

(1892)

UNITED STATES COMMISSION OF FISH AND FISHERIES.

PART XVIII.

REPORT

OF

THE COMMISSIONER

FOR

THE YEAR ENDING JUNE 30, 1892.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1894.

Of the take of eggs, 2,852,250 were sent to the Sisson hatchery of the California Fish Commission; 50,000 to the Mexican Government at the City of Mexico; 25,500 were hatched and the fry liberated at the station; and 448,250, or about 13.25 per cent, were lost in developing.

FORT GASTON STATION, CALIFORNIA (CAPT. F. H. EDMUNDS, U. S. A., IN CHARGE).

The conduct of this station and its auxiliary at Redwood has continued under the direction of Capt. Frank H. Edmunds, U. S. Army.

In July the ponds for young salmon and breeding trout were completed and the extension of the hatchery building so as to contain 40 troughs was begun, being completed by October. Arrangements were made in August for the construction of a small hatchery, 14 feet square, with a capacity of 8 troughs, at Redwood, which was completed in October. In November a water-supply tank was built for the Redwood hatchery.

The first salmon eggs collected at the Redwood hatchery were taken December 3, and their gathering was continued to March 10, the total yield being 300,000, of which 150,000 were transferred to the Fort Gaston Station and 150,000 retained for hatching at Redwood. Of those taken to Fort Gaston 2,000 died during transfer. The remainder began to hatch February 9, and were all hatched by March 10. The loss in fry was about 400. On May 30 and 31, 147,600 young salmon were turned into Supply Creek, a branch of the Trinity River, and distant from the station about a quarter of a mile. The eggs retained at the Redwood hatchery commenced hatching March 12. These eggs were taken February 2, and the period of their incubation was much shorter than heretofore, the usual time being sixty to ninety days. The unusually mild weather prevailing during the winter was undoubtedly the cause. The hatching was completed by April 30, producing 142,500 fry, which were released through a sluice, on May 1, into Minor Creek, a tributary of Redwood Creek. During August 25,000 young salmon reared at the station were turned into Supply Creek.

The rainbow trout taken during the previous season, and held in the station ponds for breeders, were spawned February 24 to 27, yielding about 9,000 eggs, and a further gathering of 12,000 eggs was made between March 1 and 19, making a total collection of 21,000. Hatching commenced April 10, and was completed May 29, producing 18,450 fry.

On January 30, 1892, 20,000 eggs of the eastern brook trout purchased of Mr. J. Annin, jr., of Caledonia, N. Y., were received at the station. On unpacking, the number of dead eggs was 225, and the subsequent loss was 9,393. The remainder began hatching February 5, and nearly 80 per cent were hatched by the close of the month. The loss in fry was a little over 500, mainly occurring during April.

The 25,000 eggs of the Von Behr trout shipped from the Northville Station January 22 were received February 2 in excellent condition, on unpacking but 10 eggs being found dead. The subsequent loss in eggs was 113. Hatching commenced February 18 and was finished Febru-

ary 26, the number of fry produced being 24,877. At the close of the year there were at the station—

Rainbow trout (breeders)	300
Rainbow trout (fry)	18,450
Von Behr trout (fry)	24,856
Brook trout (fry)	9,854

On July 1 the reservation was turned over to the Interior Department for Indian school purposes, in accordance with the act of July 31, 1892, and Capt. Edmunds and his command transferred to Benicia Barracks, Cal. In this connection the Commissioner takes pleasure in acknowledging the hearty and efficient aid extended by Capt. Edmunds in the conduct of the Commission's work at Fort Gaston and Redwood.

CLACKAMAS STATION, OREGON (WALDO F. HUBBARD, SUPERINTENDENT).

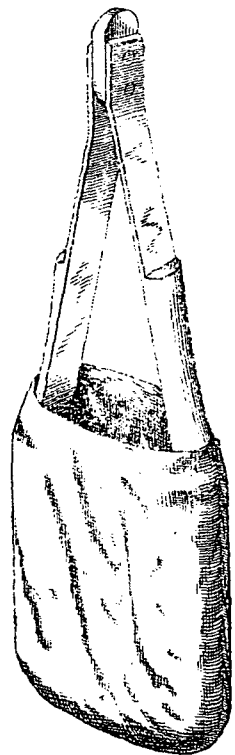
The work of this station consists in the propagation of the quinnat salmon. On August 25, 1891, the work of clearing the fishing-grounds and building the traps was begun. Some distance below the rack, which was built at the end of the previous year, were two channels, in each of which a trap was placed. Between the rack and the traps all the large rocks were removed from the river, which left a bed of fine gravel where the salmon came to spawn and thence were driven into the traps. A second fishing-place, further down the river, was made. Here the fish were caught by a net and put in pens, where they were kept till stripped of their spawn.

