25 per cent. The cost of the seed oyster depends principally upon the quality of the seed. Some years when the set has been good, seed may be purchased on some of the beds as low as 75 cents to $1 per barrel. A good quality of seed will usually cost from $2 to $3.50 per barrel. The freight rates are also subject to considerable variation, ranging from $550 or $600, to $700 or $750 per carload of 120 to 140 barrels. The cost of handling on the beds depends o much upon the methods pursued that a general estimate can hardly be given; the principal item of expense after the beds have been properly prepared being the planting, the rehandling at the time they are broken from the collectors, the protection during the time they are on the beds and the gathering, boxing and marketing when they are ready for the market. Fair-sized oysters in good condition will sell at present at 15 to 20 cents per dozen.

Best Land All Taken.

So great has been the demand for oyster land during the past few years that practically all the land belonging to the state and suitable for this purpose has been bought up. Not only this, but hundreds of acres of tide lands quite unsuited for oyster culture have been taken by those who did not understand the requirements for good oyster land. Unless the state throws open for sale some of the land now included in the oyster reserves, anyone wishing to purchase land for the cultivation of oysters must buy from those who already hold the land.

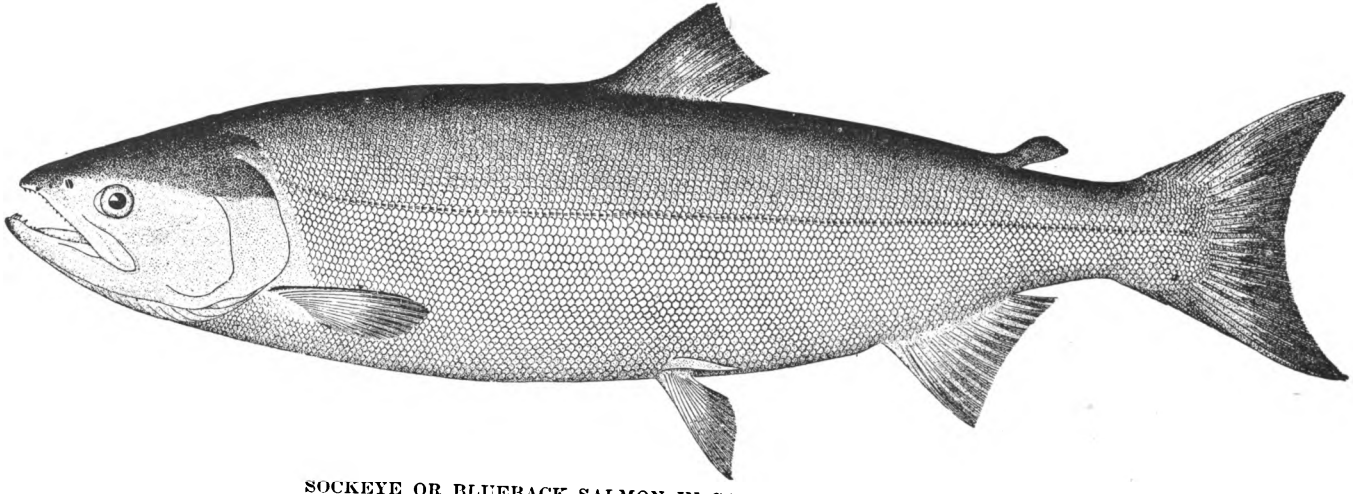
NATIVE OYSTERS.

Although the last legislature failed to set aside any funds for the investigations of problems connected with the cultivation of the native oyster and the maintenance of the state oyster reserves, we have given this matter as much time as we could spare from our

other work, and have visited most of the principal beds in the state and have caused to be carried on a few experiments with these oysters at the experimental station. We were so successful in catching native spat in the floats used in the Eastern oyster experiments that we wish to call your special attention to this part of the work. All the shells and collectors in these floats were thickly covered over with spat within a month from the time they were placed in the water. Since that time their growth has been remarkable, so that they now make as fine a lot of seed as could be found anywhere. There are a few native oysters in the bay, so that the floats anchored there are of course near them, and undoubtedly got their supply of embryos from this source, but the floats that are anchored outside are at least half a mile from any beds, and the young oysters that are caught there must have been carried by the tides while in the swimming stage at least this distance.

Near the station is a state oyster reserve, which still has a very few oysters left on it. A small sink float with a slat bottom, and holding about six inches of water, was anchored near these beds, and in a short time the shells that were placed in it were covered over with spat. Next season we propose to build a few larger floats, and keep an exact account of the cost of producing a certain amount of seed, and in other ways determine whether the seed can be produced cheap enough in this way to make it of commercial importance under our present methods of oyster culture. While it i possible that it will not be profitable to employ such methods for catching seed as long as they can be obtained from the natural beds, the supply from these beds is so rapidly decreasing that some other source of supply must be found unless some radical change is made in our method of dealing with these state reserves.

We have just begun a series of interesting experiments with a view to increasing the size and controlling in a measure the flavor of some of our native oysters. Some of the oysters that were caught in the floats a year ago have reached such a size and shape as to make them of particular interest. Next year during the spawning season they will be kept to themselves, and by a careful process of selection it is believed that we will be able to obtain new and important varieties of this oyster just as we obtain new and



SOCKEYE OR BLUEBACK SALMON IN SALT WATER, (*Oncorhynchus nerka*).

better varieties of other animals by carefully selecting the best and rejecting the inferior specimens. The native oyster, even as it is, will always be in demand, and if by some method of selection the size and quality can be brought to a higher standard, it will be a matter of great interest not only to the oyster industry, but to the whole state of Washington. Of course a few years must elapse before any practical results would be apparent, but if the results can be finally obtained, the matter of time is of secondary importance.

In order that we might better acquaint ourselves with the true condition of the state oyster reserves, many of the most important have been visited from time to time and careful observations made. The condition of the great majority of these beds is deplorable, many of them showing to a remarkable degree the destructive results of being overworked and unprotected. As the law now stands, anyone who desires, by paying a small license fee, may go onto the beds and take away as many oysters as he can gather up. During the early history of the oyster industry, the natural beds suffered but little in this way, because comparatively few oysters were taken from them. During the last few years, however, the demand for seed oysters has been so great that the opening of every season sees on some of these beds scores of boats, each manned by from one to three men, ready to take away often in a few days' time all the oysters that have accumulated there since the last open season. Many of the beds have been entirely ruined in this way, and others are fast being depleted. If the present state of affairs exists a few years longer, the state may own any number of oyster reserves, but it will own no oyster beds, for the oysters will have all disappeared long since. In examining some of these reserves, it is difficult to understand why they were ever set aside as oyster reserves. Some of them certainly never had enough oysters on them to constitute a source of supply, and never will be productive until made so by careful cultivation. The condition of other beds indicates that they may at one time have been more or less productive, but the oysters are so scarce on them now that even the Indians have ceased to hunt for them there.

We can see no reason why such lands should be withheld from sale. As it lies today, it is of absolutely no value to the state or to

any individual; whereas, if it was sold, it would be a source of revenue to the state not only at the time of sale, but later as taxable property that would be constantly increasing in value. With proper cultivation, many of these beds could be made to yield good returns for any labor or capital invested in them.

With those beds which are still more or less productive, the case is different, and there is little doubt but that they should still be held as state reserves. Their sale would work a great hardship on those who are depending on the natural beds as a source of seed supply to stock their private beds. But as we have pointed out before, if these reserves are given no more protection than they have at present, this source of supply will soon be exhausted. Let us by all means give them some adequate protection, either by setting them aside in turn and allowing them to recuperate, by restricting the number of oysters that shall be taken during any one season, or by making some other provision to have them cared for in such a way that they will not be wholly destroyed. If the license fee collected from those working the beds is not enough to pay the expense of protecting them, increase the license, or, perhaps better still, sell the seed to the planters at a certain fixed price per sack. Surely those who are at present reaping the benefit of the state's generosity would not object to bearing the expense of caring for these beds. On several of the beds that we have visited we found the star-fish in great abundance, often hundreds of them to the square yard. These were living almost wholly on young oysters, as nearly all the larger oysters had been tonged off during the previous season. Until one has seen the results of the work of these star-fish, it is hard to conceive the damage that such an army can work on a bed in a few days. It seems almost beyond belief that those who depend on these beds for their seed supply would stand by and let them be thus depleted, when a small amount of work would protect them from these ravages. But "everybody's business is nobody's business," so even when the County Board of Oyster Land Commissioners issues a call for work to be done on the beds, the notice, as often as not, passes unheeded and the board, rather than make trouble, lets the matter pass and the work is not done. Too much blame, however, should not be placed upon the oystermen. As a rule, we

find among them as high a percentage of intelligent and public-spirited men as we do in any other industry—men who know what is needed and are willing to do their share, but the trouble is, we believe, in the fact that no one has had authority in these matters, and so there has been no one to organize and lead the work. Summing up, then, we would say: The state oyster reserves may be divided into two classes—productive, and non-productive, the latter constituting the largest portion of the reserves. We believe that it would be to the best interest of the state and the oyster industry to sell all the unproductive beds; we believe that all the productive beds should be withheld from sale, as at present, but that some strong, determined, organized effort should be made to keep them from being so nearly depleted every year; some one who thoroughly understands the oyster business, and who knows how much work a bed will stand, should be given authority to inspect these beds from time to time during the open season, and when, in his judgment, further tonging would injure the beds, order all work stopped for that season; a sufficient tax should be placed on the oysters taken from the natural beds to pay the expenses of patroling, protecting from star-fish and doing any other work that might be deemed necessary to protect the beds.

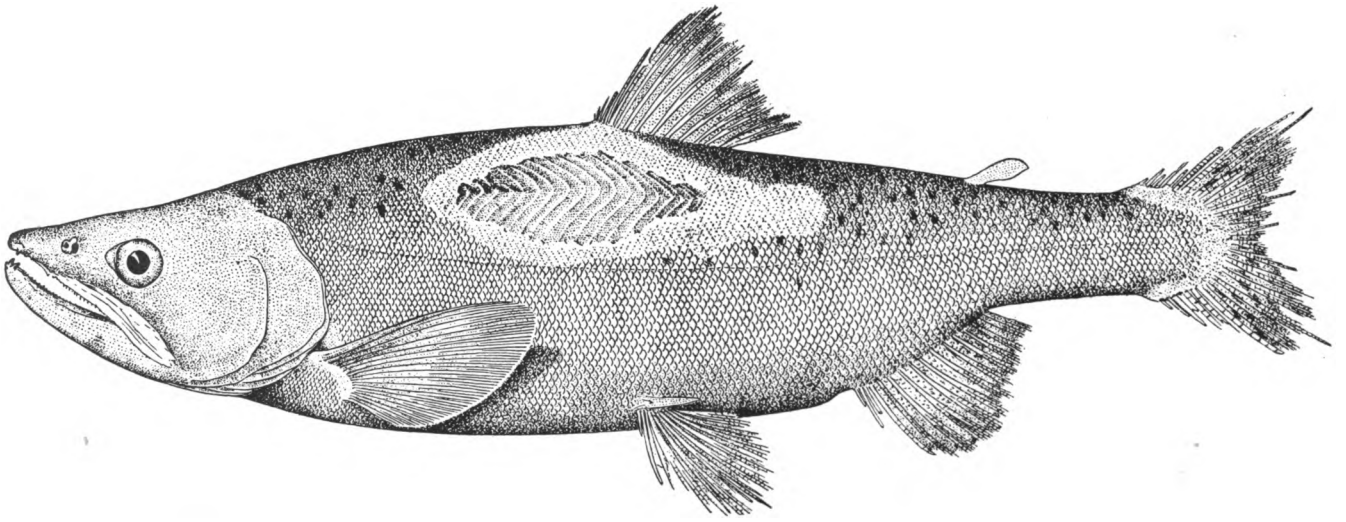
GAME.

Under the supervision of this office is another commerce which may not properly be called an industry, but in the future may become a great revenue to the state. I refer to the game department. While our game laws are in a crude state, and many of our best trout streams fished out and forests depleted of their kind, still it is not too late to retrieve all we have lost in this respect. If new laws are enacted and properly adhered to, we can yet make the State of Washington one of the greatest sporting paradises of the world. In this connection I desire to call your attention to the State of Maine. In a review I recently read, it was authoritatively stated that ten years ago the fish in its streams were exhausted and its forests depleted of game, but by wise legislation and a strict enforcement of law, it has in this short time restocked its streams with fish and increased its forest game to such an extent that it was estimated in the year 1901 that people who

sought to spend their summer months in that state solely for pastime and recreation distributed among the inhabitants thereof the enormous sum of $10,000,000, and shipped out over one line of railroad game to the value of $6,000,000. Surely the State of Maine represents no more scenic beauty than the State of Washington; her mountains are not more grand; her rippling streams sing no sweeter music; her forests send forth no more fragrant perfume, and our summer climate surpasses that of any other country on earth. With our forets full of game and our streams full of fish, the state would soon be peopled by tourists who believe the serious side of life should be brightened by outdoor sports, and to whom the wisp of a fish and the ripple of water are as music; to whom wild game in the forest, the majestic trees, and lakes and streams in which fish abound, appear to them in all its grandeur and mystery. Therefore, let us enact wise laws for the protection of our game and the restocking of our trout streams, and all the energy of this department will be devoted towards the enforcement of the laws.

HATCHERY WORK.

This has been one of the most successful years in hatchery work that the state has ever witnessed; having gathered a much larger amount of spawn than has ever been taken in any previous year. At the same time, a good many of our hatcheries were located without due consideration for the gathering of spawn, and some, at least, are located in undesirable localities, and in at least one or two instances the elements have so changed the currents of the streams upon which they are located, that notwithstanding what they may have been, their operation now is no longer a profitable investment to the state, and I would recommend the enactment of a law that whenever, in the opinion of the Fish Commission, a hatchery can no longer be operated with profit to the state, the board be granted the right to dispose of the same, in such a manner and on such terms as would be to the best interests of the state. It is far better, in my opinion, that property of this character be sold and the money returned to the maintenance fund, than for the state to continue its operation at a loss.



SOCKEYE, SHOWING MUTILATIONS RECEIVED ON SPAWNING GROUNDS.

KALAMA HATCHERY.

The Kalama hatchery was the first built in the state, having been erected in 1895; it is located on the Kalama river, about four miles from the town of Kalama, and has a capacity of 8,000,000 fry. After a few years operation it was found to be located too far up the river for the sufficient taking of spawn and in the year 1899 a site was selected further down the river, near the spawning ground, and an eyeing station erected where the eggs are eyed and then transmitted to the main hatchery, where the process of propagation is completed and the young fry are held until ready for liberation. By this arrangement, the Kalama hatchery has been made one of the best in the state. Heretofore, the eyeing station has not been operated but about sixty days in each year, but on account of the large number of spawn taken we are compelled this year to operate it as a hatchery. The title to both the hatchery property and the eyeing station, as well as the water rights, seem to be in good condition so far as the papers in my possession show. There has been but little repairs made upon the buildings since they were erected, and next year considerable improvements will have to be made to ensure its successful operation.

CHINOOK HATCHERY.

This hatchery was also built in 1895, and is located in Pacific County, on the Chinook river, about one mile from the village of Chinook. It has always been a fairly successful hatchery. The method of operation has been to take the fish direct from the traps in Bakers Bay, and tow them in crates made for that purpose to the mouth of the Chinook river, where we have racks built across the river to prevent the fish from returning to the bay, and where they are liberated and ascend the river at their leisure, usually arriving at the hatchery about the time they are ready to spawn. In previous years the hatchery has been somewhat handicapped by not having the number of fish we desired from the traps, but this year I made arrangements with the trap men to leave the traps in until we obtain the desired number of fish, and the result has been that we have the hatchery crowded to its utmost capacity. The state does not own the land upon which the hatchery is located, but has a twenty-year lease from 1895.

CHEHALIS HATCHERY.

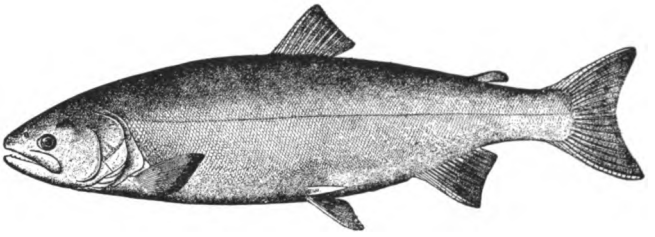
This hatchery was built in 1897, and is one of the finest constructed buildings in the state, has a capacity of 6,000,000 fry, and is located on the south bank of the Chehalis river, about four miles from the village of Montesano. The plant has never been a success until the present season. It is located too far down the stream, and the fish pass the hatchery long before they are ripe. There was an attempt made to remedy this oversight by building a dam at the mouth of the stream near the hatchery, and construct a pond in which the fish were placed while green to retain them until the ripening stage, but the water was not sufficient and became too stagnant for the health of the fish, and they all, or nearly all, expired before reaching the spawning stage. In opposition to public opinion, I constructed a rack across the Satsop, a tributary flowing into the Chehalis river about six miles above the hatchery, and the result has demonstrated the wisdom of the undertaking, having secured more spawn this year than was necessary to fill the hatchery and for the first time in the history of this plant, it is crowded to its utmost capacity. The state has a warranty deed for the land upon which the hatchery is erected, including three and one-third acres, together with the necessary water right for the convenient operation of the plant, and so far as I can ascertain, without an abstract of the property before me, the title seems to be good.

WHITE RIVER HATCHERY.

