New England Salmon Hatcheries and Salmon Fisheries in the Late 19th Century eBook

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BOOKRAGS

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ARTICLE I

Some results of the artificial propagation of Maine and California salmon in new England and Canada, *recorded in the years* 1879 *and* 1880

Compiled By The United States Fish Commissioner

Bulletin of the United States Fish Commission, Vol. 1, Page 270, 1881.

New Bedford, Mass May 20, 1879.

Prof. S. F. *Baird*:

Sir: I have just been in the fish market and a crew were bringing in their fish from one of the "traps." A noticeable and peculiar feature of the fishery this year is the great numbers of young salmon caught, especially at the Vineyard, although some few are caught daily at Sconticut Neck (mouth of our river). There are apparently two different ages of them. Mostly about 2 pounds in weight (about as long as a large mackerel) and about one-half as many weighing from 6 to 8 pounds; occasionally one larger. One last week weighed 33 pounds and one 18 pounds. The fishermen think they are the young of those with which some of our rivers have been stocked, as nothing of the kind has occurred in past years at all like this.

John H. *Thomson*.

* * * * * *

Bulletin of the United States Fish Commission, Vol. 1, Page 271, 1881

New Bedford, Mass. June 1, 1879.

Prof *Spencer* F. *Baird*:

Sir: I received yours. I have examined carefully since your letter, but no salmon have been taken. The run was about the two first weeks in May and a few the last of April. Mr. Bassett had about 30 to 35 from the trap at Menimpsha, and 10 or 12 from Sconticut Neck, the mouth of our river. Mr. Bartlett, at his fish market, had about one dozen; 12 from the traps near the mouth of Slocum's River, six miles west of here, and I have heard of two taken at mouth of Westport River.

As to the particular species, I do not get any reliable information, as so few of our fishermen know anything about salmon, and in fact the men from the traps on Sconticut Neck did not know what the fish were.

John H. *Thomson*.

* * * * * *

Fishing items. “A ten-pound salmon and seventeen tautog, weighing over one hundred pounds, were taken from the weirs of Magnolia, Thursday night. This is the first salmon caught off Cape Ann for over thirty years. On Saturday morning three more large salmon were taken and 150 large mackerel. The fishermen are highly elated at the prospect of salmon catching.” (Cape Ann Advertiser, June 6, 1879.)

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[Postscript to a letter from Monroe A. Green, New York State Fishery Commission, to Fred Mather, June 9, 1879.]

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“P. S.—Kennebec salmon caught to-day in the Hudson River at Bath near Albany weighing twelve and a half pounds, sold for 40 cents per pound. The first that have been caught for years.”

* * * * * *

State of Maine, *department of fisheries*,
Bangor, August 25, 1879. [Extracts.]

Dear professor: We have had a great run of salmon this year, and consisting largely of fish planted by us in the Penobscot four or five years ago, so far as we could judge; there were a very large number, running from 9 to 12 pounds. The east and west branches of the Penobscot report a great many fish in the river. On the Mattawamkeag where we put in 250,000 and upwards, in 1875 and 1876, a great many salmon are reported trying to get over the lower dam at Gordon’s Falls, 13 feet high. These fish were put in at Bancroft, Eaton and Kingman, on the European and North American Railroad. The dam at Kingham is 13 feet; at Slewgundy, 14 feet; at Gordon’s Falls, 13 feet and yet a salmon has been hooked on a trout fly at Bancroft and salmon are seen in the river at Kingman, and between the dams at Slewgundy and Gordon’s Falls. The dealers in our city have retailed this season 50 tons Penobscot salmon, and about 3 tons Saint John salmon; it all sells as Penobscot salmon. Saint John salmon costs here, duty and all included, about 14 cents per pound. Our first salmon sells at $1 per pound, and so on down to 12 1/2 cents the last of the season.’

Salmon at Bucksport has sold to dealers here at 8 cents. Two tons taken at Bucksport and Orland in 24 hours. Average price at retail here for whole season, 25 cents.

Truly, yours,

E. M. Stillwell.

* * * * * *

State of Maine, *department of fisheries*,
Bangor, October 4, 1879.

Dear professor: My delay in replying to your kind letter has been from no want of courtesy, but a desire to send you the required “data” you asked. Neither myself nor Mr. Atkins have been able to procure them. The weir fishermen keep no records at all, and it is difficult to obtain from them anything reliable; while the fishermen above tidewater are a bad set of confirmed poachers, whose only occupation is hunting and fishing both in and out of season. They are always jealous and loth to let us know how good a thing they make of it, for fear of us and fear of competition from their own class.