On September 8 the first eggs were taken from four salmon caught in one of the traps. It soon became evident, however, that but few fish could be caught at the station, owing to the existence, about five miles below, of a dam across the river which in low water prevented the ascent of the salmon. As a good many fish were seen below this dam a temporary collecting-station was there established September 21. A large tent, to serve as a hatchery, was placed on a small island below the dam, from which, by means of a flume, water was led into the hatching troughs. Two spawn-takers were left at this station, the parent fish being purchased from the fishermen in the vicinity.

Eggs were obtained daily during October, the total amount gathered being 1,185,000. The number of eggs taken at the regular station during the season, from September 8 to October 31, was 851,500. The total take of eggs was 2,036,500. The number of salmon spawned at the station was 198, and at the tent 247. The average number of eggs to the full-roed fish was about 5,000. Eye-spots began showing in the eggs taken at the temporary hatchery about October 24, when 90,000 eggs packed in boxes, on cotton-flannel trays, were transferred to the station without loss.

increased the more simple the appliances of the laboratory. Hence, during a short stay at the seashore for the purpose of study of these forms, where the equipment of a hastily constructed laboratory is necessarily meager, great inconvenience is experienced.

In order to obviate this difficulty I have used a method which I found both simple and satisfactory. Small bags having the shape represented in the accompanying figure are made of bolting cloth, a fine mesh being used so that the desired organisms can not pass through. The organisms having been removed by means of an ordinary glass tube from the glass dish in which the surface nets were emptied, are now transferred to the bag just described. During this manipulation the little bag is kept open by means of a pair of forceps in the manner indicated, after which the bag is securely closed by tying a string around its mouth. Several bags filled in this way are then placed in an Erlenmeyer flask or, in the absence of this, into a common wide-mouth bottle.



A suitable weight, preferably a glass rod, having been placed on the bags to prevent them from floating, the solution of chromic acid is now poured over them and permitted to remain in contact for twenty-four hours. The bags are then removed, and having been attached to a long piece of cord, with an interval of 2 or 3 inches between every two bags, the whole is tied to any convenient object and washed in a stream of water until free from the chromic acid. This usually takes about two hours. The bags are now removed from the water and immersed in the staining fluid for a sufficient time. The excess of stain is washed away in water, and if overstaining has occurred the organisms can be decolorized while still inclosed in the bags by adding a trace of HCl to the water. The bags are now cut open, the stained organisms transferred to a watch glass and mounted. Should they still be overstained they can be further decolorized in the manner stated.

Report to
Comm. 1892

5.—ESTABLISHMENT OF STATIONS FOR THE PROPAGATION OF SALMON ON THE PACIFIC COAST.

By J. J. BRICE, *Commander, United States Navy.*

WASHINGTON, D. C., *November 15, 1892.*

SIR: I have the honor to submit herewith a report of investigations and operations on the Pacific Coast in reference to the establishment of stations for the propagation of salmon.

The salmon, which formerly inhabited the Pacific Coast waters in countless millions, extending from Alaska to Monterey, are becoming each year more reduced in numbers in the yearly run, and the question resolves itself into one of almost final extinction or prompt and active measures for their protection and propagation. The importance of speedily furnishing a supply equal to the demand by artificial means is emphasized in the value of the fish industry on that coast, amounting to something like \$7,000,000 yearly.

The seal fisheries are a national question and the most prominent subject before the people, verging on war, yet their actual commercial value is not so great as the fish industry on the Pacific, which is gradually slipping away from us through depletion by indifference and improvident destruction. The ruin has continued without interruption until some of the streams, formerly alive with fish, are now nearly exhausted and becoming as destitute of salmon as the Hudson and the other eastern rivers which were, in early times, abundantly stocked with many species of *Salmonidae*. This destruction took place before artificial propagation was practiced, an excuse for that day and time; but it also serves as a warning in the present, with our knowledge of artificial means, to protect and guard the Pacific Coast streams from the same misfortune.

To formulate a plan to restore the salmon in their original numbers to the various streams on that coast and offset the yearly catch by artificial propagation has been my duty.

The urgent necessity for speedy action is manifest in the fact that there are many obstacles in the way of the rehabilitation of a river once depleted of its fish, aside from the great increase in the labor and the expense of transporting young fry from remote localities. It was therefore recommended to the United States Fish Commission to establish hatcheries on military or other Government reservations, and

similar desirable localities for the production of the different species of salmon, so arranged as to benefit all the streams on the Pacific Coast.