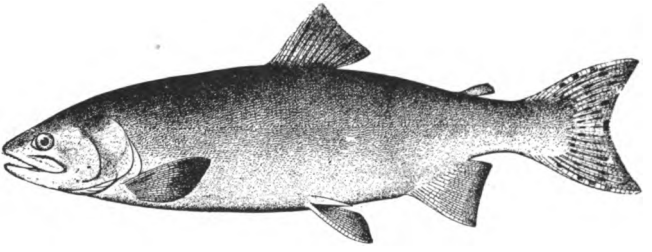
This hatchery is situated on Soos creek, about three miles from the city of Auburn, in King County. The creek empties into a branch of the White river. The hatchery is well filled with fish and spawn at present. Quite an improvement can be made at this hatchery by building double racks in the branch into which the creek empties, and we can take a great many more Chinook (Quinnat) spawn. The state also has a commodious dwelling here, with a deed to one acre of land. We have a good water system here, but so far I have been unable to find out in what condition the title is.

SAMISH HATCHERY.

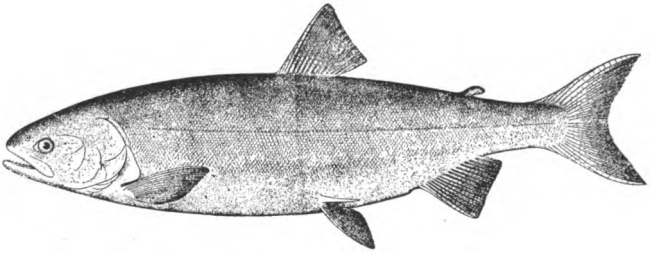
This hatchery was erected and first operated during the fall of 1899. It is situated on Friday creek, a tributary to the Samish



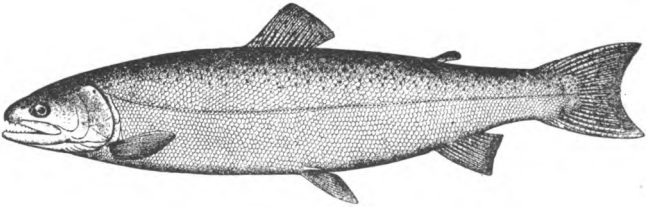
SILVER SALMON, (*Oncorhynchus kisutch*).



HUMPBACK SALMON, (*Oncorhynchus gorbuscha*).



DOG SALMON, (*Oncorhynchus keta*).



STEELHEAD, (*Salmo gairdneri*).

river, about three-quarters of a mile from Belfast, in Skagit County. Considerable trouble has been caused by unsatisfactory water system at this place, and last year a dam was constructed in the creek to furnish water for the hatchery, and a flume built to float cedar bolts from the dam to a point on the Samish river below the hatchery. This dam proved so faulty of construction that during the first part of April last it gave away, causing the hatchery to be without water, and resulting in a small loss of young fry. The dam that we built this summer is now in shape to last for years. The capacity of the hatchery is about 5,000,000, and has about all the spawn it can hold. The state has a good dwelling house here, and a deed to two and three-quarters acres of land, and we take our water supply from our own land.

WIND RIVER HATCHERY.

This plant was built during the summer of 1899, and is a good hatchery. It is situated on Wind river, about one-half mile from its mouth, in Skamania County. The hatchery was first built on the west side of the river, and the water was taken by a steam pump. This location proved unsatisfactory, however, and last year the plant was moved to the east side of the river, and a gravity system substituted. This system does not furnish water enough for the hatchery, and 2,000,000 eggs had to be moved to another hatchery this season. This hatchery has taken more than double the amount of spawn this season ever taken at this point in former years.

KLICKITAT HATCHERY.

This hatchery was built in 1900, but has never been fully completed, and never had been operated. I visited the hatchery in May and fully investigated the condition of the station, and if salmon ever did inhabit this stream, they have long since ceased to make it their spawning ground. The river empties its water in the Columbia up-stream, making it a very unfavorable condition for the salmon to ascend. I talked with many old settlers and Indians living along the river, and they all informed me that salmon had not been plentiful in the stream for years, and for the last few seasons they had almost become extinct. Upon investiga-

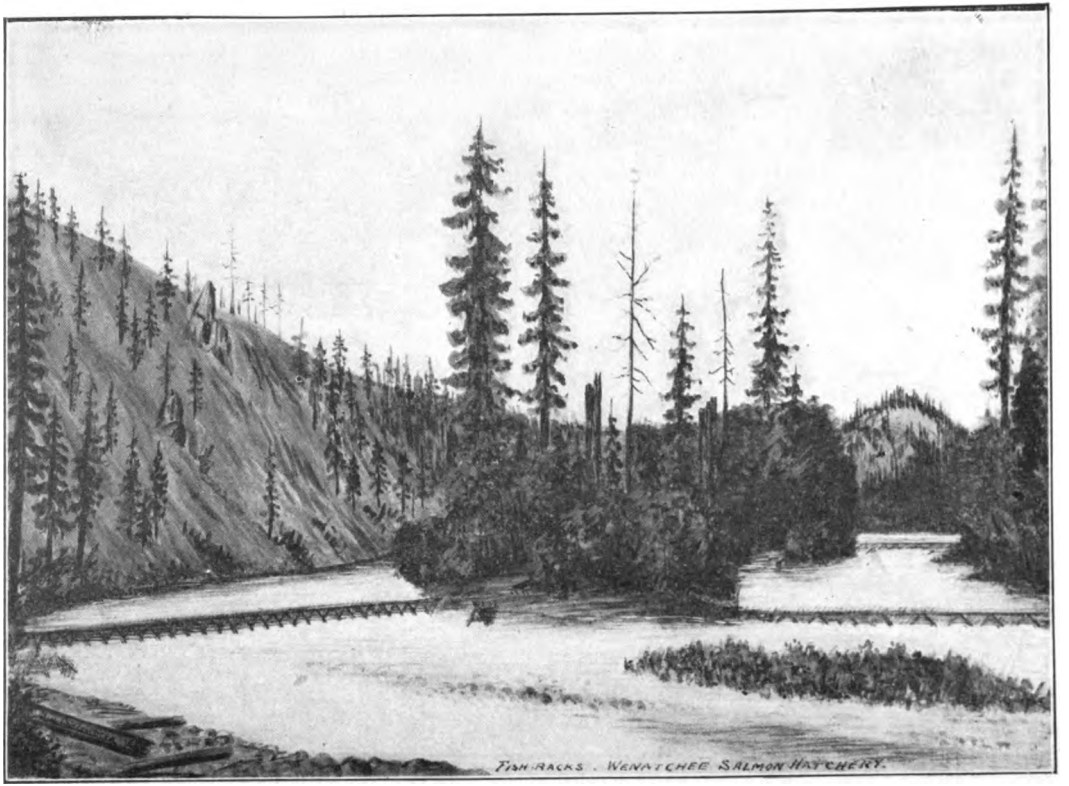
tion I found that the state had no title to this property, and that it was government land. I immediately notified the Land Commissioner of this fact, and requested him to reserve it as state land, and lease it to this department for hatchery purposes, but before this was done someone filed a homestead on the same and cut us off from our good intentions. The state, therefore, has no title to the site upon which this hatchery is located. Early in the season I learned that the Columbia River & Northern Railway Company had located their line through the land and directly across our water line. After considerable correspondence I perfected a settlement with the railroad company for $250 as damages to our water right, but acting under the advice of the Attorney General, he questioned the advisability of my right to accept the same, and it is doubtful if the state now will ever receive anything, directly or indirectly, from this hatchery investment. It is located on the Klickitat river, in Klickitat County, about four miles from the village of Lyle.

WILLAPA HATCHERY.

This plant is situated on a small tributary to the Willapa river, in Pacific County, and was first operated during the fall of 1900; that season the racks washed out and the hatchery was practically a failure; however, last year a dam was constructed in the Willapa river, and the hatchery done very well. This season a new trap has been constructed and earlier fishing has been done. The hatchery is filled with spawn and young salmon this year. One bad feature of this plant is that after the plant had been constructed it was discovered that not sufficient land had been purchased to secure a good water system. Consequently the sum of $25.00 per year has to be paid for the water right, and the state cannot secure a deed to the same, but the state has a deed to 5.89 acres, upon which the hatchery and a good dwelling house is situated.

DUNGENESS HATCHERY.

This hatchery is situated on the Dungeness river, about seven miles from the town of Dungeness, in Clallam County. It was first operated last season, and was almost a failure. Only 340,600 eggs



FISH-RACKS, WENATCHEE HATCHERY.

were taken, and an accident to the water system resulted in the young fry being turned out of the hatchery at an early stage. The water system has been repaired, and is now in good order, and at present the troughs are crowded to their fullest capacity. In the spring I ordered racks thrown across the river, and the result was that we obtained 1,500,000 steelhead spawn, and during the summer took a large amount of Chinook spawn, and are now again filling the hatchery with fall fish spawn, making it one of the best hatcheries in the state. The state has a good dwelling house here, and a deed to 85-100 acres of land.

SKOKOMISH HATCHERY.

This hatchery is situated about four miles from the mouth of the Skokomish river, in Mason county, and has a capacity of about 8,000,000 fry. This plant was constructed during the fall of 1899. It has the best water system of any hatchery in the state, and the troughs are now full of spawn and young fry. The state has a deed to twenty-four acres of land at this station, and a dwelling house for the accommodation of the help. There was an attempt made last year to operate an eyeing station, in connection with this hatchery, on the north fork of the Skokomish river, for the purpose of taking steelhead spawn, but the station proved a failure.

STILLAGUAMISH HATCHERY.

This hatchery was first operated last season, and the location is not an ideal one. The water system is very poor. A wheel was first used to supply the hatchery with water but was so placed that it failed to work after the first freshet in the river. A dam was built, but was so badly damaged last season that it had to be rebuilt this year. There is no place to retain the fish taken, and as the fish are green when they first come, it is very difficult to hold them until ripe. The fishing grounds are very poor and, in fact, the location chosen for the plant is very undesirable. The hatchery is located too far down the river. We have managed, however, to secure enough spawn to justify us in operating the hatchery this season. The hatchery is located on the Stillaguamish river, about four miles from the town of Arlington, in Snohomish

County. The state has a good dwelling house and a deed to two acres of ground.

SNOHOMISH HATCHERY.

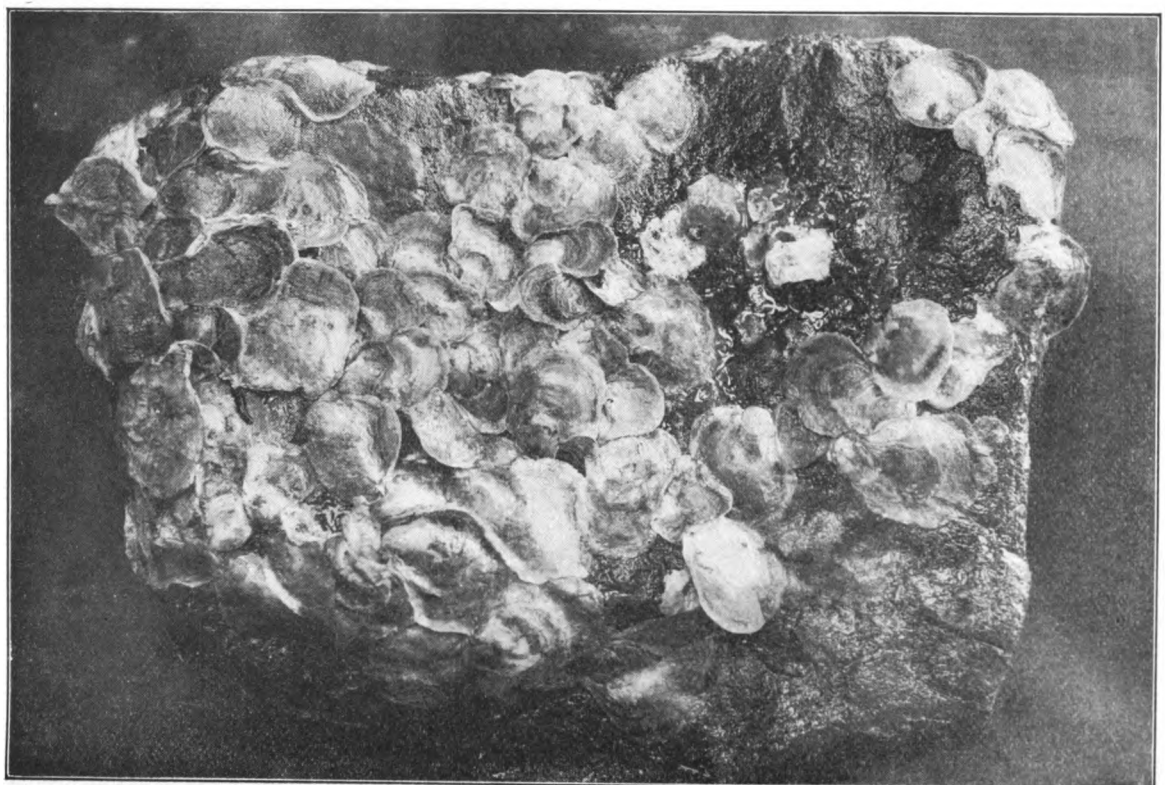
This plant was constructed during the year 1899, but was not finished in time to be operated that season. In former years the water system was poor; this year a new flume was built and sufficient water can be taken to supply the hatchery at all times. A new trap was also built this year at a point about four miles above the hatchery. I am of the opinion that if a rack was constructed across the Skokomish river at a point just above the stream on which the hatchery is situated, a great many Tyee (Quinnat) eggs can be taken. This plant has proved very successful this year, and the hatchery is filled with eggs and fish. The state has a good dwelling house here, and a deed to 3.7 acres of land, together with a partial title to the water right, which I hope to have perfected in a short time. The hatchery is located in Snohomish County, about one mile from the town of Sultan.

NISQUALLY HATCHERY.

This hatchery is situated on Muck creek, a tributary to the Snohomish river, and is about four miles from the town of Roy, in Pierce county. This is a good plant, but can be improved by building a rack across the Nisqually river at a point just above the mouth of Muck creek. Considerable Chinook (Quinnat) spawn can be taken if this improvement is made. A new water system has been constructed this season, and other improvements made. The hatchery is filled with spawn this season. The state has a modern dwelling house here, and a deed to one acre of land.

NOOKSACK HATCHERY.

This hatchery is situated on Kendall creek, a tributary of the Nooksack river, about two miles from the railway station at Kendall. The plant was erected during the summer of 1899, and has been a very successful one. The water for this hatchery was first furnished by two water wheels, but they proved so unsatisfactory that the hatchery was moved and a gravity system substituted. A great many improvements have been made at this hatchery this



NATIVE OYSTERS,

One year old, attached to rock; set and reared in one of the floats at the Fisheries Experiment Station. (About two-thirds natural size.)

season, and the plant is now crowded to its utmost capacity. The state has two dwelling houses erected at this plant, and has a warranty deed for 6.42 acres of land, together with a lease for the water right for a period of ten years from the 29th day of July, 1901, at an annual rental of $25 per year.

LITTLE SPOKANE HATCHERY.

This plant is situated on the Little Spokane river, about ten miles from the city of Spokane, and was built in 1899. The plant has been a failure from the day it was built, and has only been used at hatch out the overplus from the Wenatchee and Kalama hatcheries. It has a capacity of 2,000,000 fry. It was not in operation during the present season, and not enough spawn can be taken at this point to pay for operating the plant. The state has a good dwelling house in connection with the hatchery, and has a special warranty deed to 5.18 acres of land, together with a deed to the water right for the supply of the hatchery.

WENATCHEE HATCHERY.

This hatchery is situated in the northwest quarter of the northwest quarter, section sixteen, township twenty-five north, range seventeen east, on the Wenatchee river and tributary to the Columbia river, and about one and one-third miles from Chiwaukum, a Great Northern railway station. The state has erected a fine hatchery building and residence, but until recently no steps had ever been taken to secure any title to the land, but I am now in negotiation with the State Land Commissioner for a long-term lease to the premises. This plant was erected during the summer of 1899. Owing to the location of this hatchery the cost of maintenance is greater than at any other hatchery of the same capacity. The extreme cold winters, heavy snows, difficulty in controlling the river and the isolation of the plant, makes it an expensive one to operate. However, good work has been done, and this season the hatchery will be filled.

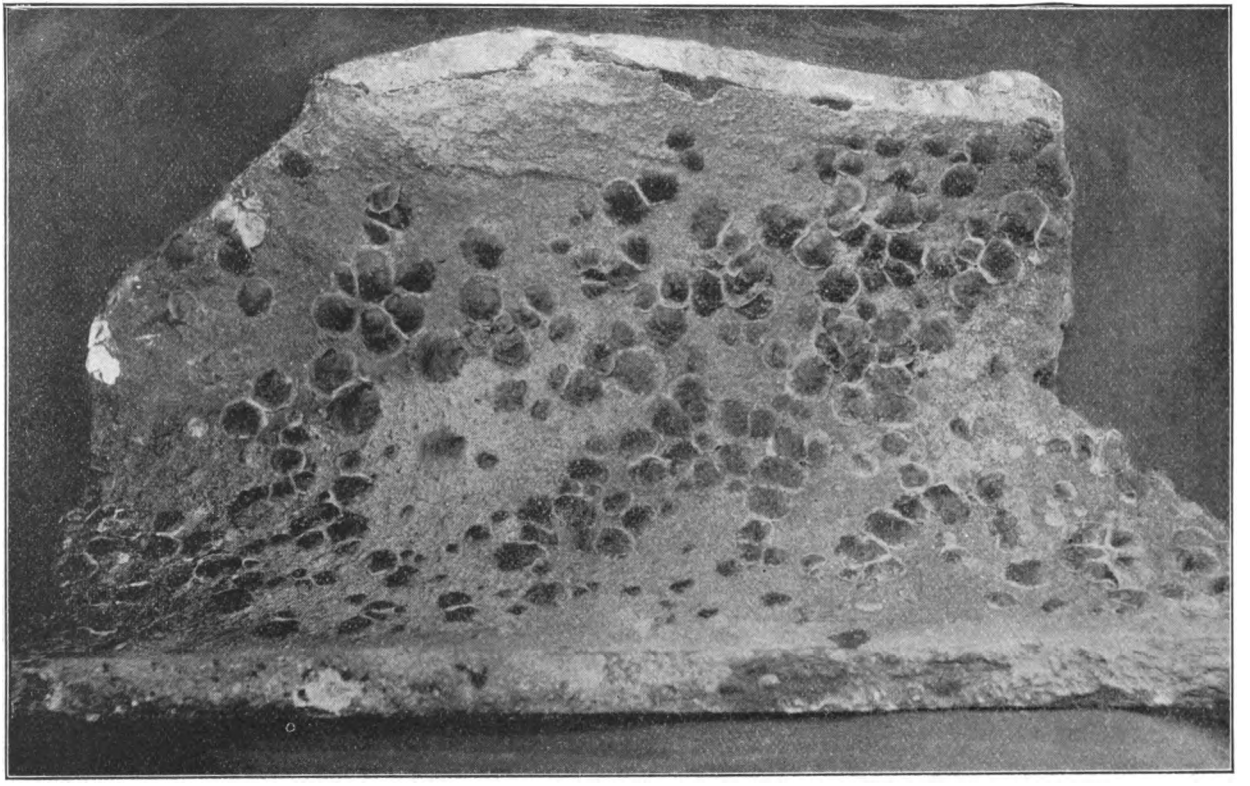
COLVILLE HATCHERY.