Four or five years since I put in some 300,000 salmon fry into the Mattawamkeag at Bancroft, Eaton, Kingsmore, and at Mattawamkeag village. There are three dams between Mattawamkeag and Bancroft—none less than 12 feet high. About six weeks since Mr. Nathaniel Sweat, a railroad conductor on the European and North American Railroad, while fishing for trout from a pier above the railroad bridge at Bancroft, hooked a large salmon and lost his line and flies. Salmon in great numbers have been continually jumping below the first dam, which is called “Gordon’s Falls.”

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My colleague, Everett Smith, of Portland, a civil engineer, while making a survey for a fishway, counted 15 salmon jumping in 30 minutes. A Mr. Bailey, who is foreman of the repair shop at Mattawamkeag walked up to the falls some three weeks since entirely out of curiosity excited by the rumors of the sight, and counted 60 salmon jumping in about an hour, within half or three-quarters of a mile of the falls. This is on the Mattawamkeag, which is a great tributary of the Penobscot.

On the east branch of the Penobscot there has been a great run of salmon. An explorer on the Wassattaquoik reported the pools literally black with salmon. A party of poachers, hearing the rumor, went in from the town of Hodgon and killed 25. I inclose you a letter to me from Mr. Prentiss, one of our most wealthy and prominent merchants, which speaks for itself: I will be obliged to you if you will return this, as I shall have occasion to use it in my report.

On the West branch of the Penobscot I hear reports of large numbers of salmon, but the breaking of the two great dams at Chesancook and the North Twin Dam, which holds back the great magazine of water of the great tributary lakes which feed the Penobscot, which is used to drive the logs cut in the winter, through the summer's drought, has let up all the fish which hitherto were held back until the opening of the gates to let the logs through. These fish would not, of course, be seen, as they would silently make their way up.

I regret that I have nothing of more value to give you. Hoping that this small contribution may at least cheer you as it has me,

I remain, truly, yours,

E. M. *Stilwell*, Commissioner of Fisheries for State of Maine.

* * * * * *

Prof. *Spencer* F. *Baird*,
United States Commissioner Fish and Fisheries.
Bangor, October 3, 1879.

M. *Stilwell*, Esq.,

Dear sir: Prof. C. E. Hamlin of Harvard, and I made a trip to Mount Katahdin last month for scientific examination and survey of the mountain. I had been salmon fishing in July on the Grand Bonaventure, on Bay of Chaleur, and I could not see why we could not catch salmon on the east branch of the Penobscot at the Hunt place where we crossed it on our way in to Katahdin. I thought the pool from mouth of Wassatiquoik to the Hunt place, about a half-mile, must be an excellent salmon pool, and my guide and the people there confirmed this opinion. They said over a hundred salmon had been taken

in that one pool this season. The nearest settlement, and only one on the whole east branch, is about six miles out from there, and the young men go on Sundays and fish with drift-nets. No regular fishing for market—only a backwoods local supply can be used. These fish were about of one size—say 8 to 11 pounds.

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There were never enough fish here before to make it worth while for them to drift for them. A few years ago no salmon were caught there at all. Twenty-two years ago, before our fish laws were enacted, the farmer at the Hunt place used to have a net that went entirely across the river clear to the bottom, which he kept all the time stretched across, and he only used to get two or three salmon a week. I was there August, 1857, with Mr. Joseph Carr, an old salmon fisher, and we fished for ten days and could not get a rise. The net had been taken up, because the farmer did not get fish enough to pay for looking after it.

But the stocking the river makes it good fishing and I intend to try the east branch next season with the fly.

Very truly,

Henry M. *Prentiss*.

* * * * * *

October 13, 1879
East Windsor Hill, Conn.

Professor *Baird*:

Dear sir: It may be of interest to you to know that your salmon are not all lost. Last Friday, 10th, I was with a party of three fishing in Snipsic Lake, and one of our party caught a salmon that weighed 1 3/4 pounds. This is the second one taken since the pond was stocked as I was told. The other was caught this summer and weighed 12 ounces.

Cannot something be done to save our fish in Connecticut River? There is an establishment at Holyoke, Mass., and another at Windsor Locks, Conn., that are manufacturing logs into paper, and I am told that the chemicals used for that purpose are let off into the river twice a day, and that the fish for half a mile come up as though they had been cockled.