As an experimental effort and the commencement of the system, a hatchery was established at Fort Gaston, Humboldt County, Cal. This is the central hatchery, and has auxiliary or subhatcheries on the neighboring streams which empty directly into the ocean. These auxiliary hatcheries are used for taking the spawn and depositing the young fry on or near the spawning-grounds, and are kept open only during the spawning and hatching season, which would be about four months of the year. Besides the auxiliary station at Redwood River, it is proposed to connect with the Gaston Station two others on the Mad and Eel rivers. There are other streams near by which could be utilized in the same way, all emptying into the sea. In addition to stocking the waters of the Pacific with salmon and other indigenous fish, the central hatchery at Gaston is provided with ponds used for hatching and propagating eastern and foreign fish, such as landlocked salmon, eastern and German trout. Breeding ponds are in use, filled with the two last-mentioned fish, from which many will be distributed in the streams and waters throughout the country.

Other localities have been examined and suitable places inspected for hatcheries, those on the Colville Reservation near the head of the Columbia River and another at Lake Cœur d'Alene being particularly favorable. Military or Government reservations were selected for several reasons, prominent among them being the assured protection of the young fish. For convenience it is also desirable that the hatcheries should be located near the heads of the streams in the vicinity of the spawning-grounds, where fish are more likely to be found ripe and ready for stripping of their eggs. While the system need not be confined to Government reservations, such localities are preferable where facilities for the work meet with the requirements.

The streams should be stocked from the several varieties found on the Pacific Coast, preferably the indigenous or the kind of salmon which visit the particular stream. Great danger attends the introduction in any stream of fish not belonging to the waters. A stronger and more rapacious strange fish is sure to destroy the weaker native occupants of the stream, and give in return for the destruction probably an inferior and less prolific salmon.

The waters in Humboldt County, Cal., are also free from vagrant and predatory fish; consequently the young can be placed in the stream at an early age without molestation except from the trout which inhabit all these waters. The yearling trout is the voracious enemy of the young salmon, and being small himself is capable of pursuing the little fish into shoal water, their haven of refuge from danger. The destruction of salmon fry by these active young trout is very great. Therefore it is not policy to stock the same stream with both salmon and trout. Since there is no comparison in their commercial value

there should be no question as to which should receive the attention and protection of the Fish Commission. The Fort Gaston station is on the Trinity River, a tributary to the Klamath. The fish appear here early in the winter months and again in the spring to spawn.

When the salmon enters the river and commences his long journey to the spawning-grounds it is truly the effort of his life, resulting in many cases in death from accident or exhaustion. During this time he eats nothing, a wise provision of nature, otherwise the spawn, which is the most attractive food for fish, would be consumed by the multitudes which throng the streams during the spawning season. The salmon enter the river in good condition, well fortified with fat, upon which they maintain their strength, combined with the constant supply of nutriment from the destruction of the oil-bearing tissues which envelop the ovary and the outside membrane covering, the latter holding the eggs and oily essence surrounding them. Disintegration of the ovary adjuncts and spermatie parts begins shortly after the fish enter the river, in both male and female, but the supply is not so great in the former, because the burden and exertion are less.

The conjunction of natural causes in assisting the salmon in all his movements and in the manner of depositing the eggs is as interesting as it is beautiful. In the operation of spawning, from my own observation, the salmon on arriving at the place selected remains quiet until recovered from the effects of the long journey from the sea, and for this purpose they select a pool where there is protection and concealment, under driftwood or an overhanging bank. In pairs, male and female, they build their nests generally in the swift water on the ripple above or below the pool, the male guarding it with great jealousy by fighting away all intruders. The pool serves as a place of concealment during the day; the spawning and nest-making takes place at night or early in the morning, continuing during the daytime if it is overcast and dark. The act of spawning by the female may go on at intervals for a week before all the eggs are deposited.

The construction of the nest is commenced by digging an elongated hole, extending up and down the stream, and located in the swift water above or below the pool, the fish using the nose and fins in making the excavation, throwing out the sand and gravel in volumes in their effort. The stones and gravel are carried just below the excavation by the current, forming a nest covering a space sometimes more than 6 feet in diameter, the small particles of sand and dirt being carried far down the stream.

It seems strange that a collection of stones and pebbles should form a fish nest, and it becomes a matter of speculation as to the manner of secreting the eggs under a mass of stones. Yet nature has made it very simple, and secured its results in a matter-of-fact way. The eggs are deposited in the hole by the female and impregnated by the male. During the fertilization, which takes from half an hour to fifty minutes,

the eggs cling together in a mass and to the bottom of the stream; they then commence to separate, and the gentle current sweeping down through the trough-like hole carries the egg out of the excavation, as it becomes detached from the mass, and onto the nest of stones below, where it tumbles from one stone to another, until it drops into one of the crevices, eventually finding its way to the bottom of the pile or nest, and there lies securely hidden away, well protected from predatory fish, until it is finally hatched.