This hatchery was constructed in 1900. It is erected on state land, of which this department has a lease for five years. It is

located about one mile from Kettle Falls, on the Colville river, in Stevens County. It was operated in 1901, but only took about 90,000 spawn, and I concluded that the expense of operation would not justify the results obtained and closed the plant down for the present season. I placed Mr. D. M. Richard in charge, at a nominal salary, with instructions to closely watch the river and report to me the number of salmon that ascended the stream this season, and he reports there has only been seen forty-five salmon so far. I have no doubt that at one time this was a fine salmon stream, but a freshet they had a few years ago changed the entire condition of the river. Instead of emptying its waters down the Columbia, as in former years, it now discharges its waters up stream. The channel of the Columbia river has changed from the east side to the west side, and this, together with the freshet in the Colville river, has left the spawning grounds in the river covered with large boulders, and has completely destroyed whatever natural conditions favorable for spawning ever existed.

METHOW HATCHERY.

This plant was erected in the year 1899, and has a capacity of about 3,000,000 fry. It was beautifully located on government land, at the junction of Twisp creek and Methow river, in the village of Twisp, Okanogan County. For the last two seasons it 11—FISH COMRS REport—Johnson, opr.... .... has been a very successful plant. Upon my first visit of inspection to this plant I found one of the best systems of gravity supply in the state, but upon investigation discovered that the state had no right or title to the water supply, and I immediately went to work to perfect the state's title to this important feature of our hachery, with satisfactory result, when I discovered that the State Land to perfect that state's title to this important efature of our hatchery, was located, from sale, and that one Mrs. Phebe E. Zenor had filed a homestead entry on the premises. I have been negotiating the entire year, or since I discovered the condition of the title, with Mrs. Zenor for some kind of a settlement that would be satisfactory to the state, but my labors so far in that direction have been without fruitful results, and just what will be the outcome of the matter I am not at this time prepared to state, but am in hopes that a set-



NATIVE OYSTERS,

Three months old, attached to piece of whitewashed tile; set and reared in one of the floats at the Fisheries Experiment Station. (About one-third natural size.)

tlement may be perfected whereby the state will not be any great loser from this enterprise.

FISHERIES EXPERIMENT STATION.

The preliminary work that led to the establishment of a permanent "Experiment Station" was commenced four years ago, when the legislature made a small appropriation to experiment with the propagation of Eastern oysters. In the investigations that were then carried on it was discovered that there were many problems, other than oyster culture, that were of vital importance to the fisheries industry of the state. This led to the establishment, by the state, of a permanent experiment station, to investigate the habits and life history of all sub-marine species of animal life. It is of paramount importance for the successful operation of the fisheries department, that the experiment station should becontinued, and that liberal appropriation should be made for the investigation of the many scientific problems that are daily presenting themselves in this department. Prof. Doane has made such an exhaustive, interesting and able report of the work done at this station that I consider it unnecessary for me to go into the details of what has been accomplished at this plant. The station is located on school land, and this department has a lease from the state for thirty-two and one-quarter acres, until June 29th, 1905, for which we pay $32.25 rental per annum. The land can be bought from the state for the sum of $322.50, and as our water right is in an unsatisfactory condition, I would recommend the purchase of the same. Following is Prof. Doane's report in full to me, with the exception of his "Notes on the Oyster Industry," which I have cut out, believing that I have covered all the ground on that subject that space will permit of:

REPORT OF THE FISHERIES EXPERIMENTAL STATION,

BY

R. W. DOANE, Superintendent.

November 5th, 1902.

HON. T. R. KERSHAW,

State Fish Commissioner, Whatcom, Washington:

Dear Sir.—I have the honor to submit herewith my report on the work done at the Fisheries Experiment Station since its establishment in April, 1901.

Most respectfully yours,

R. W. DOANE.

THE ESTABLISHMENT OF THE STATION.

Four years ago the state legislature set aside a small amount of money to enable the Fish Commissioner to carry on a series of experiments to determine whether the Eastern oysters would propagate in the waters of this state, or, if they did not, to determine, if possible, why.

At the Fish Commissioner's request, and with the consent of the officers of the State Agricultural College, with which institution I was then connected, I took charge of these experiments, devoting what time I could spare to them during the summer months. The report of the first two seasons' work will be found in the report of the Fish Commissioner for 1899-1900.

Encouraged by the results obtained by this preliminary work, the Commissioner decided, if possible, to continue it. But, in order that more direct attention might be given to it, he decided upon the establishment of a permanent Scientific Experiment Station, to which all the problems relating to the fishing industry might be referred for investigation. The legislature having pro-

vided the necessary funds, such a station was established, and I was again asked to take charge of the work as superintendent of the station—a position which I accepted April 1st, 1901, resigning my position at the college in order that my whole attention might be given to this work.

After carefully reviewing the various possible locations for such a station, and taking into consideration the large field of work that it would be necessary to cover, it was decided that no better place could be found than the place selected the previous year at Keyport Landing, on the east arm of Port Orchard Bay, with Pearson as the nearest postoffice. The portion of the building that had been used as living rooms during the summer of 1900, was fitted up as a small hatchery, where the eggs of salmon, trout and other fish might be handled. An abundant supply of water was brought down in a flume from a small stream some 1,500 feet above the hatchery; a small five-roomed cottage was built as a residence for the superintendent, and other improvements made on the grounds. The laboratory was fitted with cases, desk, tables and shelves, and well equipped with necessary apparatus, including one B B 5 Bausch & Lomb microscope, giving a magnification of from 41 to 900 diameters; one dissecting microscope, one automatic laboratory microtome, paraffin bath, balances, dissecting tools, thermometers, including one deep-sea and two maximum and minimum thermometers; one set specific gravity spindles, glassware, containers, chemicals, etc. No provision having been made for literature, we have been adding from time to time to our own library such books as were needed, until now we have accessible for reference over one hundred volumes of standard works relating to fish, oysters, birds, clams, crabs, shrimps, etc., besides about twice that many pamphlets and reports from various stations in this country and Europe which are doing more or less work along this line.

As far as possible we have tried to restrict out work during the past two years to the salmon and oyster industries, but as there have been so many calls for information along other lines of the fishing industry, we have devoted more or less time to them. Early in June it was found that with the construction and other work it would be impossible for me to oversee the general work of the

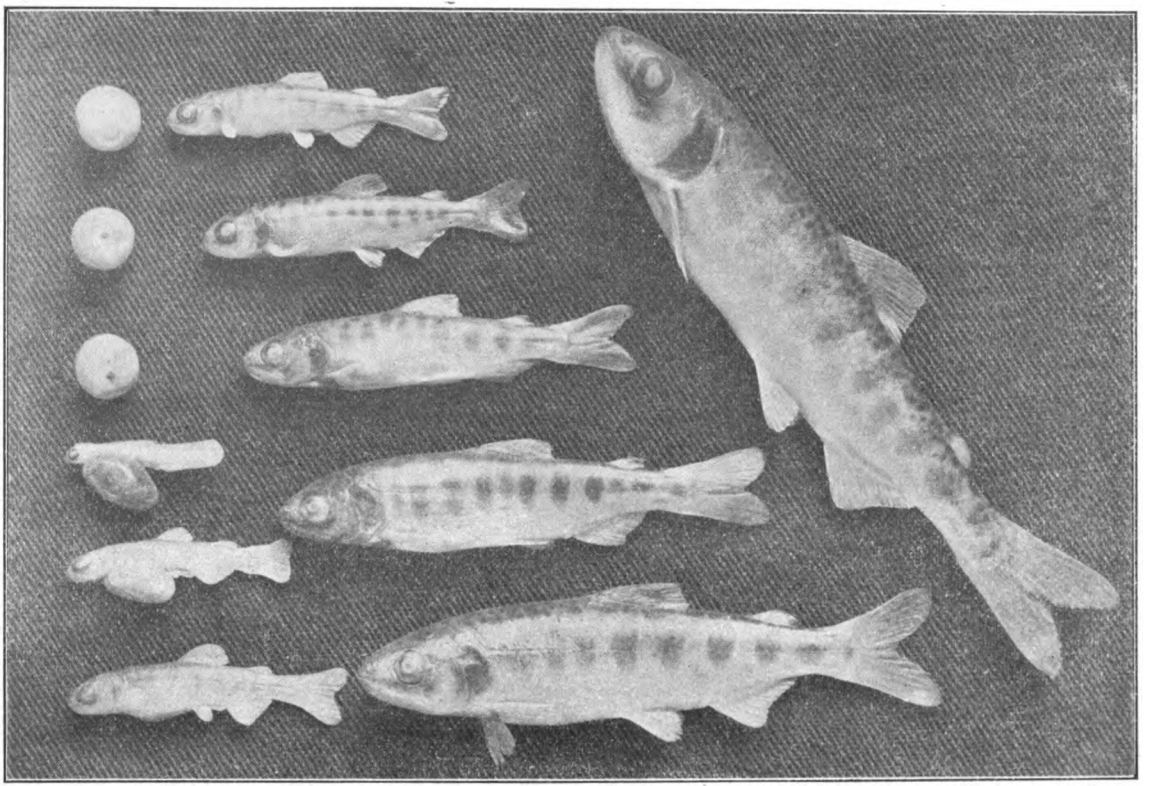
station as it should be done, unless I had a laboratory assistant who could take some of the laboratory work off my hands. Mr. W. C. Doane, of Stanford University, having made particular studies along this line, and having assisted us the previous year, was again sent for and has ably assisted in all the work until last September, when the state of our funds made it necessary to reduce our working staff.

In the bill providing for the establishment of this station, it is known as the Scientific Experiment Station. On account of its location it has become somewhat generally known as the Keyport Experiment Station, and it is also sometimes called the Oyster Experiment Station, under the impression that our work here is wholly with the oysters. None of these names, it seems, are entirely satisfactory, as they are not descriptive of the work and purposes of the station. As the station is still comparatively new and not widely known under any of these names, we would suggest that, with your approval, it be known in the future as the Fisheries Experiment Station.

Provision for Voluntary Workers.

Those who have been working along scientific lines have long felt the need of some central station here on Puget Sound where special investigators might come and make a study of the fauna and flora of these waters. Heretofore those wishing to pursue any studies along these lines have usually had to do so under such adverse conditions that there has been but little original research work undertaken here. Since the establishment of this station we have been asked by several workers, not only from this state, but from other parts of the Coast and from the East, if some provision could not be made so that those wishing to carry on any marine work could make use of our laboratory and other facilities here.

At the present time, however, our laboratory is already so crowded that we have been able to offer but little accommodations to any one wishing to carry on any of this work. We wish to call your special attention to this matter, and earnestly recommend that provision be made so that this class of workers will find conditions so favorable here that many of them will come here



DEVELOPMENT OF CHINOOK SALMON.

(1) Egg just fertilized; (2) 30 days after fertilization; (3) 60 days after fertilization; (4) just hatched; (5) 30 days old; (6) 60 days old; (7) fed for 30 days; (8) fed for 60 days; (9) fed for 90 days; (10) fed for 120 days; (11) fed for 150 days; (12) fed for 180 days. Reared and fed in nursery ponds and tanks at the Fisheries Experiment Station. (Slightly reduced.)

to carry on their investigations. The presence of such independent investigators here would be of great value not only to the station but to the whole fishing industry at large. As we have pointed out in the following pages, there are so many problems connected with the habits, food and life history of so many of the forms directly or indirectly connected with our fisheries, that it will be several years before they can all be even touched upon, unless there are several workers in the field.

We believe that with very little extra expense provision could be made here for the accommodation of a few workers each season, who would be glad to come and pursue work along their special lines. Arrangements might be made to have the results of their investigations published with the report of the station, whenever they proved to be of sufficient economic or scientific value.

Our Museum.

There is not in the state at present anything like a complete collection of the fish or fishery products of our waters. Not having any funds available for buying museum jars and meeting other necessary expenses, we have made but little effort toward making a collection of these forms. Some collecting has been done, however, and it is our purpose to begin at once, and in a systematic way, a collection of all the forms of life that in any way bear any relation to our fishing industry. The collecting, preserving and classifying of this material will, of course, take a great deal of time and labor, but if proper museum arrangements are provided and provision is made so that specialists may make this their headquarters while carrying on their investigations, the collection will grow rapidly and in a short time become of inestimable value to the fishery industry and of great scientific interest.

THE SALMON.

Our lack of knowledge concerning many important points in the life history of the salmon is deplorable. Certain observations made in California within the last two or three years by members of the United States Fish Commission have shed much light on some of the more important problems in this matter, but much yet

remains to be done before we are as familiar as we should be with the development, life and habits of these important food fishes.

One of the principal reasons for the establishment of a Fisheries Experiment Station was that there seemed to be a great need of a continuous series of careful observations and experiments being made under the advantageous conditions that might be found at such a place. The location of this station is in many respects a particularly favorable one for these investigations. As the salmon spend by far the greater portion of their life in salt water, it is necessary that they be studied there as well as in fresh water. The small bay on which we are located lends itself admirably for this purpose. In the open sound near by salmon of various kinds and sizes may be taken most of the year. Two small streams within easy reach provide places where the fish may be studied as they come from the sea to the spawning beds, where some eggs may be taken and the young salmon studied as they make their way back to the sea. Several hatcheries where eggs of different species may be obtained, and where other work may be carried on, are easily accessible.

Many of the experiments are of such a nature that three, four or more years must elapse before the full results can be determined. Some that have been made need to be checked by others made under similar and dissimilar conditions, before the results will be of particular value. A brief outline of the work as planned, and a review of some of the work already done will, however, be of interest. The following general headings will indicate briefly the scope of the work undertaken:

I.—Experiments in taking and caring for the reproductive elements; (1) vitality of the spermatazoa under various conditions; (2) vitality of the ova under various conditions; (3) methods of fertilizing the eggs; (4) methods of caring for the fertilized eggs.

II.—Development of the eggs.

III.—Study of the alevin: (1) In the hatchery; (2) in artificial ponds; (3) under natural conditions.

IV.—Study of the fry: (1) How soon do they need food? (2) how long should they be kept in the hatchery? (3) feeding in ponds and tanks, effect on growth and habits; (4) habits, food

and growth under natural conditions; (5) migration, where, how, why, rate; (6) time of entering salt water.

V.—Habits and food while in salt water.

VI.—Age at which they return to spawn.

VII.—Habits and condition at spawning time.

Taking and Caring for the Reproductive Elements.