Both of these factories are at the foot of falls where the fish collect and stop in great numbers and are all killed. Our shores and sand-bars are literally lined with dead fish. Three salmon have been found among them within two miles of my office. They were judged to weigh 12, 20 and 25 pounds. The dead fish are so numerous that eagles are here after them. I have received nine that have been shot here in the past two seasons.

I have written you in order that the fish commissioners might stop this nuisance and save the fish that they have taken so much pains to propagate.

Truly yours,

Wm Hood, East Windsor Hill, Conn., October 13, 1879

* * * * * *

Saint Stephen, March 1, 1880.

Prof. *Spencer* F. *Baird*
U. S. Commissioner Fish and Fisheries:

Dear Sir: I send you remarks in relation to the Restigouche and Saint Croix Rivers, which, though crude, I am sure are quite correct, as they are either taken from the official statistics, or are facts of which I am myself cognizant. You may, if of use, publish any part of them.

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I very much wish we could procure some young shad for the Saint Croix; this fish was once very abundant, and perhaps would be again if introduced. I know you have been very successful in restocking the Connecticut. Our old people deplore the loss of the shad—say it was a much better food-fish than the salmon. I do a great deal of shooting, and am much interested in ornithology, and specimens of our birds that you might want I should be happy to lookout for; do a good deal of coast shooting winters; have been hopefully looking for a Labrador duck for a number of seasons—fear they have totally disappeared.

I have nice spring-water conducted to my house and think of doing a little fish-hatching in a small way. The amount of water I can spare is a stream of about half inch diameter; the force will be considerable, as the water rises to top of my house, some 50 feet above where I should set trays. I write to you to ask what hatching apparatus would be best to get, where to buy, and probable cost. I am trying to get some sea-trout ova to hatch in it. I presume all your California ova have been disposed of ere this.

Frank Todd.

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Saint Stephen, March 1, 1880.

Prof *Spencer* F. *Baird*, U. S. Commissioner Fish and Fisheries:

Sir: In regard to the Saint Croix, would say, that it was once one of the most prolific salmon rivers in New Brunswick, but owing to the erection of impassable dams, fifteen or twenty years ago, this valuable fish had almost entirely disappeared. At about this time fishways were placed in all the dams, and gradually salmon began to increase, but the first great stimulus was given some ten years ago by the distribution of some hundreds of thousands of young salmon in the headwaters, by the fishery commissioners of Maine.

The Dobsis Club also placed in the Saint Croix some 200,000 or more from their hatchery, a portion being the California salmon. With these exceptions our river has had no artificial aid, but for the last five years the number of salmon has largely increased, due mainly, no doubt, to the deposits before mentioned.

The fish ways are generally in good condition (although some improvements will be made), and fish have easy access to headwaters, That large numbers go up and spawn is evidenced by the large numbers of smolt seen at the head of tidal water in the spring, many being taken by boys with the rod. I have reason to expect that our government will hereafter distribute annually in the Saint Croix a goodly number of young salmon which, together with the contributions of the Maine commissioners will soon make this fish again abundant. Alewives are very abundant and apparently increasing every year.

Shad that were once plenty have entirely disappeared. I very much wish that the river could be stocked with this valuable fish; possibly you could kindly assist us in this.

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Landlocked salmon (here so called) are, I think, nearly or quite as plenty at Grand Lake Stream as they were ten years ago; this, I think, is almost entirely due to the hatchery under the charge of Mr. Atkins; the tannery at the head of the stream having entirely destroyed their natural spawning beds, the deposit of hair and other refuse being in some places inches deep. The twenty-five per cent. of all fish hatched, which are honestly returned to our river, is, I think, each year more than we would get by the natural process, under present circumstances, in ten years.

Frank Todd.

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SAINT STEPHEN, N. B., DOMINION OF CANADA.

Prof. *Spencer* F. *Baird*, U. S. Commissioner Fish and Fisheries:

Sir: I think it has been clearly demonstrated in this Dominion that by artificial propagation and a fair amount of protection, all natural salmon rivers may be kept thoroughly stocked with this fish, and rivers that have been depleted, through any cause, brought back to their former excellence.

I would instance the river Restigouche in support of the above statement.

This river, which empties into the Bay of Chaleur, is now, and always has been, the foremost salmon river in New Brunswick, both as to size and number of fish. It has not a dam or obstruction to the free passage of fish from its mouth to its source, yet up to 1868 and 1869 the numbers of salmon had constantly decreased. This, no doubt, was occasioned by excessive netting at the mouth, and spearing the fish during the summer in the pools; natural production was not able to keep up with this waste.