It takes from forty to sixty days for the eggs to hatch, the time depending upon the temperature of the water. After hatching the fish remain in the nest about twenty days, until the umbilical sac is exhausted, having at this time but one instinct—to hide and burrow deeper into the nest. After the substance of the sac is consumed the little fish approaches the surface to snap at passing particles of food, and in so doing is washed away from the nest and finally makes its way to the shoal water near the shore, gradually dropping downstream until the fall freshets come and carry it into the larger streams, and eventually into the ocean.

Salmon make their nests and spawn differently under different circumstances. If prevented from reaching their spawning-ground, by late freshets or other obstacles, they will spawn in the river or deposit their eggs in the muddy bottom of a pool, if there are no gravel beds available. In both instances most of the eggs are lost. By artificial means as much as 95 per cent of the eggs are hatched; and in depositing the young fry it has been the custom at the Fort Gaston station to place them in the streams near the spawning-grounds five or six weeks after hatching. Young salmon fed abundantly in the ponds for four or five months before they are put in the streams acquire different habits, and are inclined to linger in the fresh water the year round, having become too strong to be carried out by the fall and winter freshets against their inclination. The salmon is very much the victim of circumstances, and in his movements is governed more or less by freshets and the temperature of the water. From the latter he is most naturally controlled in seeking more genial surroundings. The early stage of a little salmon's existence is made up of continuous alarms to avoid danger, and the commencement of his life is spent in hiding and darting about until he gains sufficient strength and activity to venture abroad for food, trusting to speed for safety.

The method of taking salmon for spawn at Fort Gaston consists in running a wire fence diagonally across the stream, near the upper end of which is inserted a V-shaped trap made of the same wire stretched over a wooden frame; the pointed end of the trap is placed upstream and the wire fence extends to the shores from each corner of the lower end. In the lower face of the trap is a hole large enough for the salmon to enter, with converging steel rods, 18 inches long, extending inwardly from around the opening; these are pressed apart as the salmon enters and spring

back into place when he is secure inside. The traps are located below the spawning-ground and convenient to the hatchery.

The Fort Gaston station was the experimental attempt in the commencement of a systematic plan to stock yearly the streams on the Pacific with salmon, and in view of the satisfactory results given by this station it is recommended that the system be extended by establishing hatcheries with 4 auxiliary stations each in the following localities: One on the Chilcat River, in Alaska, or in its vicinity; one on Puget Sound; one on the Colville Reservation, Columbia River, and one on Eel River, California. It is also recommended to increase the Gaston station with 3 auxiliary hatcheries, and connect with the McCloud station 4 auxiliary stations.

The following is an estimate of the cost of establishing and maintaining these proposed stations:

Four central hatcheries, buildings, and apparatus, at \$2,000.....	\$8,000
Twenty auxiliary hatcheries, at \$300 each	6,000
Five superintendents, at \$1,200 per year each	6,000
Six laborers, at \$40 per month each for twelve months	2,880
Twenty-four laborers, at \$40 per month each for four months.....	3,840
Yearly miscellaneous expenses of each central hatchery, including its auxiliary stations	1,500
Total miscellaneous expenses yearly of five stations, not including the McCloud hatchery.....	7,500

With this small outlay of public money each important salmon stream on the Pacific Coast could be stocked with young fish artificially hatched far exceeding in numbers the yearly catch or market demand.

As the farmer recognizes the necessity of replenishing his stock every year, in like manner the same prudent forethought is required in regard to the occupants of the streams, and the expenditures for this purpose in the plan suggested are insignificant when compared to the millions of dollars represented in the result.

For the further protection of the fish on that coast, it is suggested that one of the rivers, the Klamath, for instance, and its tributaries, be held by the Government as a fish preserve, prohibiting seining or taking salmon in any way for commercial purposes. A great national nursery would thereby be established, from which not only the Pacific Coast would be benefited, but the whole country. The land extending some distance from the mouth of the Klamath River is, I believe, a Government reservation, requiring no special legislation to close the stream to outside enterprise.

Authorities give the salmon (genus *Oncorhynchus*) on the Pacific Coast as representing five species. The king, quinnat, or chinook salmon has an average weight of 22 pounds; there are 16 rays on the anal fin to distinguish it. The blueback salmon weighs from 5 to 8 pounds and has 14 to 16 rays on its anal fin. The silver salmon, weighing from 3 to 8 pounds, has 13 rays on the anal fin to distinguish it. The dog salmon, with an average weight of 12 pounds, has 14 anal rays. In the fall the

male dog salmon is red and his jaws are much distorted. This is also true of the humpback salmon, which is small, weighing up to 6 pounds and having 15 anal rays.