Several of the hatcheries of this state, as well as some of the hatcheries in California and Oregon, were visited with a view to studying the different methods of taking and caring for the eggs. The methods of capturing the fish are wholly dependent on local conditions. In some places they may be taken in traps right at the hatchery door; in others it is necessary to catch them with a seine or drift-net, sometimes at considerable distances from the hatchery. Practically the same general methods of taking the eggs are adopted at all the hatcheries. As regards the detail of these methods, however, we find a wide diversity of opinions. Some hatcherymen exercise little or no care in handling the female before the eggs are taken; others are very careful about this point, believing that rough treatment will injure the eggs. Our observations and experiments indicate that many of the eggs found dead in the hatchery are eggs that have been injured by the rough handling of the fish before the eggs were taken. Some prefer to take the eggs from the fish while she is still alive; others find it easier to kill the fish first by striking a sharp blow on the head with a club. The latter method seems preferable, as it makes it possible to take a large percentage of the eggs; they are not injured in the least, and there is less trouble in handling the fish. It often happens that by the bursting of blood vessels more or less blood is found on the eggs, and as the blood prevents the milt from fertilizing the eggs they are usually lost. Some hatcherymen find that they have less trouble in this respect if they cut the throat of the fish and allow it to bleed freely before they spawn it. The fish may then be spawned in the usual way, or it may be cut open and the eggs allowed to pour into the spawning pan. It has not been found profitable to try to wash the blood from bloody eggs, as a large proportion of them are found to be not susceptible to fertilization after they have been in water more than a minute. Mr. Rutter, of

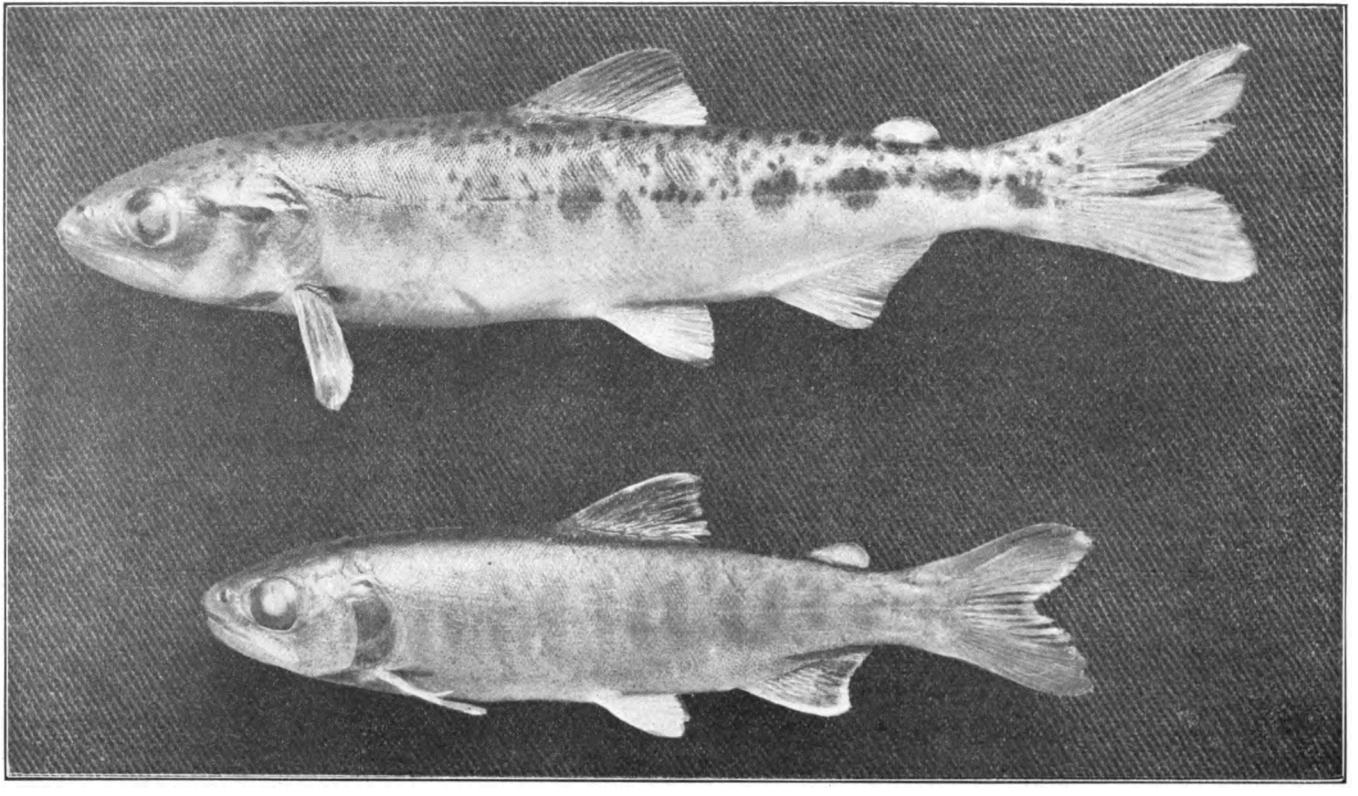
the United States Fish Commission, has found, however, that the eggs may be washed in a normal salt solution for from five to ten minutes with no perceptible loss. We have carried on some experiments along the same lines, but the results are not yet conclusive. It is possible that by adopting some such method as this we may be able to save all or a greater part of the bloody eggs. Many other experiments to test the vitality of the spermatazoa and the ova under different conditions have been made, but these need to be checked by others before the results are published. In the hatchery, experiments to determine the influence of a large or small amount of water, the influence of light, sediment, changes of temperature, effects of moving or handling the eggs at different ages, etc., have been begun, but are not yet completed.

Development of the Egg.

We have been able to devote but little time to the study of the development of the egg. Some work has been done, however, and we hope to be able to devote much more time to this during the coming season.

The Alevin.

The experiments in the different methods of handling the young fish, from the time they are hatched until the yolk sac is absorbed and they are ready to begin feeding, have already given important practical results. As soon as the young fish are hatched they require much more room than the same number of eggs required, and the older they grow the more room they must have if they are going to thrive properly. The usual method of handling them is to distribute them throughout the various troughs in the hatchery, often taxing to the utmost the capacity of the plant, and using space for this purpose that otherwise might be devoted to hatching more eggs. Experiments conducted here at the station and at several of the hatcheries have shown that with properly constructed ponds the capacity of the hatchery may be very greatly increased. As soon as the fish are hatched they may be taken from the troughs and placed in these ponds, where they thrive fully as well and in many instances better than they do in the hatchery. The ponds should have an abundant supply of water, and be so constructed that they can easily be kept clean.



NO. 1, (upper figure), CHINOOK SALMON,
Nine months old; reared and fed at the Fisheries Experiment Station.

NO. 2. CHINOOK SALMON,
Sixteen months old; taken from a natural spawning stream. (Both natural size.)

Some study has been made of the habits of the fish at this stage of development, both in their native streams and under conditions here at the station which resemble the natural conditions so closely as not to effect the movements of the fish, and possess the advantage of being wholly under our control.

The Fry.

The greater part of our time during the past year and a half has been devoted to studies and experiments with the young salmon from the time they are ready to begin feeding to the time they are ready to enter the salt water. In view of our present hatchery methods, this seems to us of primary importance. We hatch millions of fish, and keep them in the troughs until all, or nearly all, of he available food in the yolk sac is absorbed, then turn them into the streams, assuming that they are fully able to take care of themselves after that. The few observations that have been made along this line show that most of them do live and thrive and in time pass down to the sea, but that many of them perish at the hands of their natural enemies there can be no doubt. As soon as they reach the stream their fight for existence begins. During a visit to one of the hatcheries last winter, a number of young salmon from three and a half to five and a half inches long, and presumably about sixteen months old, were seen just below the outlet of the overflow from the hatchery, quickly picking up and dispatching any young fry that escaped in the overflow. During the early part of some of our experiments, before a screen was placed across the entrance to the flume, trout would occasionally find their way into some of the tanks or ponds. Their presence was soon indicated by the mutilated condition of some of the fry that were taken from the ponds from time to time. Most commonly we would find that a considerable piece of flesh had been torn from the under side of the young salmon, usually just back of the head, the wound often exposing the heart, if, indeed, it had not been torn away. In every instance where we found a young salmon thus mutilated, we found one or more trout in the pond. This trout (Salmo clarkii), on account of the bright red blotches on the under side of its lower jaw, is commonly known as the "cut-throat trout." If further observations show that it is as adept in cutting the throat of young

salmon, as these experiments would indicate, its name will have a new and frightful significance.

A few other fresh-water fish and a few birds are known to feed more or less upon small fish of all kinds, and in a good stream young salmon doubtless make up a considerable part of their bill of fare. The food of the young fry consists principally of insects, either larva, pupa or adults. During the winter season this food is comparatively scarce, even in the best of streams, and only the strongest and most active of the young fish get their due share each day.

With all these things in mind, it was considered advisable to begin a series of experiments with a view of keeping the young salmon in tanks and ponds where they might be fed and cared for until they had become somewhat stronger and more active, or until the food was more abundant in the streams. In the fir grove, at the edge of which the hatchery is located, a series of ponds and tanks were constructed. The ponds are so arranged that the water flows from one to the other through short open ditches. These ditches are lined with cobblestone, and as each has a considerable fall the water is thus abundantly aerated. The first pond is cemented and is forty feet long, five feet wide and ten to fifteen inches deep; the second, which is about the same size as the first, has the bottom and sides covered with small cobblestones, and is from eighteen to twenty-four inches deep; the third is fifty feet long, ten feet wide and about three feet deep; the fourth is forty-five feet long, nine feet wide and two feet deep, and receives the overflow from the hatchery and tanks as well as from the upper ponds. The fifth pond is somewhat irregular in shape, but is about ninety feet long, from eight to fourteen feet wide, and from six inches to four feet deep. The sixth pond is on the tide flats, and was made by building a dyke across the entrance to a small inlet. A tight board wall was built across the dyke and around the lower side of the pond, so that the tide can come and go only through a single large opening which is covered over with a screen to keep the salmon from running out or other fish from coming in. When the tide is out, the water in this pond is from one to three feet deep, but during a high tide it is from two to five feet deep. Pond 7, the largest of the series, and located lower

with the Eastern oysters. Ponds five and six are connected by a small artificial stream about two hundred yards long, from one to three feet wide and from three inches to one foot deep. This stream winds around through the grove in such a way that the fall is gradual and uniform, and in no place is the current so swift that the young fish cannot make their way against it. A number of pools and eddies and the logs, roots, grasses and ferns along the banks all go to make the conditions along the stream exactly like those of a natural stream.

The tanks, six in number, are each twelve feet long, three and a half feet wide and two to three and a half feet deep. They are sunk in the ground, have earth bottoms and each is supplied by a separate stream.

The age at which the young salmon begin taking food depends not only upon the species but upon the surrounding conditions of temperature, etc., a high temperature hastening development and, of course, causing the fish to begin feeding earlier. On January 4th the stomachs of a few Chinook salmon that had hatched November 22nd were examined and found to contain a small amount of food that they had taken while in the troughs. The average temperature of the water in the hatchery during these forty-three days was 41.18 deg F. A lot of silver salmon hatched April 1st would feed quite freely on the ground fish and liver thrown to them on April 25th. The temperature of the water during these twenty-five days averaged 45.17 degrees.

The first set of feeding experiments was begun with Chinook salmon when they were about fifty days old, the yolk being practically all absorbed. The average length at this time was about 35 m. m., the average weight nearly .5 grams. Some were kept in the hatchery troughs, some in the nursery tanks and others in the ponds. During the first three months fresh fish, salt fish, liver and shorts were used as food, the fish and liver being ground up in a small sausage mill. Perch, bullheads, herring, flounders, soles and other kinds of fish were used. These were caught from time to time in a seine, some being salted and others kept in salt water floats provided for them.

Much the same series of experiments was begun later with the young silver salmon and a little work has been done on the

other species. These experiments at the station are checked and supplemented as far as possible by work at different hatcheries as time and opportunity affords.

As this work is only about half completed, it is too early yet to give the details of the experiments or to draw any conclusions. The results obtained so far are very satisfactory, intensely interesting and indicate, we believe, that they will be of much practical value. Under certain conditions we are able to make the young salmon develop twice as rapidly as they do under natural conditions. Just what advantage this will be to the salmon we have yet to demonstrate, but it is undoubtedly true that the larger and stronger they are when they are turned into the streams, the better able they will be to take care of themselves.

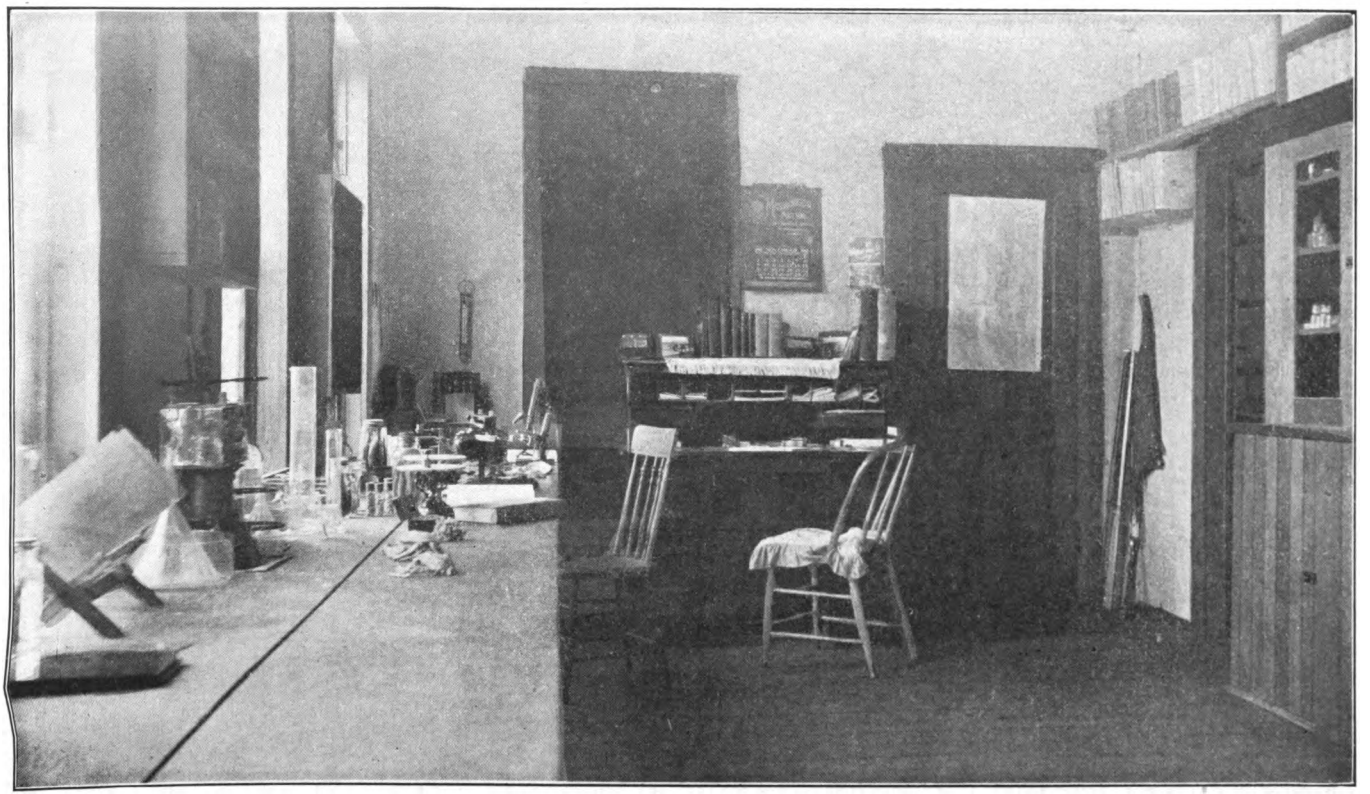
Much data and material has been collected to aid us in the studies of the habits, food and growth of the young salmon under natural conditions. In this we have received valuable assistance from some of the hatcherymen who have sent us series of young fish of different ages. Conditions are so various along different streams and along the different parts of the same stream that these observations must be carried on carefully for several seasons before we will be warranted in drawing any general conclusions.

Habits and Food While in Salt Water.

A few observations have been made with a view to determining the movements and food of these fish during their stay in the salt water. The nature of the work is such that progress is slow, but with the added facilities which we hope to have at our disposal during the next season, it is believed that much may be accomplished along this line. The location of the station and the conditions prevailing here on Puget Sound make the opportunities for the study of this topic exceptionally favorable and it is hoped that we will be able to devote a good deal of time to this during the next few seasons.

Age at Which They Return to Spawn and the Condition at Spawning Time.

A number of experiments have been made trying to find some satisfactory method of marking the young salmon so they may be



INTERIOR VIEW OF LABORATORY AT THE FISHERIES EXPERIMENT STATION.

recognized when they return to fresh water to spawn. Such a mark must fulfill the following requirements: It must not materially injure the fish or affect its movements; it must be permanent; it must be of such a nature that there is little or no danger of a similar mark being made by accident on other fish; it is desirable, though not altogether necessary, that it may be easily detected in the adult fish in the ordinary process of handling. During the last season we have marked several hundred fish in various ways and kept them in separate lots in order that the results might be watched. So far, however, we have been able to find but one mark that would fulfill all these requirements, and that is the old one of cutting off the adipose fin. This mark has been used so often that it is now of little value, at least until a number of years have passed without it having been used at all. Many of the marks tried would seem perfectly satisfactory for a while, but sooner or later they would fall short of one or more of the requirements. It was surprising to us to find how many of the marks on the tail, fins, opercle, or maxillary would heal over and thus be entirely obliterated. Until a wholly satisfactory mark is found, the estimates as to how old the fish are when they reach the spawning beds will be open to debate. A rather extensive series of experiments bearing on this subject has been planned for this next season.

Only a little time was devoted to the study of the fish on the spawning beds. Enough was done, however, to impress upon us the need of a more thorough study of the habits and conditions of the fish at this time.

EASTERN OYSTERS.

Review of Work During 1899 and 1900.

The investigations during the first two seasons had shown conclusively that the eastern oyster would thrive well when transplanted in the waters of this state and that the older oysters would spawn freely. Difficulty was experienced, however, in getting any spat to set. What these difficulties were may be better understood if we give again a brief review of the early life history of this oyster.

Our native oyster is hermaphroditic and viviparous; that is, both ova and spermatazoa are produced in the same individual and the eggs are fertilized in the gill and mantle cavities where they pass through the early stages of development. At spawning season, when these young embryos are set free, they have already reached the swimming stage and are soon ready to attach themselves to some convenient shell or other collector, where they remain fixed throughout life.

The eastern oyster, on the other hand, is unisexual, the ova and spermatazoa being produced in different individuals. During spawning season the female produces millions of over which are set free in the water, to meet by chance with the spermatazoa from the male. If this union takes place the ova are fertilized and soon lose their original pear shape and become quite round. If they are not fertilized they soon perish. Within two or three hours after fertilization these ova, which are single cells too small to be detected with the unaided eye, begin to divide, and in two hours more we have, instead of single round cells, whole masses of cells, the masses themselves being rounded and about the size of the original cells. A little later, small thread-like projections, or cilia, begin to appear on one side. The embryos have now reached the swimming stage, for by means of these cilia the young oysters are able to move about through the water at will. They remain in this stage from three to six days, or until the shells have begun to form, when they sink to the bottom, and, if they are fortunate enough to strike some suitable collector, they become attached and begin to take on the character of the adult oyster. From this time on the young oysters are comparatively free from danger, but the number that reach maturity is very small when compared with the number that perish or are destroyed in one way or another.