In the year 1868 the number of salmon was so small that the total catch by anglers was only 20 salmon, and the commercial yield only 37,000 pounds. At about this date, the first salmon hatchery of the Dominion was built upon this river and a better system of protection inaugurated; every year since some hundreds of thousands of young salmon have been hatched and placed in these waters, and the result has been, that in 1878 one angler alone (out of hundreds that were fishing the river) in sixteen days killed by his own rod eighty salmon, seventy-five of which averaged over twenty-six pounds each; while at the same time the numbers that were being taken by the net fishermen below, for commercial purposes, were beyond precedent, amounting in that one division alone (not counting local and home consumption) to the enormous weight of 500,000 pounds, and the cash receipts for salmon in Restigouche County that year amounted to more than $40,000, besides which some $5,000 was expended by anglers; this result was almost entirely brought about by artificial propagation. A new hatchery of size

sufficient to produce five million young fish annually will no doubt soon be erected by the Dominion Government upon this river.

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A somewhat similar record might be given of the river Saguenay. Some years ago anglers and net fishers of this river said it was useless to lease from the department, as the scarcity of salmon was such as not to warrant the outlay. A hatchery was built, and this state of things is now wonderfully changed; so much so, indeed, that in 1878 salmon, from the great numbers which were taken at the tidal fisheries, became a drug in the market, selling often as low as three cents per pound, and angling in the tributaries was most excellent.

Some one hundred million young salmon have been artificially hatched and distributed in the waters of the Dominion during the last few years, and new government hatcheries are constantly being erected.

Yours, &c.,

Frank Todd, Fishery Overseer, Saint Croix District.

ARTICLE II

SKETCH OF THE PENOBSCOT SALMON-BREEDING ESTABLISHMENT

by

Charles G. Atkins

Written by request of Prof. S. F. Baird, for the London Exhibition, 1883

Bulletin of the United States Fish Commission, Vol. 3, Page 373, 1883

The rivers of the United States tributary to the Atlantic, north of the Hudson, were, in their natural state, the resorts of the migratory salmon, *Salmo salar*, and most of them continued to support important fisheries for this species down to recent times. The occupation of the country by Europeans introduced a new set of antagonistic forces which began even in the seventeenth and eighteenth centuries to operate against the natural increase and maintenance of the salmon and other migratory fishes.

In many localities the closing of smaller streams by dams, and the pursuit of the fish with nets and other implements, had already begun to tell on their number; but it was not until the present century that the industrial activities of the country began to seize upon the water power of the larger rivers and to interrupt in them by lofty dams the ascent of salmon to their principal spawning grounds. These forces were rapid in their operations, aided as they were by a greatly augmented demand for food from a rapidly increasing population.

In 1865 the salmon fisheries were extinct in all but five or six of the thirty rivers known to have been originally inhabited by them. In many of these rivers the last salmon had been taken, and in others the occurrence of individual specimens was extremely rare. Among the exhausted rivers may be mentioned the Connecticut, 380 miles long; the Merrimack,180 miles long; the Saco,120 miles long; the Androscoggin, 220 miles long; and some twenty smaller rivers. There still survived salmon fisheries in the following rivers, namely, the Penobscot, the Kennebec, the Denny's, the East Machias, the Saint Croix, and the Aroostook, a tributary of the Saint John. The most productive of these was the Penobscot, yielding 5,000 to 10,000 salmon yearly. The Kennebec occasionally yielded 1,200 in a year, but generally much less. The other rivers were still less productive.

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The movement for the re-establishment of these fisheries originated in action of the legislature of New Hampshire, seconded by that of the neighboring state of Massachusetts, having in view primarily the fisheries of the Merrimack and Connecticut Rivers. The course of the Merrimack lies wholly within the states of New Hampshire and Massachusetts; that of the Connecticut lies partly in the state of Connecticut, and many of its tributaries are in the state of Vermont. These two states were therefore early interested in the project, and their action soon led to similar exertions on the part of Rhode Island and Maine. Within the borders of the six states mentioned, collectively known as “New England,” are all of the rivers of the United States known to have been frequented by the sea-going *Salmo salar*, with the possible exception of certain rivers, tributary to the Saint Lawrence, in the northern part of New York.