Among the offshoots of the *Salmonida* is the steelhead, which, from good authority, is the salmon trout, the same species as the rainbow trout in the streams. In point of fact the steelhead and rainbow trout were originally one and the same fish, so far as at present known from their construction, the difference in size being due to their habits and the extensive surroundings of the steelhead. In construction, except its size, the steelhead is a trout, but in habits a salmon. The rainbow trout may become a salmon trout (or steelhead) when its habits are anadromous, which could occur through accident, such as an unusual freshet in which the rainbow trout is washed into the estuaries of the rivers and the sea. The rich food and boundless extent of territory off the mouths of rivers account for his increase in size and strength. This growth is noticed in the salmon as being comparatively insignificant while remaining in fresh water, but rapid upon its first visit to the sea. Fish food is most plentiful in the ocean near the estuaries of the rivers, as the influence of the fresh-water stream is felt many miles at sea, causing an abundant growth of marine vegetation or vast pastures, attracting the smaller fish and crustacea upon which the salmon feed, returning yearly to their native rivers to spawn.

Very respectfully,

J. J. BRICE,
Commander, U. S. Navy.

Hon. MARSHALL McDONALD,
United States Fish Commissioner.

6.—THE ICHTHYOLOGICAL COLLECTIONS OF THE STEAMER ALBATROSS DURING THE YEARS 1890 AND 1891.

By CHARLES H. GILBERT, PH. D.,
Professor of Zoology in Leland Stanford Junior University.

REPORT ON THE FISHES COLLECTED IN BERING SEA AND THE NORTH PACIFIC OCEAN DURING THE SUMMER OF 1890.

During the summer of 1890 the writer accompanied the *Albatross* as chief naturalist during its exploration of Alaskan waters. The plan for the cruise, outlined by the Commissioner, contemplated a thorough examination of the cod banks of Bristol Bay and the area surrounding the Aleutian Islands, followed by an exploration of the deeper waters of the western portion of Bering Sea. It is much to be regretted that unforeseen hindrances prevented the accomplishment of the latter part of this plan. But two hauls of the beam trawl were taken beyond the 1,000-fathom line in Bering Sea, and the interesting results only emphasize the importance of making a thorough exploration of this region.

The narrative and some of the general results of the cruise have been already given by Commander Z. L. Tanner (Report of Commissioner of Fish and Fisheries for 1889-91, pp. 226-256), and the economic phases have been treated sufficiently by the fishery expert, A. B. Alexander (*l. c.*, pp. 280-290). The present paper contains a list of the fishes collected during the cruise, with notes and descriptions of new or little-known forms.

One hundred and forty-three dredging stations were occupied, numbered 3210 to 3352 inclusive, the large beam trawl being usually employed. Of these, stations 3210 to 3227 form a line extending from a point south of the Sannak Islands westward through Unimak Pass to Unalaska; stations 3228 to 3306 were in the shallow waters of Bristol Bay (3½ to 81 fathoms) and were very monotonous; stations 3307 and 3308 were in the depressed basin occupying the western portion of Bering Sea and were of extreme interest; stations 3309 to 3336, also very rich in results, were to the northward of Unalaska Island in depths of 19 to 578 fathoms; stations 3337 to 3342 form a line extending across the North Pacific from Unalaska to Vancouver Island, station 3342, taken off Queen Charlotte Island in 1,588 fathoms, proving much the most interesting haul of the cruise; stations 3343 to 3352 were off the coasts of Washington, Oregon, and northern California.

NOTE.—The writer desires to express here his indebtedness to his colleague, Prof. W. W. Thoburn, who rendered very material assistance in preparing this report.

UNITED STATES COMMISSION OF FISH AND FISHERIES.

PART XVII.

REPORT

OF

THE COMMISSIONER

FOR

1889 to 1891.

[FROM JULY 1, 1889, TO JUNE 30, 1891.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1893.

ber 26, 1889, to produce 1,105,000 eggs. The captures amounted to 1,129 males and 382 females, 252 of the latter being in spawning condition. The small production was the result of the decreased run of adults.

Of the eggs taken, 974,000 were shipped to the hatchery of the California Fish Commission at Sisson, where they were hatched and the fry released in the Sacramento River. Those retained produced 60,000 fry, which were liberated in McCloud River.

On October 7, 1889, stormy weather began and rising waters made imperative the lifting of the obstructing racks, thereby permitting the free passage and escape of the adult salmon into the head streams. Fishing for the late run was resumed October 16, but another rise in the river, five days later, submerged and washed out a portion of the dam and endangered the safety of the power wheel and buildings. Large numbers of salmon again passed on above. Receding water permitted the renewal of the dam November 5, but there were very few brood fish subject to capture remaining in the lower stream. From November 9 to 19, something over 600,000 eggs were secured. These were from a catch of 94 males and 170 females, 119 of the latter having ripe spawn. Freshets continued every month till June, 1890, the height of the water reaching 15 feet in February. On December 2 the wheel boats requiring to be dropped into an eddy for safety, the water supply was obtained by means of the steam pump.