It has been estimated that an average sized eastern oyster lays about sixteen or twenty million eggs in a single season. The number of spermatazoa that the male produces is almost inconceivable. Yet when we remember that these elements are set free in the water to be swept here and there by the tides and currents, it is not surprising to find that only a small portion of the ova are ever fertilized. Especially is this apt to be true if only a few scattered oysters are spawning in a large bay. We have seen that

within a few hours after the eggs have been fertilized the young embryos reach the swimming stage. This is a period of great danger, for the first use the little oysters make of their newly acquired locomotive organs is to use them in swimming to the surface of the water. Here they remain in a perfectly defenseless condition for several days, the time depending upon the temperature of the water. While here they are not only exposed to various enemies, but a sudden fall in temperature, a cold wind or a cold rain may destroy millons and millions of the young oysters in a very short time. As soon as they leave the surface and swim at greater depths the danger from these things is greatly diminished. But another great danger is soon upon them. As the shell grows larger and they sink deeper they must find some firm substance to which they may attach themselves or they will sink in the mud and be smothered. Even after they become attached a very thin layer of sediment settling over them will smother them just as effectively as if they were buried an inch deep. Then come still other dangers; if the young settle too thickly on any stone, shell or other collector, as they grow and develop some of them must necessarily be crowded out and those remaining are still at all times subject to the attacks of starfish and various other enemies.

Notwithstanding all these dangers that beset the young oyster in every stage of its existence, a considerable number of them survive each year in their native waters. Some years the catch will be so small as to hardly pay the oystermen for the working of the beds; then will come a particularly favorable season and the supply will seem almost unlimited.

In view of all of these facts, it is not surprising that the oysterman who plants a few of the eastern oysters on his beds here in this state, expecting them to propagate, is doomed to disappointment. Even should the eggs be fertilized, after the young embryos reach the swimming stage they may be carried by the tides or currents for miles from the beds where the parent oysters lay. Not until we have large numbers of these oysters in our waters as they have in some of the waters along the Atlantic coast can we ever hope to obtain more than an occasional oyster in this way.

The temperature of the water along the Atlantic coast in the regions where the oysters thrive best is said to rarely fall below

70 degrees during the spawning season and the average over the best spawning beds is probably somewhat higher than that. The temperature, too, is more nearly uniform; the nights being almost as hot as the days the water gets but little cooler during the night.

Tests taken at Tokeland on Willapa harbor during the months of June, July, August and September, 1899, showed the average temperature of the water at the surface to be 65.5 degrees. Another series taken at the same place during July and August, 1900, showed an average of 65 degrees. No tests were taken at night. A more complete series of tests taken at the experiment station during July and August, 1900, showed an average of 64.6 degrees in the open sound. Three things, then, seemed necessary before we could hope for success in catching any spat. First, enough oysters must be planted on some bed and planted close enough to insure the eggs being fertilized after they have been cast into the water; second, some provision must be made to keep any swimming embryos that might be developed from being carried by the tides to distant parts of the bay or sound where they would be lost; third, some provision must be made to prevent the sudden and great changes in the temperature of the water, and, if possible, to raise the average so that the minimum during the spawning season would not fall below 70 degrees.

The object of enclosing the small bay at the experiment station was to bring about as nearly as possible these conditions. The dam was provided with gates arranged in such a way that the water could be let in or out as desired and held at any required depth. The water was kept circulating by means of a propeller near the end of a flume which was open at both ends. A car load of oysters was planted near the flume in such a position that the water passing from one end of the flume to the other, outside, would pass directly over the beds. In a series of large tanks kept supplied with water by a steam pump, an effort was made to rear young embryos that had been obtained by artifically fertilizing the eggs. The collectors soon became covered with sediment, however, and no spat set.

In the large sink floats, many spat were obtained which at first were thought to be young eastern oysters, but when large enough for positive identification they proved to be natives.

SEASON OF 1901.

The Bay.

An examination of the beds early in the spring of 1901 showed that most of the oysters that had been planted during the previous season had passed the winter very successfully and were in good condition. A few that had been planted in the old channel had been covered over with seaweeds and later with sediment and were thus smothered. This portion of the bed was tonged over thoroughly and the live oysters moved to higher, firmer ground. On May 2nd, another car load of oysters was received from Fair Haven, Conn. This lot was made up of forty barrels from Virginia and sixty-five barrels from Connecticut. They were in prime condition upon arrival and practically all alive. They were planted in the bay near the other beds. On June 4th three barrels of one-year-olds and two barrels of two-year-olds were received and planted on a portion of the bed especially prepared for them.

An examination of the dam showed that the teredoes had done much damage to all of the timbers below the low water line. The floor was completely eaten away and had to be replaced and a few new braces added. We were thus enabled to control the water during most of the season. Considerable trouble was experienced, however, by some part of the dam giving away at frequent intervals, each time causing several days' delay with the experiments, even though the break could be repaired during the next low tide.

Early in June the reproductive elements in many of the oysters were found to be in various stages of development and by June 25th, many were found to be spawning. Several scow loads of shells were scattered over the beds and the propeller kept running most of the time. The difficulty experienced in controlling the water made this set of experiments unsatisfactory and but little was accomplished.

The one-year-old seed oysters were taken up during the winter and separted from the collectors. It was found that the loss since planting had been very small. They had made a fine growth and were in good condition.

The Floats.

Three more floats like the one used the previous season were built. Two of these were anchored in the bay and one outside with

float No. 1. They were made to hold various depths of water and the slat bottom in all cases covered over with burlap and sand or fine gravel. Oysters planted in some of these floats seemed to thrive well but in others nearly half the oysters died after being in the float about six weeks. It was found that the burlap and sand did not allow for a sufficient circulation, the water often becoming crowded with infusorians and other minute organisms within a few days' time. The floor of one section of float No. 1 was not covered with burlap, only a little coarse gravel thrown in. The oysters in this section were in fine condition during the whole season and nearly all that were opened in the early part of the season were full of spawn. After spawning they fattened more rapidly than those on the beds. This was doubtless due to the warmer water, as the water in the floats was usually several degrees warmer than that outside. At night, however, the temperature dropped very rapidly so that the morning tests often showed the water in the floats colder than that outside. These sudden changes probably account for the fact that no eastern oyster spat was taken.

The Tanks.

The insides of the three upper tanks were covered with cement in order that there might be no chance of the wood tainting the water. This seemed to be a decided improvement, as it was much easier to keep these free from sediment and slime. A small filter tank was built and the water forced through three or four inches of fine gravel before it was let into the tanks. This took out much of the sediment but would not catch the fine stuff.

Temperature.

During this season more or less complete temperature and density records were kept at a number of stations. Those that more particularly concern us now, however, are the temperature records taken at station 1 inside the bay while the gates were closed, and those taken at station 2 in the open sound outside the bay. In this series two or three tests were taken each day at different stages of the tide during July, August and September; no tests were taken earlier than 7 a. m. or later than 7 p. m.

	—Station 1—			—Station 2—		
	July.	Aug.	Sept.	July.	Aug.	Sept.
Maximum	76	76	71	72	76	65
Minimum	64	63	58	59	59	57
Average	67.92	69.42	63.86	63.37	63.58	60.31

SEASON OF 1902.

The Bay.

At the beginning of this season it was found that the teredoes had continued their destructive work on the dam which was now in a much worse conditon than ever before. A new floor was put in and some new braces added, but the first high tide that came after the gates had been closed tore out all this work and showed that all the timbers that were below the water were in such a condition that it would be useless to try to do anything with them. We were therefore unable to use the dam this season and the tides were free to come and go in the bay.

The Dykes.

Along one edge of the bay a dyke about 190 feet long was built between two points of land, thus enclosing a body of water about 200 feet long and 50 feet wide. When the tide is out the water in this pond is from six inches to three feet deep and about twice that deep when the tide is in. In order that we might be able to control the density of the water, the small stream that leads from the hatchery and fish ponds was led into the upper end of this pond. As this pond was also to be used in our experiments with young salmon, a tight board wall high enough to keep out the highest tides was built around it with only two openings through which the tides might enter. These openings were covered with galvanized iron screen with one-quarter or three-eighths inch mesh. Throughout the experiments this pond was known as pond 7. The high wall by reflecting the sun's rays and shutting off the breeze raised the temperature of the water to a considerable extent. It was soon found that the fresh water that flowed in did not mix readily with the salt water, most of it simply flowing over the surface and out at the other end of the pond. It was found, too, that too much fresh water was entering, so an open flume was built across the pond with the lower end near one of the openings in the

wall and on a level with it, so that while the tide was out no fresh water entered the pond, but as soon as the tide began to come in and the level of the water raised to the flume the fresh water mingled with the salt and was carried by the currents to all parts of the pond. Several barrels of oysters and sacks of clam shells were scattered over the bottom and placed on screens at various depths. During the early part of the season, several of the oysters died, probably because the water was too fresh, but after this trouble was remedied they all did well and apparently spawned freely, but no spat has yet been found on any of the collectors.

As the season advanced, several possible improvements in the arrangement of this pond suggested themselves, but it was too late to make the necessary changes then. These will be made before the beginning of next season and it is believed that more satisfactory results will follow.

Just below one of the outlets of this pond another smaller dyke was constructed with walls only one foot high. As most of the fresh water from pond 7 flowed through the long narrow pond thus formed, the density was quite low while the tide was out, but as soon as the tide came in the density was of course the same as that of the rest of the bay.

On a piece of tideland outside the bay that contains some good oysterland, four dykes of different sizes and depths were built and stocked with eastern oysters and at the proper time well supplied with shells and other collectors. As the spawning season approached these oysters ripened the reproductive elements and presumably spawned, as later many were found in a partially or wholly spawned-out condition. No young spat has been found on any of the collectors, however. A few oysters were planted over other parts of this bed outside the dykes, some of them below the low tide line. They have been in fine condition all the time and during the spawning season many were full of spawn.

The Floats.

The floats were used this year without the bottoms being covered with sand as before. At the proper season they were well supplied with clam shells and spawning oysters. Three weeks

later the shells were found covered with native oyster spawn, but no eastern oyster spat was found at this time or later.

The Tanks.

Much attention was given to the experiments with the tanks this season. The upper tank was supplied with a coil of two inch pipe through which the exhaust steam from the pump was driven and into which live steam could be turned when desired. The coil is close to the bottom of the tank, one end being near the place where the water from the filter tank enters. With this arrangement we were able to keep the water in the upper tank at any desird temperature and so control the temperature in the other tanks, also. The temperature of the upper tank was kept close to 78 degrees or 80 degrees during the month that the experiment was in progress and at no time was it allowed to get as low as 70 degrees or as high as 85 degrees. Tank 2 averaged about 74 degrees; tank 3, 72 degrees; tank 4, 70 degrees. The bottoms of the tanks were well shelled and a number of trays covered with shells were suspended at various depths. Almost every day for a period of two weeks, millions of embryos obtained by artificial fertilization were placed in some of these tanks. On August 14th, an examination was made of some of the shells and a few young oysters were found which were believed to be eastern oysters. Later a more thorough examination was made and many others were found. These were all kept in trays in one of the floats after the tanks had been emptied, but a recent examination of them proves them all to be native oysters, the swimming embryos of which were pumped up from the bay and forced through the filter tank into the other tanks.

Pond 9.

Below this series of tanks and receiving the overflow from them was constructed a small pond 25 feet by 10 feet, and about 3½ feet deep. A little fresh water, the overflow from a small hydraulic ram was let into the upper end of the pond at the same place that the salt water entered so that the two were thoroughly mixed. A complete series of tests was not kept for this pond, but from a number taken at various times the temperature of the water was found to average about 70 degrees during the day and 68

degrees at night. The bottom and sides were well covered with clam shells and other collectors and a number of eastern oysters were planted in here at the beginning of the spawning season. These seemed to spawn freely but no spat set.

In all the tanks, ponds, floats and dykes we placed as collectors, besides the clam shells, large pieces of broken tile which had been coated over with whitewash. If the convex side of the tile is placed uppermost, the lower or concave side is kept quite free from sediment and thus makes an excellent collector. They were whitewashed by being dipped into a barrel of thin whitewash made by using two or three parts of sand to one part of lime. By thus whitewashing the tile before they are placed in the water, any oysters that become attached may be easily removed as the coating flakes off easily taking the oyster with it. These tiles are largely used in Europe. In the floats and many places on the bed these become thickly covered with native oysters but no eastern oysters were found.

Temperature.

During the winter of 1901-'02 and the summer of '02, a series of records was kept of the temperature of the air and of the temperature and density of the water both inside and outside the bay. This series is not complete, however, and until some of the gaps have been filled in it will not be of enough general interest to publish.

From July 11th to August 24th, the time during which the eastern oysters were spawning on the beds, a very complete record was kept of the temperature of the water in the bay, tests being taken every three or four hours during the day and night. It should be remembered that the gates were open all the time and the tide ebbed and flowed so that the temperature shown in the following table will be approximately that of any other bed similarly situated. In order to condense the table only the maximum, minimum and average temperature for each hour during this time is given.

	3 A.M.	6 A.M.	9 A.M.	12 N.	4 P.M.	7 P.M.	9 P.M.	12
Maximum	62	60	70	76	78	70	68	63
Minimum	54	51	57	61	61	60	58	56
Average	58.22	57.71	60.82	64.84	67.17	63.60	65.82	59.7

Average from 9 a. m. to 7 p. m. 64.12
Average from 9 p. m. to 6 a. m. 59.37
Average for 24 hours during this period 61.74

A study of the detailed record brings out the following additional points; all readings over 70 degrees were taken on warm sunny days, usually in the afternoon when the tide was out and only a little water was in the bay; the lowest temperature occurred at night when the tide was out; as soon as the tide commenced to come in, the temperature of the water in the bay dropped very rapidly, the greatest drop in three hours being from 78 degrees to 65 degrees or a drop of 13 degrees; a drop of 10 degrees in one or two hours was quite common.

Summary and Discussion.

The question set before us at the beginning of these experiments was "will the eastern oyster propagate in the waters of this state, or, if not, why not?"

The first season's work showed that the reproductive elements ripened while the oysters were on the beds and that there was every indication that the ova and sperm were cast into the water. It was believed, however, that the chances of the ova being fertilized in this way were small unless large numbers of the oysters were found on the beds. During the next two seasons two carloads of oysters were planted in a small bay where it was believed that this difficulty might be overcome. In order that any swimming embryos that might result from natural spawning might not be carried by the tides to distant parts of the sound, various provisions were made for holding them within limited areas. At the end of the second season's work it was believed that we had been successful in catching a few spat of the eastern oyster, but as they developed further, they proved to be native spat. All the characters, such as size, shape, color markings, etc., usually given as distinguishing character of the two species, are of no value in helping us to distinguish the very young.

Various reports have reached us from time to time of eastern oyster spat being taken at different places in the state. We have made careful investigation in every case and have always found that there was a mistake in determining the species of the oyster or that, after carefully tracing the history of the oyster, they were found to have been shipped from the east.

All the evidence thus far then, seems to point to the conclusion that although the eastern oyster will spawn here, it will not, when left to itself, propagate in the waters of this state. For the reasons for this we would again call your attention to the life history of this oyster as given in the early part of this report and to the temperature records, especially those taken during the last spawning season. Those who have made a careful study of the conditions favorable for a good set of spat in the east all agree that for the best results the temperature should not fall below 70 degrees during the spawning season and that the average is usually somewhat higher than that. Lower temperatures may be reached and a good catch still result, but the change must be gradual. Our records showed 61.74 degrees as the average temperature of the water in the open bay during the spawning, and what is just as bad or probably worse, the changes from a high to a low temperature were often very sudden. So, while we are not yet prepared to say positively that this is the case, we believe that the low temperature and sudden change are the principal causes, at least, of our not being able to propagate the eastern oysters in the open waters of the sound.

Attempts were made during the past season to control the temperature of the water by holding it in high protected dykes or by artifically heating it. The results of these experiments were such as to lead us to believe that something may be accomplished along this line, and during the next season much of our attention will be given to this part of the work. The tanks will be re-modeled in order to give a better circulation and a better chance to heat the water; a few changes will be made in the arrangement of the dykes already constructed and a few new ones built in other suitable localities. If we can succeed in keeping the temperature high enough and still have the water circulating freely, there is every reason to believe that we will yet be able to propagate the eastern oyster on the Pacific coast.

JAPANESE OYSTERS.

In our last report we called attention to the advisability of introducing some of the Japanese oysters into the waters of this state. Since that time we have made further investigation in re-

gard to this subject and wish to again call it to your attention. There are several species of oysters occuring in the different parts of the Japanese islands and under various conditions of temperature, etc. We have seen specimens of the shells of some of these oysters that were certainly as fine in shape and size as any eastern oyster we have ever seen. We have had considerable correspondence with different parties in regard to this and from all that can be learned in this way it would seem that there is here an excellent chance for us to materially add to our fishery resources. The subject is worthy of serious consideration and we trust that provision will be made for making a thorough investigation of the matter and, if everything promises well, to begin a series of experiments by introducing a few barrels and planting them in a favorable locality.

LOBSTERS.

In 1889 the United States Fish Commissioner made a shipment of lobsters to this state and distributed them as follows: Off Cape Disappointment, 88; Willapa harbor, 22; Scow bay, 24; off Hudson Point, 25; off Wilsons Point, 74. Since that time no investigations have been made to determine whether these experiments were successful or not.

It is a matter of surprise and comment among those who are familiar with the conditions here and along the Atlantic coast that we have never made any further effort to introduce the eastern lobsters into the waters of Puget Sound. During the last three or four years we have given this subject a good deal of attention, and from what we have learned of the habits of the lobster in its native water and of the conditions here, there is every reason to believe that the introduction of this much prized shell fish into the waters of the state would not be difficult. Although the matter has not been discussed with them, it is not unlikely that if we take the initiative, the United States Fish Commissioner would again aid us in this in every way possible.

CRAWFISH.

At least three species of crawfish occur in the streams, rivers and lakes of this state. The most common (*Astacus nigrescens*) occurs in all the coast streams from Alaska to San Francisco. This

species, however, does not seem to attain the large size and excellent flavor of the common for (*A. leniusculus*) found in the Willamette river and its tributares and the lower Columbia. It was believed that could this latter species be introduced into some of the streams and lakes in different parts of the state, it might soon establish itself here and in time become an important fishery product.

In June, 1901, a shipment of about one hundred dozen crawfish was received from Meadow Lake, Oregon. These were planted in ponds 4 and 5 here at the station after they had been provided with a low board wall around the edge to keep the crawfish from escaping into the bay. Some difficulty was experienced in keeping them in these ponds and it was a long while before they became thoroughly contented in their new home. In September of the same year we made a short visit to the various points in the Willamette valley, learning what we could of the conditions under which the crawfish thrived most favorably there. Arrangements were made for several shipments from the Tualatin river, where the best fish were found. Some of these were planted in Island lake in Kitsap county, which seemed to be particularly well adapted to this purpose. Many others were planted at various points along the Duwamish river where the conditions seemed favorable.

Observations made from time to time in the localities where these shipments were planted show that the crawfish are thriving well, and it is hoped that within a few years we may be able to establish this excellent food fish in many of our lakes and streams. These experiments will be watched with interest by many who regard the crawfish as one of the most delicately flavored of all our shell-fish.

CRABS.

Of the many species of crabs occurring in the waters of this state only one (*Cancer magister*) is at present of any commercial importance. The principal sources of supply are Dungeness, Blaine and Point Roberts, although crabs are taken in greater or less quantities in various other places on the Sound and Willapa and Grays harbor.

Although the crab fishing industry in this state is already of

considerable importance and is being developed more and more each year, nothing has ever been done in the way of regulating or assisting it. It is said that the crabs are not nearly as plentiful now as they were a few years ago and it is very likely that as the demand grows larger and the number of fishermen engaging in the industry increases the supply will become still smaller unless some protection is afforded the industry. At present we know but little concerning the life or habits of this important shell-fish, and it is sincerely hoped that in connection with the general work of this station some provision may be made so that some time may be devoted to the study of this crab in order that we may be able to deal intelligently with the problems concerning it.

Two other species of crabs (*C. productus* and *C. gracalis*) are occasionally taken and used for food, but they are seldom seen on the markets.

In this connection, we wish to call your attention to the desirability of introducing the eastern "Blue Crab" (*Callinectes hastatus*) into our waters. There is little doubt but that they would thrive well here. While not as large as our largest native crab its flavor is much more delicate and if introduced would probably soon be in great demand especially by those who are used to it in the east.

SHRIMPS AND PRAWNS.

The terms "Shrimp" and "Prawn" seem to not be very well defined, the term "shrimp" usually being applied to the smaller, and "prawn" to the larger forms, sometimes of the same species. Several species of both the larger and smaller forms occur within the borders of our state. The common shrimp of our market (*Pandulus danae ?*) is quite large and is therefore often called a prawn. It is taken together with one or two other closely related species and a few smaller forms. The common shrimp of the east and south (*Crangon vulgaris*), although occurring in considerable numbers in Puget Sound, is too small to be of market value with our present methods of handling.

Although the shrimping industry has assumed considerable proportions within the last few years, its development has been due almost wholly to the energy of one firm, Haines Oyster & Commission Company, who until recently were operating the only

boats engaged in this fishing. Just now most of the fishing is being done in Hoods canal, but many other places such as around Anderson's and McNeals islands, Quartermaster harbor, West Passage, etc., are still fished with profit.

Very little is known of the life history, habits or movements of fish. Last April our attention was called to the large amount of egg-bearing shrimps in the market and we began making inquiries with a view to finding out what was known concerning their spawning habits. Again in September and October a large per cent of those found on the market were "in berry." Little could be learned in this way, however, without devoting considerable time to the subject and the matter had to be dropped until we can arrange to make a series of investigations in connection with the other work that we expect to begin with the increased facilities for this kind of work that we hope to have at our disposal next season.

It is well known that all these small crustaceans form no inconsiderable part of the food of many of our important fish, and for this reason if for no other a careful study should be made of their distribution, habits, and life history. The results of such investigations would probably be the immediate building up of this heretofore neglected industry under such restrictions as would properly protect it and our other fisheries.

We wish to call your attention to the advisability of such investigations being begun at once, as it is only too evident that these shrimp need protection at least during the spawning season, but until more is known concerning them it would be hard to make intelligent regulations regarding this industry. The nature of these investigations are such that they must extend over a considerable period of time, but with work of the station as planned for the next two years this could be carried on with but little additional expense.

CLAMS.

There are eight or ten different species of clams and cockles within the borders of our state that are largely used as food, as well as a few other species that are less commonly used. Our long, wide, sandy sea-beaches are the home of the much prized "Razor-clam" (*Machaera patula* Dixon) once so abundant, but now fast decreasing in numbers on account of over-fishing and lack of pro-

tection. The thousands of acres of tide-flats on Puget Sound and Willapa and Grays harbor left bare by the receding tides furnish most excellent feeding grounds not only for our native oyster and its more aristocratic cousin, the eastern oyster, but for many an humble clam as well. Among the more important of these may be mentioned the large "Giant clam" or "Geoduck" (*Glycimeris generosa* Gld.); the great "Washington clam" or "Gaper clam" (*Schizothoerus nuttalli Conr.*); the "Butter clam" (*Saxidomous nuttalli Conr.*); the "Eastern clam" (*Mya arenaria Linn.*); The "Cockle (*Cardium corbis Martq;* and the "Little Neck clam" or "Hard Shell" or "Rock clam" (*Tapes staminea Conr.*)

The Butter clam and the Little Neck clam are of the most importance on Puget Sound, the former being largely canned, the latter going into the markets fresh. The Eastern clam is more commonly used in Willapa harbor, where it is found in considerable abundance. It is said to have been introduced there from San Francisco before 1884, at which time it was quite common. The only record we can find of its having been introduced into Puget Sound is in Dr. Smith's article in the U. S. Fish Com. Bulletin for 1895, in which he says: "It is stated that about six or seven years ago the original plants were taken from Shoalwater bay by the engineer of a coasting steamer and deposited near Tacoma." They are now generally distributed all over the sound and quite abundant in many localities.

Of some of these clams the supply seems at present to be almost inexhaustible, others by their decreasing numbers already show the effect of close fishing and indiscriminate destruction. It is safe to say that if nothing is done to protect the clam industry it will be but a few years before the best beds will be in the same deplorable condition that many of our native oyster beds are today. With the building of clam canneries and the increased demand from other sources, these beds will soon be so depleted that it will be several years before they can be restored. Little or nothing is known of the breeding habits of any of these clams or of their early life history. Until we can gather some information along this line, no intelligent action looking toward their protection can be taken. The Indians are the principal clam diggers, the white men declining to go into the business and thus come into direct competition

with the Indians even though good wages can be made. It is believed, however, that as the supply becomes smaller and our increased knowledge of the habits of the various species enables us to properly cultivate and care for the beds, the man who owns a good piece of land suitable for clam-culture will be considered almost as fortunate as the man who owns good oyster land. The subject is worthy of your special consideration.

AN ANNOTATED LIST OF THE MORE COMMON FISHES OF THE STATE OF WASHINGTON WITH A LIST OF INTRODUCED SPECIES.

Although the pressure of other work at the station has left us but little time to devote to the study of the fish fauna of the state we have been able to gather a few notes from time to time that, later, we hope to embody in a report on this subject. These notes have been based principally on fish caught in seines at or near the station or seen in the markets or packing houses at various seasons of the year. The dealers have always showed us many favors in this, allowing us to make detailed examinations of fish when we did not care to take them away and often supplying us with valuable information as to the seasons when certain species were most abundant, their market value, etc. During our visits to the various hatcheries we have also been able to make a little study of some of the streams and have received much help from some of the hatcherymen who have supplied us with specimens and notes.

In making a record and study of the facts thus gathered we found it convenient to make out a list of all the fish known to occur in the state of Washington as recorded in Jordon & Evermann's "Fishes of North and Middle America" (Bulletin 47, U. S. National Museum.) In this list we recorded 186 species, but as many of these were rare or occurred only occasionally within our limits the list was revised and made to include only the more common or those of some special interest and a few notes as to size, abundance, food, value, etc., were added.

As this list has been of considerable aid to us and as several who have seen it have asked for copies of it, we submit it to you with our report believing it will be of general interest.

We have often been asked to give the title of some book describing the fish of this state. No book dealing with the fish of this state alone has been published, but to any one wishing a book relating to fish which is at once popular and interesting as well as scientific we would recommend Jordon & Evermann's "American Food and Game Fishes," Doubleday, Page & Co., 1902. Aside from the bulletin above referred to, which is in four large volumes and wholly scientific, this is the most complete and reliable work on this subject. Many interesting and instructive articles dealing with the fish and fishery industry of this state may be found in the various reports and bulletins of the U. S. Fish Commission.

The Dogfishes.

Fam Squalidae.

DOGFISH—(*Squalis sucklii*) (Girard) very abundant especially in certain parts of Puget Sound, valued for the oil extracted from its liver.

The Skates.

Fam Rajidae.

SKATE—(*Raja rhina* J. & G.) not uncommon, sometimes reaches a length of 2½ feet.

COMMON SKATE, RAY—(*Raja binoculata Girard*)—Quite common especially on sandy shores; reaches a length of over six feet and a weight of over sixty pounds. The "wings" of this and the preceding species often used as food and usually found on the markets.

The Chimaeras.

Fam Chimaeridae.

RATFISH—(*Hydrolagus colleri,* Lay & Bennett)—Quite common in Puget Sound; rarely used as food, but occasionally seen in the market.

The Sturgeons.

Fam Acipenseridae.

WHITE STURGEON—(*Acipenser transmontanus*) (Richardson) —Common; running up the rivers in the spring; reaches a length

of 5 to 10 feet, and a weight of 300 to 500 pounds; largely used as food, although the meat is coarse; largely frozen and shipped east; known also as Columbia River Sturgeon and Pacific Sturgeon.

GREEN STURGEON—(*Acipenser mediostris Ayres*)—Smaller and less abundant than the white sturgeon and not used as food, being reputed poisonous.

The Suckers.

Fam Catostomidae.

MOUNTAIN SUCKER—(*Pantosteus jordani,* Evermann).

LONG-NOSED SUCKER—(*Catostomus catostomus*) (Forster).

COLUMBIA RIVER SUCKER—(*Catostomus macrocheilus*) (Girard).

These three species are found in more or less abundance in different parts of the state, the first two in streams in the upper Columbia river basin, the last all along the Columbia and in various streams and lakes west of the Cascades. Frequently used as food.

The Carps, Chubs and Minnows.

Fam Cyprinidae.

HARD-MOUTHED CHUB—(*Acrocheilus alutaceus*) (Agassiz and Pickering). Locally abundant in many of our streams, but but rarely used as food.

COLUMBIA RIVER CHUB—(*Mylocheilus caurinus*) (Richardson)—Very abundant in many of the streams of the state, sometimes entering salt water; sometimes reaches a length of a foot, and is largely used as food; said to destroy large numbers of trout and salmon eggs on the spawning beds; known also as "Whitefish," "fresh water herring," "Trout," etc.

SQUAW-FISH—(*Ptychocheilus oregonensis*) (Richardson)—Common in nearly all the streams and lakes in the state; reaching a length of two to four feet; largely used as food.

GIRDLED MINNOW—(*Leuciscus balateatus*) (Richardson)—Common in many of the streams and lakes in the state; reaching a length of 4 and 6 inches.

LONG-NOSED DACE—(*Rhynichtyhys cataractae dulcis*) (Girard)—Quite common in Columbia river basin in swift streams; reaching a length of five inches.

The Herrings and Sardines.

Fam Clupeidae.

HERRING—(*Clupea pallasii Cuvier and Valencrennes*)—Very abundant; sometimes reaching a length of 16 inches; an important food fish, being smoked, dried and salted in large numbers; largely used for bait; being ruthlessly and foolishly destroyed by the fishermen by the young being left to die on the beach.

SARDINE—(*Clupanondon caeruleus*) (Girard)—Abundant; an important and excellent food fish.

The Anchovies.

Fam Eugraulidae.

ANCHOVY—(*Eugraulis mordax*) (Girard)—Abundant, occurring in large schools; highly valued as food; largely used as bait; reaching a length of 7 inches.

The Whitefish, Salmon and Trout.

Fam Salmonidae.

WHITEFISH—(*Oregonus williamsoni*) (Girard)—Quite common in many of our lakes and streams; reaching a length of 1 foot; an excellent food fish.

HUMPBACK SALMON—(*Oncorhynchus gorbuscha*) (Walbum)—Rather common in the Columbia and its tributaries and in Puget Sound and its tributaries; in Puget Sound only in odd years, few in even years; smallest of the salmon, averaging only 4 to 5 pounds; females often used for food and canned, males less often used.

DOG SALMON—(*Oncorhynchus keta*) (Walbum)—Abundant; ascending all streams to spawn; used as food and canned when caught in salt water; known in the markets as "Fall salmon," "Comax," etc.

CHINOOK SALMON—(*Oncorhynchus tschawytscha*) (Walbum)—Very abundant in the Columbia river; less common in Puget Sound; one of our most important food fishes; average weight 18 to 25 pounds, but reaching a weight of 60 pounds. Along the Columbia river known as "Chinook," "Quinnat," "Tyee," "King," or "Columbia River" salmon. In Puget Sound more commonly known as "Spring salmon," "Chinook," or "Jack" salmon.

In Grays harbor and Willapa harbor known as "Black salmon" or "Chinook."

SILVER SALMON—(*Oncorhynchus kisutch*) (Walbum)—Vary common in Puget Sound and tributaries; less common in the Columbia River and Grays Harbor and Willapa Harbor; third in importance of our salmon.

SOCKEYE SALMON—(*Oncorhynchus nerka*) (Walbum)—Abundant in the lower Puget Sound and less common in the Columbia river. Commercially the most important fish in the state; known in the Columbia as the "Blueback salmon"; further up the streams and in the lakes as the "Red salmon," or "Red fish."

CUT-THROAT TROUT—(*Salmo clarkii*) (Richardson)—Common in all the coast streams; an excellent food and game fish; known also as "Columbia River Trout," "Black-spotted trout," "Brook trout," etc. Variety *gibbsi* occurs in the streams of Eastern Washington.

SALMON TROUT, STEELHEAD—(*Salmo gairdneri*) (Richardson)—Common in Puget Sound and tributaries, occurring also in the Columbia river and tributaries; returns to salt water after spawning; an excellent food fish; canned with the silver salmon.

The following landlocked varieties occur: *kamloops*, in Kamloops lake and tributaries of upper Columbia; *beardsleei, crescentis* and *bathoecetor*, in Lake Crescent; *jordani* and *declivifrons*, in Lake Sutherland.

RAINBOW TROUT—(*Salmo irideus masoni*) (Suckley)—Rather common in the coast streams; small size, rarely weighing a pound.

DOLLY VARDEN TROUT—(*Salvelinus parki*) (Suckley)—Quite common in many streams of the state, sometimes descending into the sea, where it reaches a weight of 10 to 12 pounds; not so highly valued as food as some of the other trout.

The Smelts.

Fam Argentinidae.

CANDLEFISH. EULACHON—(*Thaleichthys pacificus*) (Richardson)—Common in the spring; one of our finest food fishes, the flavor being even finer than that of the trout; reaches a length of 12 inches, but the average is much less.

SMELT—(*Osmerus thaleichthys*) (Ayres)—Common and an important food fish though hardly as fine as the eulachon; length, about six inches.

The Sticklebacks.

Fam Gasterosteridae.

STICKLEBACKS—(*Gasterosteus cataphratus*) (Pallus) and (*G. williamsoni microcephalus*) (Girard)—These two species occur in considerable abundance, the former chiefly in salt water, the latter chiefly in streams and brackish water. Small pugnaceous fish, exceedingly destructive to the spawn and fry of other fish.

The Sand Launces.

Fam Ammodytidae.

SAND LAUNCE—(*Ammodytes personatus*) (Girard)—Occurs in large schools in Puget Sound on sandy beaches burying itself in the sand; an excellent food fish.

The Perch.

Fam Embiotocidae.

SHINER—(*Cymatogaster aggregatus*) (Gibbons)—The most abundant of our perch; found near sandy or muddy shallow bottoms and about the wharves; reaches a length of six inches; but little used as food.

SURF-FISH—(*Amphysticus argenteus*) (Agassiz)—Rather common along the sandy shores of the coast.

BLUE PERCH, BLACK PERCH—(*Embiotoca jacksoni*) (Agassiz)—Rather common; reaches a length of a foot; the flesh is poor.

STRIPED PERCH, BLUE PERCH—(*Taeniotoca lateralis*) (Agassiz)—Very common; reaching a weight of two pounds; largely used as food.

WHITE PERCH, PORGEE—(*Damalichthys argyrosomus*) (Girard)—One of the most common of our perch; reaching a length of a foot; largely used as food and highly esteemed by some.

The Rockfishes.

Fam Scorpaenidae.

BLACK BASS—(*Sebastodes melanopus*) (Girard)—Abundant in Puget Sound and along the coast, reaching a length of 20 inches; an important food fish.

RED ROCK COD—(*Sebastodes pinniger*) (Gill)—Common in rather deep water; an important food fish.

RED ROCKFISH—(*Sebastodes ruberrimus*) (Cramer)—Rather common; reaching a length of over 2 feet; a food fish.

BROWN ROCKFISH—(*Sebastodes articulatus dallii*) (Ergenmann & Beeson)—Common in shallow water in Puget Sound; used as food.

ROCKFISH—(*Sebastodes caurinus*) (Richardson)—Quite common in Puget Sound and largely used as foodd.