On December 14, 1889, 125,000 eggs were forwarded to New York, for shipment to France and Norway; on December 16, 100,000 to Fort Gaston Station; and on December 17, 355,000 to the California fish commissioners at Sisson. From those retained, 24,000 fry were produced and liberated in McCloud River, 1,000 being held till March, and successfully nourished on corn-meal mush boiled with beef. The total loss on the 1,709,000 eggs taken was 71,000, or about 4 per cent.

The early run of salmon yielded their eggs in water at about 60° F., the temperature descending as low as 50° on one day; the late run spawned in a temperature ranging from 45° to 50°.

1890-91.

In consequence of damages sustained from the high water of the previous spring, it was again necessary to renew the obstructing dam and accessories. Its rebuilding was commenced July 1, 1890, native timbers, cut in May by the station employes, being utilized.

Everything was in readiness August 27, when the schools of spawning salmon arrived. Between this date and September 23, 1890, 912 fish yielded 3,652,000 eggs. Of these, 50,000 were forwarded to E. Cházari, City of Mexico, and 2,838,000 to the California fish commissioners, from September 24 to October 10, further shipments being discontinued on the receipt of a message that their hatchery was filled. The remaining eggs were developed at Baird Station, the production of fry being 582,000.

Seining for the fish of the late run was commenced November 6, 1890. The continued low water of the river, however, permitted uninterrupted fishing by cannery operators on the Sacramento River below, and only a small number escaped their nets to reach the station. The season of collecting terminated November 25, with the obtainment of 64 ripe females, which produced 263,000 eggs. Of these eggs, 100,000 were forwarded December 31, via New York, to France. The remainder were hatched at the station and produced 140,000 fry, which, with the 582,000 fry of the earlier hatching, were liberated in McCloud River and its tributary, the Pit River. The total loss of eggs at the station was 205,000, or about 5 per cent. In releasing the 722,000 fry the seine skiff was used with much advantage, the cans being placed therein and the fry put out in small numbers at various shallows in the river occurring in a distance of about 5 miles.

FORT GASTON STATION, CALIFORNIA (CAPTS. W. E. DOUGHERTY, U. S. ARMY, AND FRANK H. EDMUNDS, U. S. ARMY, IN CHARGE).

In view of the urgent and many requests received from citizens in the regions of the Rocky Mountains and the Pacific coast to stock their waters with suitable food-fishes, and the difficulties and cost attending shipments from the eastern stations of the Commission, the question of locating fish-cultural stations on the military reservations of those regions was considered, and Lieut. Commander J. J. Brice, U. S. Navy, who was employed under detail from the Navy Department, was directed to make a reconnaissance. Upon his report and recommendations the reservation at Fort Gaston, Humboldt County, Cal., was decided upon as offering the necessary requirements; and, in compliance with the request of this office, the Secretary of War, on October 16, 1889, gave instructions permitting the use of a portion of the same by the Fish Commission. The organization of the station was intrusted to Mr. Brice, who arrived at the place the latter part of November with some of the equipment. The use of a building, 32 feet by 16 feet, into which an abundant supply of pure, cold water was led by gravity, was granted by the commandant of the post, Capt. W. E. Dougherty, U. S. Army, who also undertook the general charge of the conduct of the station. Mr. W. H. Morgan, who was serving as fish-culturist at one of the eastern stations of the Commission, was assigned as foreman. Capt. Dougherty remained in charge of the work till October 1, 1890, when he was succeeded by Capt. F. H. Edmunds, U. S. Army, who had been placed in command of the post.

1893

(1889-1891)

UNITED STATES COMMISSION OF FISH AND FISHERIES.

PART XIX.

REPORT

OF

THE COMMISSIONER

FOR

THE YEAR ENDING JUNE 30, 1893.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1895.

Storms were frequent and of severe character. In October 250,000 eggs were destroyed by high water, and in December the McCloud River was swollen to a height of 17½ feet, no mails being received during a period of ten days. The current wheel, supplying the hatchery with water, escaped damage, and at the end of the season was taken to pieces and stored.

In the statement which follows it will be seen that 533,100 young salmon were liberated at the station, these having been placed in the McCloud River in December. Egg transfers to the California commission are shown by dates.