ROCK COD, YELLOW-SPOTTED ROCKFISH—(*Sebastodes nebulosus*) (Ayres)—Common in rather deep water; reaching a length of 12 inches; a food fish.

The Skilfishes.

Fam Anoplopomidae.

BLACK COD, COAL FISH, SKIL—(*Anoplopoma fimbria*) (Pallas)—Rather common in Puget Sound; reaching a length of over three feet; usually taken with the halibut; a fine food fish; always in demand; small specimens often seen on the market under the name of "Puget Sound Mackerel."

The Greenlings.

Fam Hexagramidae.

ROCK TROUT—(*Hexagrammos decagrammos*) (Pallas).

GREENLING—(*H. stelleri Tilesius*).

RED ROCK TROUT—(*H. supercillosus*) (Pallas).

The first two are quite common in Puget Sound, and the last less common; all largely used as food.

LING COD, BLUE COD—(*Ophiodon elongatus*) (Girard)—Abundant; reaching a weight of 40 or 50 pounds; a very important food fish; known also as "Cultus Cod" and "Buffalo Cod."

The Sculpins and Bullheads.

Fam Cottidae.

This family is represented by more than twenty species, all of which are more or less common; they are seldom used as food. The following are some of the more common or important:

CABEZON—(*Scorpaenichthys marmoratus*) (Ayres)—One of

the largest sculpins, reaching a weight of 20 to 25 pounds; sometimes used for food, but coarse and tough.

RED SCULPIN—(*Hemilepidotus hemilepidotus*) (Tilesius)—Abundant in shallow water in Puget Sound; reaches a length of 12 to 18 inches.

GREAT SCULPIN — (*Myoxocephalus polyacanthocephalus*) (Pallas)—One of our most common and largest sculpins; reaching a length of 2 to 2½ feet.

SMOOTH CABEZON—(*Leptocottus ormatus*) (Girard)—Very common; reaching a length of a foot.

PRICKLY BULLHEAD—(*Cottus asper*) (Richardson)—Common in many of the streams of the Cascades, where it is an mportant enemy of salmon and trout eggs.

The Sea Poachers.

Fam Agonidae.

ALLIGATOR FISH—(*Podothecus acipenserinus*) (Tilesius)—Very common in shallow water in Puget Sound; reaches a length of a foot; not used as food.

The Toad-Fishes.

Fam Batrachoididae.

SINGING FISH—Midshipman—(*Porichthys notatus*) (Girard)—Common under stones near the shore; it makes a peculiar humming noise with its air bladder, hence its name, "Singing fish"; reaches a length of a foot, though usually smaller; not used for food.

The Blennies.

Fam Blenniidae.

Eleven species belonging to this family, seven of which are more or less common; from small to rather large eel-like fishes and not of economic importance.

The Hakes.

Fam Merlucciidae.

HAKE—(*Merluccius productus*) (Ayres)—Abundant along the coast and in Puget Sound at moderate depths; largely used as

food. Often seen in the market under the name of "Salt-water mackerel."

The Codfishes.

Fam Gadidae.

POLLOCK—(*Theragra fucensis*) (J. & G.)—Quite common in Puget Sound; a food fish of some value.

TOMCOD—(*Microgadus proximus*) (Girard)—Very abundant; a food fish of considerable value; reaching a length of 12 inches.

CODFISH—(*Gadus macrocephalus*) (Tilesus)—Locally abundant at certain seasons when the supply exceeds the demand; large numbers used fresh, but more smoked or salted; reaches a length of 16 to 18 inches.

The Halibuts and Flounders.

Fam Pleuronectidae.

HALIBUT—(*Hypoglossus hypoglossus*) (Linnaeus)—Found most abundant off Cape Flattery; one of our most important food fishes; reaches a weight of over 150 pounds.

SOLE—(*Eopsetta jordani*) (Lockinton)—Not very abundant, but a fine food fish.

SOLE—(*Hypoglossides elassodon*) (J. & G.)—Rather common; used as food.

SOLE—(*Psettichthys melanostictus*) (Girard)—Abundant in Puget Sound; one of our best soles.

DIAMOND FLOUNDER—(*Platichthys stellatus*) (Pallas)—The most common flounder in Puget Sound; largely used as food; reaches a length of 2 feet.

A LIST OF THE FISHES INTRODUCED INTO WASHINGTON BY THE U. S. FISH COMMISSION.

Our state has not been as active as it should be in the matter of introducing food and game fishes from other parts of the world. While our natural fishery resources are far greater than those of any other state, yet there are many fine streams and many beautiful lakes that could be made far more attractive and useful if a very little money was spent in stocking them with choice varieties of food and game fish that were suited to their particular conditions. Practically all the shipments made thus far have been made by the U. S. Fish Commission. During the past year we have been endeavoring to learn something concerning the success of these experiments, but as we have not been able to visit the various localities where the plantings were made, with the proper appliances for taking and caring for any fish that might be found, we have been able to gather but few facts of any importance.

In the Bulletin of the U. S. Fish Commission for 1895 appears an important article by Dr. H. M. Smith, entitled "A Review of the History and Results of the Attempts to Acclimatize Fish and Other Water Animals in the Pacific States." The following notes are based principally on that article and on later reports of the commission and are given with the hope that they may awaken further interest in this matter and lead to a more thorough investigation of the condition of these fish in our state.

SHAD (*Alosa sapidissima*) (Wilson). Shad were first introduced into California in 1871. They were taken in the Columbia river as early as 1876, and in Puget Sound as early as 1882, having worked their way up from the California coast. In 1885 and 1886 910,000 shad were planted in the Columbia and Willamette rivers. Since that time these fish have become increasingly abundant, until now they are taken in nearly all the waters along the coast.

CATFISH (*Ameiurus spp*). It seems that no definite record has been kept of the introduction of catfish into this state. They first began to appear in the Columbia river about 1886 or 1888.

Since that time their numbers have increased largely along that river and some are found in other parts of the state, other shipments probably having been made. We have seen specimens in the Seattle markets from the Columbia river and from Lake Union, but as they were dressed we were unable to determine the species.

CARP (*Cyprinus carpio L.*) Snce 1882 the U. S. Fish Commission have made several shipments of carp to parties in different sections of the state, usually for the purpose of stocking private ponds or streams. In many of these sections the carp are now abundant and are regarded by many as a great pest. They are of little value for food, and it seems a pity that efforts thus expended were not directed toward the introduction of one of the better food or game fishes.

TENCH (*Tinca tinca*). "In 1895 a number of shipments of yearling tench were made to the Pacific states. * * * 100 were put in Fourth of July lake, Fitz lake and a pond in Spokane county, Washington."

WHITEFISH (*Coregonus clupeiformis* Mitchell). In 1889 nearly 700,000 whitefish were planted in Washington by the U. S. Fish Commission. Some of these were placed in Lake Washington, some in La Camas lake and others in Silver lake. In 1896 investigations in Lake Washington failed to show any of these fish there, and since that time nothing definite has been learned concerning them. A few catches have been reported, but as this species is not very unlike our native whitefish (*C. williamsoni*), it may be that the two species have been confused. In 1889 another shipment of 160,000 fry was planted in Lake Washington.

EASTERN BROOK TROUT (*Salvelinus fontinalis*) (Mitchell.) In 1894 shipments of this fish were made to this state. "The fish put in Washington waters consisted of 356 yearlings in Twin lake, 750 in Mountain lake, 750 in Kelly lake, 750 in Hooker lake, 1,150 in Cranberry lake, 1,150 in Johns lake, and 51 in Lake Washington, a total of 4,976." Since that time other plantings have been made as follows: In 1897, 1,000 in Fish lake; in 1898, 4,000 in Caldwell and Little Spokane creeks, 3,000 in Lake Whatcom, 4,000 at Orilla; in 1899, 1,000 in Spring brook at Spokane, 3,500 in

Rock creek at Winona, 2,500 in Clear lake near Whatcom, 2,500 in Lake Cushman, Tacoma, 1,500 in Spokane river, 3,000 in Wilbur creek at Willow, 1,500 in Columbia river at Wenatchee, 1,500 in Little Spokane river; in 1900, 3,000 in Lake Wildwood near Whatcom, 5,000 in Little Spokane, 1,000 in Ahtanum river at Spokane, 1,000 in Touchet river at Dayton, 250 in Chambers creek at Tacoma, 250 in Lake Steilacoom, Tacoma.

LAKE TROUT (*Cristivomer namaycush*), (Walbum.) In 1900 shipments were made as follows: Newman lake, 14,955; Loon lake, 26,930; Lake Washington, 21,985; Lake Whatcom, 17,822; Wenatchee, 5,000.

CRAPPIES (*Pomoxis annularis Rafinesque*). "In 1890 285 yearling crappies were placed in Lake Washington near Seattle; the following year 220 were put in Loon lake and 50 in Liberty lake near Spokane; in 1892 25 were planted in Deer lake, near Loon lake, and in 1893 18 were put in Shepherd lake."

SUNFISH (*Lepomis sp*). "The Washington consignment consisted of 25 yearlings in Loon lake and 25 in Lake Colville in 1890; 300 in Loon lake and 150 in Deer lake in 1891, and 9 in Deer lake in 1892."

BLACK BASS (*Micropterus salmoides*), Lacepede. "Comparatively numerous plants of yearling large-mouth bass have been made by the U. S. Fish Commission in Washington during the past few years. In 1890 Washington, Loon and Colville lakes received 1,220 fish; in 1891, 125 fish were sent to Loon and Liberty lakes; the following year 3,547 fish were planted in Clear, McDonald, Loon, Deer, American, Liberty and Gravely lakes. Clear, Padden and Shepherd lakes, a private lake in Spokane county, and a public lake in Skagit county, were supplied with 400 fish in 1893. The shipments in 1895 consisted of 625 fish deposited in Loon, Cavanaugh, St. Clair, Silver, Welty and Clear lakes, the aggregate plants in Washington being 5,442."

In a number of these localities these bass are now reported as very abundant and affording some excellent fishing. They are said to be important enemies of salmon and trout.

WARMOUTH BASS (*Chaenoprythus gulosus*) Cuvier & Valenciennes. In 1892 29 of these fish were planted in Loon lake.

YELLOW PERCH (*Perca flavecens*) Mitchell.. "In 1890 25 yellow perch were planted in Loon lake and 30 in Lake Colville; in 1891 500 more in Loon lake; in 1895 50 in Loon lake, 100 in Silver lake, 200 in South Palouse river and 100 in Lake St. Clair." From some of these localities come reports that these fish are now quite abundant.

TABULATED REPORT OF FISHING INDUSTRY, PUGET SOUND DISTRICT, YEAR ENDING DECEMBER 1, 1902.

VALUE OF CANNERIES AND FACTORIES, FISHING APPLIANCES AND CAPITAL USED IN OPERATION OF SAME.

	No.	Value.
Salmon canneries and factories operated	21	$1,024,433 00
Salmon canneries and factories not operated	5	50,000 00
Crab canneries and factories operated	1	15,000 00
Clam canneries and factories operated	1	10,000 00
Sardine and herring canneries and factories operated	2	25,000 00
Capital used in operating	...	1,795,600 00
Steamboats	41	322,200 00
Launches	13	30,000 00
Pile drivers	31	140,500 00
Scows	312	184,310 00
Fishing boats and dories	350	18,605 00
Pound nets operated	148	1,767,000 00
Pound net locations not operated	157	39,250 00
Purse seines	84	58,800 00
Drag seines	92	25,300 00
Gill nets	353	56,480 00
Set nets	361	19,855 00
Total	365	$5,582,333 00

LABOR EMPLOYED IN OPERATION OF CANNERIES, FACTORIES, STEAMBOATS, FISHING APPLIANCES, ETC.

HOW EMPLOYED.	Number men.	Average annual earnings.	Total.
Canneries and factories, white labor	1,990	$217 00	$214,380 00
Canneries and factories, Chinese and Japanese	1,725	205 00	353,625 00
Canneries and factories, Indians	75	165 00	13,125 00
Steamboats	186	376 00	70,040 00
Launches	35	370 00	12,950 00
Pile drivers	303	223 00	67,570 00
Scows	193	300 00	57,900 00
Fishing boats and dories	193	300 00	57,900 00
Pound nets	760	300 00	228,000 00
Purse seines	672	400 00	268,800 00
Drag seines	276	300 00	82,800 00
Gill nets	706	300 00	211,800 00
Set nets	361	250 00	90,250 00
Fresh fish dealers	100	600 00	60,000 00
Clam and mussel fishing	100	300 00	30,000 00
Crab and shrimp fishing	90	275 00	24,750 00
Oyster industry	500	200 00	100,000 00
Total	8,265	.....	$1,943,890 00

FISH, CRABS AND CLAMS PACKED AND SALTED.

Variety—	No. of Cases.	Value.
Sockeye or blueback	372,301	$2,047,655 00
Chinook or springs	30,049	150,245 00
Silvers	85,817	429,085 00
Chums	93,492	467,460 00
Herring and smelt	10,000	47,500 00
Crabs	10,000	50,000 00
Total	8,000	48,000 00
Total	609,659	$3,239,945 00

FRESH, SALT AND SMOKED FISH SHIPPED AND CONSUMED LOCALLY.

Variety—	No. of Pounds.	Value.
Salmon, fresh, salt and smoked	20,900,000	
Sturgeon	8,000	
Smelt, fresh	1,500,000	
Halibut, fresh	20,000,000	
Halibut, salt and smoked	50,000	
Cod, salt and fresh	250,000	
Sole	60,000	
Flounders	50,000	
Mackerel	15,000	
Trout	75,000	
Herring, salt, smoked and fresh	600,000	
Shad	20,000	
Catfish	5,000	
Total	43,533,000	$1,798,900 00

SHELL FISH OUTPUT.

Variety—	Output.	Value.
Clams, sacks	30,000	
Mussels, sacks	500	
Crabs, dozens	40,000	
Shrimps, lbs	50,000	
Total	120,500	$225,650 00

GUANO AND OIL OUTPUT.

	Gals.	Value.
Three factories	50,000	$25,000 00

TOTAL VALUE OF OUTPUT FOR 1902, PUGET SOUND DISTRICT.

Salmon packed	$3,094,445 00
Fresh, salt and smoked fish	1,798,900 00
Shell fish	296,750 00
Guano, oil	25,000 00
Herring and smelt	47,500 00
Crabs	50,000 00
Clams	48,000 00
Oysters	168,000 00
Total	$5,528,595 00

TABULATED REPORT OF FISHING INDUSTRY, COLUMBIA RIVER DISTRICT, YEAR ENDING DECEMBER 1, 1902.

VALUE OF CANNERIES AND FACTORIES, FISHING APPLIANCES AND CAPITAL USED IN OPERATION OF SAME.

	No.	Value.
Canneries and factories, operated	5	$160,000 00
Canneries and factories, not operated	3	15,000 00
Capital used in operating	5	225,000 00
Steamboats	2	11,000 00
Launches	11	33,000 00
Pile drivers	2	2,400 00
Scows	12	8,200 00
Fishing boats and dories	406	40,600 00
Pound nets operated	350	280,000 00
Pound net locations, not operated	16	12,800 00
Wheels	29	8,000 00
Drag seines	52	8,500 00
Gill nets	406	64,960 00
Set nets	85	3,400 00
Total	...	$896,060 00

LABOR EMPLOYED IN OPERATION OF CANNERIES, FACTORIES, STEAMBOATS, FISHING APPLIANCES, ETC.

HOW EMPLOYED.	Number men.	Average season's earnings.	Total.
Canneries and factories, white labor	39	$400 00	$ 15,600 00
Canneries and factories, Chinese and Japanese	210	160 00	33,600 00
Steamboats	88	300 00	2,400 00
Launches	114	300 00	4,200 00
Pile drivers	5	150 00	750 00
Scows	5	300 00	1,500 00
Pound nets	350	275 00	96,250 00
Wheels	48	250 00	12,000 00
Drag seines	260	200 00	52,000 00
Gill nets	812	300 00	474,650 00
Set nets	85	150 00	12,750 00
Total	1,836	.....	$474,650 00

SALMON PACKED AND SALTED.

	No. of Cases.	Value.
Sockeye or blueback	4,235	$ 21,175 00
Chinook or springs	77,910	411,445 00
Silvers	4,435	18,820 00
Chums	10,233	40,932 00
Total	96,833	$492,372 00

SALT, FRESH AND SMOKED FISH SHIPPED AND CONSUMED LOCALLY.

	Pounds.	Value.
*Salmon, fresh	3,200,000	
Salmon, salt and smoked	280,000	
Smelt	450,000	
Trout of all kinds	24,000	
Sturgeon	11,000	
Shad	240,000	
Cod	29,000	
Catfish	8,000	
All others	34,000	
Total	4,276,000	$256,560 00

*Caught in Washington waters, and shipped into the state of Oregon.

	Sacks	Value.
Clams	2,600	$3,000 00

TOTAL VALUE OF OUTPUT FOR 1902, COLUMBIA RIVER DISTRICT.

Salmon packed	$492,372 00
Fresh, salt and smoked fish	256,560 00
Shell fish	3,000 00
Total	$751,932 00

TABULATED REPORT OF FISHING INDUSTRY, WILLAPA HARBOR DISTRICT, YEAR ENDING DECEMBER 1, 1902.

VALUE OF CANNERIES AND FACTORIES, FISHING APPLIANCES AND CAPITAL USED IN OPERATION OF SAME.

	No.	Value.
Salmon canneries and factories, operated	3	$ 40,000 00
Clam canneries and factories, operated	1	1,000 00
Capital used in operating	..	117,000 00
Launches	3	7,500 00
Pile drivers	1	300 00
Scows	2	1,200 00
Fishing boats and dories	29	1,450 00
Pound nets, operated	48	28,800 00
Pound net locations, not operated	4	2,400 00
Gill nets	2	300 00
Set nets	22	550 00
Total	..	$200,500 00

LABOR EMPLOYED IN OPERATION OF CANNERIES, FACTORIES, STEAMBOATS, FISHING APPLIANCES, ETC.

HOW EMPLOYED.	Number men.	Average season's earnings.	Total.
Salmon canneries and factories, white labor..	36	$300 00	$10,800 00
Clam canneries and factories, white labor...	4	300 00	1,200 00
Canneries and factories, Chinese.....	79	160 00	12,640 00
Launches	6	260 00	1,560 00
Pile drivers.....	5	100 00	500 00
Scows	1	300 00	300 00
Fishing boats and dories.....	4	150 00	600 00
Pound nets.....	60	200 00	12,000 00
Gill nets.....	4	300 00	1,200 00
Set nets.....	22	150 00	3,300 00
Total	221	.....	$44,100 00

SALMON PACKED AND SALTED.

	No. of Cases.	Value.
Chinook	5,836	$ 29,180 00
Silvers	9,128	41,076 00
Chums	24,528	97,112 00
Total	39,492	$167,368 00

FRESH, SALT AND SMOKED FISH SHIPPED AND CONSUMED LOCALLY.

	Pounds.	Value.
Salmon, fresh, salt and smoked.....	360,000	
All other kinds.....	30,000	
Total	390,000	$19,500 00

SHELL FISH.

	Value.
Oysters	$93,750 00
Clams	3,225 00
Crabs	2,500 00
Total	$99,475 00

TOTAL VALUE OF OUTPUT FOR 1902, WILLAPA HARBOR DISTRICT.

Salmon, packed.....	$167,368 00
Fresh, salt and smoked fish.....	19,500 00
Shell fish	99,475 00
Total	$286,343 00

TABULATED REPORT OF FISHING INDUSTRY, GRAYS HARBOR DISTRICT, YEAR ENDING DECEMBER 1, 1902.

VALUE OF CANNERIES AND FACTORIES, FISHING APPLIANCES AND CAPITAL USED IN OPERATION OF SAME.

	No.	Value.
Canneries, operated	1	$50,000 00
Canneries, not operated	1	10,000 00
Capital used in operating	..	50,000 00
Steamboats	1	2,500 00
Launches	1	2,000 00
Pile drivers	1	300 00
Scows	1	200 00
Fishing boats and dories	28	1,400 00
Pound nets operated	17	17,000 00
Gill nets	53	5,300 00
Set nets	65	1,625 00
Total	..	$140,325 00

LABOR EMPLOYED IN OPERATION OF CANNERIES, FACTORIES, STEAMBOATS, FISHING APPLIANCES, ETC.

HOW EMPLOYED.	Number men.	Average season's earnings.	Total.
Canneries and factories, white labor	10	$300 00	$ 3,000 00
Canneries and factories, Chinese & Japanese.	41	160 00	6,560 00
Steamboats	3	250 00	750 00
Launches	2	250 00	500 00
Pile drivers	5	100 00	500 00
Scows	1	200 00	200 00
Pound nets	34	150 00	5,100 00
Gill nets	106	150 00	15,900 00
Set nets	65	.....	6,500 00
Total	373	.....	$39,010 00

SALMON PACKED AND SALTED.

	No. of Cases.	Value.
Chinook	4,000	$20,000 00
Silvers	10,000	45,000 00
Chums	17,500	70,000 00
Total	31,500	$135,000 00

FRESH, SALT AND SMOKED FISH SHIPPED AND CONSUMED LOCALLY.

	Pounds.	Value.
Salmon, fresh, salt and smoked	600,000	
Sturgeon	2,000	
All other kinds	20,000	
Total	622,000	$30,000 00

TOTAL VALUE OF OUTPUT FOR 1902, GRAYS HARBOR DISTRICT.

Salmon packed	$135,000 00
Fresh, salt and smoked fish	30,000 00
Total	$165,000 00

GENERAL SUMMARY OF THE FISHERIES OF THE STATE OF WASHINGTON, FOR THE YEAR 1902, CAPITAL AND LABOR EMPLOYED, EARNINGS OF LABOR EMPLOYED, AND VALUE OF OUTPUT.

CAPITAL EMPLOYED.

Puget Sound	$5,582,333 00
Columbia river	896,060 00
Willapa harbor	200,500 00
Grays harbor	140,325 00

NUMBER OF PERSONS EMPLOYED.

Puget sound	8,265
Columbia river	1,836
Willapa harbor	221
Grays harbor	373
Total	10,695

EARNINGS OF LABOR EMPLOYED.

Puget sound	$1,943,890 00
Columbia river	474,650 00
Willapa harbor	44,100 00
Grays harbor	39,010 00
Total	$2,501,650 00

VALUE OF OUTPUT.

Puget sound	$5,528,595 00
Columbia river	751,932 00
Willapa harbor	286,343 00
Grays harbor	165,000 00
Total	$6,731,870 00

The output of the Oregon canneries on the Columbia river amounts to 458,458 cases of salmon.

OUTPUT NATIVE OYSTERS, PUGET SOUND DISTRICT.

	Sacks.	Capital invested.	Value.
Oyster Bay	25,000		$100,000 00
Little Squim	1,000		4,000 00
Mud Bay	3,000		12,000 00
Squim Bay	6,000		24,000 00
Other places	7,000		28,000 00
Total	42,000	$63,000 00	$168,000 00

EASTERN OYSTERS PLANTED PUGET SOUND DISTRICT.

Samish Bay.

	Value.
Four carloads	$4,800 00

OUTPUT OYSTERS WILLAPA HARBOR DISTRICT.

Willapa Harbor.

	Sacks.	Value.
Natives	35,000	$78,750 00
Eastern	2,000	15,000 00
Total	37,000	$93,750 00

NATIVE SEEDS TAKEN FROM NATURAL BEDS, 1902.

	Value.
175,000 sacks, at 20c per sack	$35,000 00
18 carloads of Eastern oysters planted	21,600 00

CAPITAL EMPLOYED IN OYSTER INDUSTRY, PUGET SOUND DISTRICT.

	Value.
20 plungers (boats)	$10,000 00
5 launches	10,000 00
4 carloads of Eastern oysters planted	4,800 00
Total	$24,800 00

CAPITAL EMPLOYED IN OYSTER INDUSTRY, WILLAPA HARBOR.

	Value.
25 plungers (boats)	$12,500 00
7 launches	14,000 00
18 carloads of Eastern oysters planted	21,000 00
Total	$47,500 00

TOTAL OUTPUT OF OYSTERS.

	Sacks.	Value.
Puget Sound district	42,000	$168,000 00
Willapa harbor	37,000	93,750 00
Willapa harbor (seed oysters)	175,000	35,000 00
Total	.....	$296,750 00

NUMBER OF LICENSES ISSUED DURING YEAR ENDING NOVEMBER 30, 1902.

Puget Sound Pound Nets.

298 pound nets, at $50 each	$14,900	00		
7 pound nets, two pots, at $100 each	700	00	$15,600	00

Columbia River Pound Nets.

9 pound nets, first-class, at $20 each	$ 180	00		
8 pound nets, first class, at $40 each	320	00		
275 pound nets, second class, at $10 each	2,750	00		
58 pound nets, second class, at $20 each	1,160	00	$ 4,410	00

Willapa Harbor Pound Nets.

48 pound nets, at $10 each	$ 480	00	$ 480	00

Grays Harbor Pound Nets.

17 pound nets, at $10 each	$ 170	00	$ 170	00
Total pound nets			$20,660	00

Columbia River Fish Wheels.

4 wheels, first class, stationary, at $25 each	$ 100	00		
12 wheels, second class, stationary, at $10 each	120	00		
13 scow wheels, at $15 each	195	00	$ 415	00

Gill Nets.

353 gill nets, Puget Sound District, at $2.50 each	$ 882	50		
406 gill nets, Columbia River District, at $2.50 each	1,015	00		
2 gill nets, Willapa Harbor District, at $2.50 each	5	00		
53 gill nets, Grays Harbor District, at $2.50 each	132	50		

Set Nets.

361 set nets, Puget Sound, at $2.50 each	$ 902	50		
85 set nets, Columbia River, at $2.50 each	212	50		
22 set nets, Willapa Harbor, at $2.50 each	55	00		
65 set nets, Grays Harbor, at $2.50 each	162	50	$ 1,332	50

Columbia River Seines.

9 seines, at $2.50 each	$ 22	50		
9 seines, at $5.00 each	45	00		
14 seines, at $10.00 each	140	00		
18 seines, at $15.00 each	270	00		
2 seines, at $25.00 each	50	00	$ 527	50

Puget Sound Seines.

45 drag seines, at $2.50 each	$ 112	50		
39 drag seines, at $5.00 each	195	00		
6 drag seines, at $10.00 each	60	00		
2 drag seines, at $15.00 each	30	00		
74 purse seines, at $25.00 each	1,850	00		
10 purse seines, at $50.00 each	500	00	$ 2,747	50

Individuals.

710 Puget Sound District, at $1.00 each	$ 710	00		
154 Columbia River District at $1.00 each	154	00		
21 Willapa Harbor District, at $1.00 each	21	00		
51 Grays Harbor District, at $1.00 each	51	00	$	936 00

Cannery Licenses.

2 Puget Sound District, at $150 each	$ 300	00		
1 Puget Sound District, at $200 each	200	00		
3 Puget Sound District, at $250 each	750	00		
1 Puget Sound District, at $300 each	300	00		
1 Puget Sound District, at $350 each	350	00		
1 Puget Sound District, at $400 each	400	00		
3 Puget Sound District, at $500 each	1,500	00		
1 Puget Sound District, at $800 each	800	00		
1 Puget Sound District, at $900 each	900	00		
4 Puget Sound District, at $1,000 each	4,000	00	$	9,500 00
1 Columbia River District, at $100 each	$ 100	00		
2 Columbia River District, at $150 each	300	00		
1 Columbia River District, at $200 each	200	00		
1 Columbia River District, at $250 each	250	00	$	850 00
3 Willapa Harbor District, at $100 each	$ 300	00		
1 Willapa Harbor District, at $200 each	200	00	$	500 00
1 Grays Harbor District, at $250 each	$ 250	00	$	250 00
Total				$11,100 00

Fresh Fish Dealers' Licenses.

59, Puget Sound District, at $2.50 each	$ 147	50		
4, Columbia River District, at $2.50 each	10	00		
2, Grays Harbor District, at $2.50 each	5	00	$	162 50

Fresh Fish Dealers' Reports.

(At 30 cents per ton.)

Puget Sound District	$ 286	25		
Columbia River District	24	00	$	310 25

Report of Fish Taken in Pound Nets and Wheels.

(At $1.00 per thousand fish.)

Puget Sound District pound nets	$ 3,416	93		
Columbia River pound nets and wheels	159	66		
Willapa Harbor District pound nets	25	00	$	3,601 59

Recapitulation by Districts.

Puget Sound District	$34,[illegible]3	18		
Columbia River District	7,777	66		
Willapa Harbor District	1,086	00		
Grays Harbor District	771	00	$	43,827 84

APPROPRIATIONS FOR FISHERIES DEPARTMENT, FOR TWO YEARS, ENDING APRIL 1, 1903.

OFFICE APPROPRIATIONS.

Salary commissioner, $2,000 per year	$ 4,000 00
Traveling expenses, $750 per year	1,500 00
Stenographer, at $720 per year	1,440 00
Office rent, at $325 per year	650 00
	$ 7,590 00

APPROPRIATIONS FROM FISH HATCHERY FUND.

Salary two deputies, at $1,000 per	$ 4,000 00
Traveling expenses, $500 per year each	2,000 00
Launch for Sound	4,500 00
Engineer's salary, $750 per year	1,500 00
Fuel and expenses, $1,000 per year	2,000 00
Chartering steamer on Columbia river	1,500 00
Maintenance hatcheries	70,000 00
Improvement hatcheries	12,750 00
	$98,250 00

OYSTER EXPERIMENTAL STATION.

Salary superintendent, $2,000 per year	$ 4,000 00
General expenses, $750 per year	1,500 00
Buildings and water supply	1,500 00
Car oysters	1,200 00
Machinery, floats and cleaning pond	2,000 00
Crawfish	400 00
	$10,600 00

EXPENDITURES FROM OFFICE APPROPRIATIONS, FROM APRIL 1, 1901, TO DECEMBER 1, 1902.

Fish commissioner's salary, two years	$ 4,000 00	
Expended to date		$ 3,333 34
Balance		666 66
	$ 4,000 00	$ 4,000 00
Fish commissioner's traveling expenses, two years	$ 1,500 00	
Expended to date		$ 1,318 85
Balance		181 15
	$ 1,500 00	$ 1,500 00
Salary stenographer, two years	$ 1,440 00	
Expended to date		$ 1,200 00
Balance		240 00
	$ 1,440 00	$ 1,440 00
Office rent, two years, at $325 per year	$ 650 00	
Expended to date		$ 585 00
Balance		65 00
	$ 650 00	$ 650 00

EXPENDITURES FROM FUNDS OF SCIENTIFIC EXPERIMENT STATION, FROM APRIL 1, 1901, TO NOVEMBER 1, 1902.

Salary superintendent, two years, at $2,000 per year	$ 4,000 00	
Expended to date		$ 3,166 66
Balance		833 34
	$ 4,000 00	$ 4,000 00
General expenses, two years, at $750 per year	$ 1,500 00	
Expended to date		$ 1,385 15
Balance		114 85
	$ 1,500 00	$ 1,500 00
Buildings and water supply	$ 1,500 00	
Expended to date		$ 1,499 98
Balance		02
	$ 1,500 00	$ 1,500 00
Machinery, floats, etc	$ 2,000 00	
Expended to date		$ 1,999 99
Balance		01
	$ 2,000 00	$ 2,000 00
Crawfish	$ 400 00	
Expended to date		$ 399 91
Balance		09
	$ 400 00	$ 400 00
Carload of Eastern oysters	$ 1,200 00	
Expended to date		$ 1,200 00

EXPENDITURES FROM FISH HATCHERY FUND, FROM APRIL 1, 1901, TO NOVEMBER 1, 1902.

Appropriation for maintenance hatcheries, two years	$70,000 00	
Expended to date		$57,354 72
Balance		12,645 28
	$70,000 00	$70,000 00
Appropriation for improvements hatcheries, two years	$12,750 00	
Expended to date		$ 9,960 46
Balance		2,789 54
	$12,750 00	$12,750 00
Appropriation for purchase of launch for Puget Sound	$ 4,500 00	
Expended to date		$ 4,500 00

Engineer's salary, two years, at $750 per year	$ 1,500 00	
Expended to date		$ 961 00
Balance		539 00
	$ 1,500 00	$ 1,500 00
Appropriation for fuel and expenses of launch	$ 2,000 00	
Expended to date		$ 1,429 83
Balance		570 17
	$ 2,000 00	$ 2,000 00
Appropriation for chartering launch, Columbia river	$ 1,500 00	
Expended to date		$ 1,208 45
Balance		291 55
	$ 1,500 00	$ 1,500 00
Salary two deputies at $1,000 per year	$ 4,000 00	
Expended to date		$ 3,400 00
Balance		600 00
	$ 4,000 00	$ 4,000 00
Traveling expenses of deputies, $500 each per year	$ 2,000 00	
Expended to date		$ 1,536 35
Balance		463 65
	$ 2,000 00	$ 2,000 00

AMOUNT EXPENDED FOR MAINTENANCE AND IMPROVEMENT OF HATCHERIES FROM NOVEMBER 1, 1901, TO NOVEMBER 1, 1902.

Hatchery.	Maintenance.	Improvement.
Kalama	$ 3,289 96	$ 48 44
Chinook	2,048 23	198 14
Chehalis	2,505 80	112 51
Wenatchee	3,825 80	21 29
Nooksack	2,374 78	67 91
Skokomish	2,285 68	15 36
Willapa	2,208 58	.....
Wind river	1,423 70	4 00
Samish	2,083 92	47 50
Snohomish	2,692 86	75 53
Little Spokane	314 50	.....
White river	1,668 77	28 45
Methow	1,461 95	3 05
Nisqually	1,592 85	.....
Klickitat	12 50	.....
Stillaguamish	2,076 11	317 24
Colville	677 90	34 48
Dungeness	1,679 64	129 05
Miscellaneous expenses	2,740 04	.....
Totals	$36,963 57	$ 1,102 95
Total expenditure for maintenance		$36,963 57
Total expenditure for improvements		1,102 95
Total expenditure for maintenance and improvements for the year		$38,066 52

TABULATED STATEMENT OF OUTPUT OF WASHINGTON STATE FISH HATCHERIES—FRY AND SPAWN ON HAND—SEASON OF 1902.

PUGET SOUND DISTRICT.

Hatchery.		
Nooksack	9,345,300	
Skokomish	7,763,480	
Samish	3,842,300	
Snohomish	7,823,400	
White river	4,105,000	
Nisqually	5,883,425	
Stillaguamish	2,011,000	
Dungeness	4,254,380	—45,028,285

COLUMBIA RIVER DISTRICT.

Kalama	7,500,000	
Kalama (Eyeing Station)	7,500,000	
Chinook	3,015,000	
Wenatchee	7,934,560	
Wind River	3,480,000	
Methow	2,969,350	
Colville (Not operated)	.....	
Little Spokane (Not operated)	.....	
Klickitat (Not operated)	.....	—29,431,210

WILLAPA HARBOR DISTRICT.

Willapa	4,958,910	— 4,958,910

GRAYS HARBOR DISTRICT.

Chehalis	5,100,000	— 5,100,000
Total		84,518,405

Probable output of Oregon hatcheries on Columbia river.....26,356,150

Probable output of government hatcheries on Columbia river.....23,311,860

ACKNOWLEDGEMENT.

Figures 1, 2, 3 and 4 are copied from Bulletin of the United States Fish Commission for 1896.