Date.	Run, etc.	Number.
Oct. 9.....	Summer run.....	300,900
Nov. 30.....	Fall run.....	477,000
Dec. 5.....	do.....	513,600
17.....	do.....	541,000
29.....	do.....	248,000
2.....	Fry liberated.....	533,100
	Losses, including 250,000 resulting from storm.....	916,400
	Total.....	3,530,000

Rainbow trout.—In January preparations were made for the collection of rainbow-trout eggs to be forwarded to Japan, and for that purpose 10,000 were secured. These were transferred in five consignments during March and April to Professor Sasaki, agricultural and commerce department, Tokyo, four shipments arriving in satisfactory condition. In January a new seine boat was built for future use in capturing adult salmon. In April a survey was made looking to a gravity supply of water from a neighboring stream, and after its completion the scheme was considered practicable. In June work was commenced on the rack across the McCloud River in preparation for next year's supply of adult fish, no salmon being permitted to ascend after June 30.

A collection of salmon eggs and fry, together with their natural enemies and food, was prepared in alcohol and sent forward, to be included in the exhibit at Chicago. The 7 a. m. air and water temperatures for the year are shown below:

Month.	Air.			Water.		
	Max.	Min.	Mean.	Max.	Min.	Mean.
1892.						
July.....	68	42	57.80	60	52	54.35
August.....	66	40	55.58	56	52	52.61
September.....	64	44	51.6	53	50	51.76
October.....	50	33	42.77	50	43	45.87
November.....	51	25	39.63	43	39	41.76
December.....	58	23	38.25	45	38	42.03
1893.						
January.....	46	25	33.61	45	41	42.70
February.....	45	22	37.32	46	39	42.64
March.....	52	26	40.51	48	43	45.12
April.....	58	32	43	47	41	45.73
May.....	65	40	51.35	51	46	48.74
June.....	66	47	55.06	57	48	52.6

FORT GASTON STATION, CALIFORNIA (LIVINGSTON STONE AND W. E. DOUGHERTY, CAPTAIN U. S. A., IN CHARGE).

This establishment was the first experiment in occupying a Government reservation on the west coast. Privileges granted by the Interior Department were continued, and the outlook for further good results is favorable. The water supply is unlimited and of finest quality. The building occupied combines hatchery and quarters for employees. Five ponds are employed in holding brood fish and as nurseries.

On the abandonment of the reservation for military purposes, July 1, 1892, supervision passed from Capt. Frank H. Edmunds, U. S. A., to Livingston Stone, superintendent of the Baird establishment, McCloud River, Mr. Stone remaining in charge until January, 1893. The Secretary of War was requested in December to permit Capt. William E. Dougherty, U. S. A., to resume supervision, and the request being granted, operations for the remaining half year were under his direction.

Fish brought over from the preceding fiscal year consisted of the following: Rainbow trout (brood fish), 300; rainbow trout (fry), 18,450; Von Behr trout (fry), 24,856; brook trout (fry), 9,854.

In July 15,000 rainbow-trout fry were liberated in local streams. On April 30, there were remaining on hand of Von Behr trout 12,000, and of brook trout 7,000. These were liberated in May, with the exception of 500 of the former and 400 of the latter, retained for brood stock. Those liberated were placed in the Supply, Mill, and Tishtang creeks, the number of Von Behr being 10,950, and the brook trout 6,193.

Quinnat salmon.—In August plans were inaugurated for the capture of adult salmon from the tributaries of Trinity River and from Redwood Creek, a dam and trap being constructed near the mouth of Mill Creek, a tributary of Trinity River, about 4 miles from the station. Traps were also constructed at Redwood and in Supply Creek, the latter being near the station. The limited amount of fishing on Redwood Creek, as a result of the absence of canneries on that stream, rendered it the most profitable source. Another trap in the vicinity, constructed by Indians, also furnished adult fish.

Salmon in this region ascend the streams for laying eggs twice a year, the first run occurring early in winter and the second late in spring. Eggs taken in the fall run amounted, by December 31, to 180,000, producing 117,000 fry for liberation in local waters February 23. Captures of adult fish were made to a limited extent in January and February, small numbers of eggs being taken.

In March and April 375,000 eggs were transferred from the auxiliary hatchery at Redwood to the station. Other consignments followed, which, together with those from traps on tributaries of Trinity River, furnished 540,000 fry for liberation in local streams in May and June.

Lieut. Commander J. J. Brice, U. S. N., in a report regarding the establishment of additional stations at Government reservations on

1895
(1893)

the west coast, makes the following reference to the spawning habits of salmon:

The conjunction of natural causes assisting salmon in all movements and in depositing eggs is as interesting as beautiful. In the operation of spawning, from my own observation, the salmon, on arriving at the place selected, remain quiet until recovered from the effects of the long journey from the sea, and for this purpose they select a pool where there is protection or concealment, under driftwood or overhanging bank. In pairs, male and female, they build nests, generally in the swift water on the ripple above or below the pool, the male guarding it with great jealousy, fighting away all intruders. The pool serves as a place of concealment during the day, the salmon spawning and making the nest at night or early in the morning, continuing during the day if the sky is overcast. The act of spawning may go on at intervals for a week before all the eggs are deposited. The construction of the nest is commenced by digging an elongated hole up and down stream, the fish using the snout and fins in making the excavation, throwing out sand and gravel in volumes. The stones and gravel are carried by the current below the excavation, forming a nest covering a space sometimes more than 6 feet in diameter, the small particles of sand and dirt being carried farther downstream. It seems strange that a collection of stone and pebbles should form a fish nest, yet nature has made it very simple, and secured results in a matter-of-fact way. The eggs are deposited in the hole by the female and impregnated by the male, the eggs clinging together in a mass and to the bottom, thirty to fifty minutes, at the end of which time they commence to separate. The gentle current sweeping through the trough-like hole carries each egg out of the excavation as it becomes detached from the mass and on to the nest of stones below, where it tumbles from one to another until it drops into one of the crevices, eventually finding its way to the bottom of the pile or nest, and there, lying securely hidden away, well protected from predatory fish, it finally hatches. It takes from forty to sixty days for the eggs to hatch, the time depending upon the temperature of water. After hatching the fish remain in the nest about twenty days, until the umbilical sac is exhausted, having during this time but one instinct, to hide and burrow deeper in the nest.

Steelhead salmon.—At the first haul of the seine in October a steelhead was caught, and subsequently 16 more were obtained from the Indian dam in the vicinity. These were placed in a small pond and held for the purpose of obtaining their eggs, but none was secured.

Rainbow trout.—In addition to the brood fish already on hand, 14 large specimens were obtained in October from a pond at the Indian agency. The eggs from these in March and April were sufficient to produce 100,000 fry, 20,000 of which were liberated in local waters in May, the remainder being carried over into the next fiscal year.

The mean temperature of the air in March was 43° F. and of the water 44°, in April 44.5° and 44.1°. The snow-fall was so great that on April 22 the snow was over 5 feet deep, hard packed, on the road where it crosses the mountains. The fishes remaining on hand at end of the fiscal year, June 30, 1893, are stated below:

Kind.	1893.	1892.	Brood fish.
Brook trout.....		400	
Von Behr trout.....		500	
Rainbow trout.....	80,000		250
Steelheads.....			20

CLACKAMAS STATION, OREGON (WALDO F. HUBBARD, SUPERINTENDENT).

Quinnat salmon eggs were obtained from the Clackamas and Sandy rivers, the latter stream being a new field. Alcoholic collections of eggs and fry were made and transmitted for the World's Fair.

At the opening of the fiscal year the building of a rack across the Clackamas for arresting the ascent of spawning salmon was well under way, the structure being completed July 7. The former barrier used consisted of two racks built on either side of an island, but this season the stream was closed on one side, the trap being located opposite. In the latter part of June and throughout July a growth of green moss, never before observed, was found on the bottom of the river, large quantities floating down during a period of five or six weeks, banking against the rack. Its removal required a great deal of labor. During the late summer boats were repaired and minor improvements made. In September the trap which formed a part of the rack was put in position, suitable inclosures built for holding the parent fish, and egg-collecting and hatching apparatus overhauled.

No salmon having appeared late in August, and it having been learned that they could not pass the sawmill dam at Gladstone, a tour was made to this point in company with Governor Pennoyer, the executive of the State of Oregon, the examination proving that there were no means of ascent. A fishway on this dam, owing to poor construction, was wholly ineffective. In compliance with Governor Pennoyer's request, the superintendent of the mill promised to erect a better fishway, but his promise was not fulfilled, and no fish would have passed the dam but for freshets, two of which occurred in October.

The first eggs from the Clackamas trap were taken September 20, collections being made each day thereafter until November 11, the number obtained amounting to 3,265,000. The greatest number taken in a single day was 132,000 on October 21; the smallest, 4,000 on November 11. Adult fish yielding eggs numbered 623. Male fish predominated, the exact number not being recorded. About 80 per cent of the eggs were obtained in October; 248,000 in September, 2,590,000 in October, and 427,000 in November.

Early in September two trips were made to the Sandy River, distant about 15 miles, a suitable location for a field station being found, both for an obstructing rack and water supply for developing eggs. Preparations were made for receiving and holding eggs, hatching-troughs being transported overland from the station. Water was obtained from a spring brook by means of a small dam and a wooden flume 150 feet long. Across the river a rack 175 feet long, with a trap below, was constructed. Employees were quartered in tents, all preparations being completed by September 20. The taking of eggs was commenced October 6, continuing thirty days, collections amounting to 1,179,000 from 253 fish. As soon as the eggs had developed sufficiently for eye-spots to be distinctly seen they were transferred to the station by wagon, in four loads, between November 17 and December 3, the losses sustained inci-