The governments of these states having appointed boards of commissioners to whom was confided the task of restocking the exhausted rivers, other states, one after another, adopted like measures, and in 1872 the United States Government established a commission to inquire into the condition and needs of the fisheries in general, with authority to take steps for the propagation of food fishes.

The New England commissioners turned their attention at once to the two most important of their migratory fishes, the salmon and the shad. The utter extermination of salmon from most of their rivers compelled them to consider the best mode of introducing them from abroad.

Agents were sent to the rivers of Canada, where for several years they were permitted to take salmon from their spawning beds, and some hundreds of thousands of salmon eggs were thus obtained and hatched with a measure of success. After a few seasons permits for such operations were discontinued, and the only foreign source of supply thereafter remaining open to the states was found in the breeding establishments under control of the Canadian Government, and even these were practically closed by the high price at which the eggs were valued.

In 1870 it had become clear that to a continuation of efforts it was essential that a new supply of salmon ova should be discovered. Attention was now directed to the Penobscot River in the state of Maine, which, though very unproductive compared with Canadian rivers, might yet, perhaps, be made to yield the requisite quantity of spawn.

A preliminary examination of the river brought out the following facts: The Penobscot is about 225 miles in length. The upper half of its course and nearly all of its principal tributaries lie in an uninhabited wilderness, and in this district are the breeding grounds of the salmon. The fisheries, however, are all on the lower part of the river and in the estuary into which it empties, Penobscot Bay. There was no means of knowing how great a proportion of the salmon entering this river succeeded in passing safely the traps and nets set to intercept them, but supposing half of them to escape capture there

would still be but about 6,000 fish of both sexes scattered through the hundreds of miles of rivers and streams forming the headwaters of the Penobscot.

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It was very doubtful whether they would be congregated about any one spot in sufficient numbers to supply a breeding station, and it would be impracticable to occupy any widely extended part of the river, on account of the difficulties of communication. At the mouth of the river, on the other hand, the supply of adult salmon could be found with certainty, but they must be obtained from the ordinary salmon fisheries in June and held in durance until October or November, and the possibility of confining them without interfering seriously with the normal action of their reproductive functions was not yet established. The latter plan was finally adopted, and in 1871 the first attempt at this method of breeding salmon was instituted by the commissioners' of Maine, Massachusetts, and Connecticut. The site fixed upon for an inclosure was at Craig's Pond Brook in the town of Orland, and arrangements for a supply of fish were made with two fishermen of Verona at the very mouth of the river. The salmon first brought were confined in a newly constructed artificial pond in the brook, which was of such remarkable purity that a small coin could be distinctly seen at the depth of 7 feet. All of these died except a few which after a short stay were removed to other quarters. The most prominent symptom was the appearance of a white fungoid growth in patches upon the exterior of the fish. In a lake (locally designated as Craig's Pond) of equal purity, but greater depth, several of these diseased fish recovered.

Of the salmon later obtained some were placed in an inclosure of nets in the edge of a natural pond with but 7 feet of water, of average purity, some in a shallow inclosure in a brook, and some turned loose in a natural lake of some 60 acres area, with muddy bottom and peat-colored water. In each case the salmon passed the summer with few losses, arrived at the breeding season in perfect health, and yielded at the proper time their normal amount of healthy spawn and milt, though the great sacrifice of breeding fish by the early experiments of the season reduced the crop of eggs to the small number of 72,000.

The conditions of success were thus sufficiently indicated, and in 1872 the same parties, joined with the United States Commission of Fisheries, renewed operations on a larger scale, locating their headquarters at the village of Bucksport, confining the breeding salmon in Spofford's Pond (Salmon Pond on the general map of Penobscot station), and establishing their hatchery on the brook formed by its overflow. This is the lake of 60 acres in which, as mentioned above, a few salmon had been successfully confined the year before.

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Though not at all such water as would be chosen by a salmon at large, it nevertheless proved well adapted to the purpose of an inclosure for the breeding fish. It was shallow, its greatest depth, at the season of highest water, being but 10 feet; at its upper end it abuts against an extensive swamp, and almost its entire bottom, except close to the shore, is composed of a deposit of soft, brown, peaty mud of unknown depth. The water is strongly colored with peaty solutions, has a muddy flavor, and under the rays of a summer sun becomes warmed to 70° (Fahrenheit) at the very bottom.* Yet in such a forbidding place as this, salmon passed the summer in perfect health. There were some losses, but every reason to believe them all to have been caused by injuries received prior to their inclosure.

* During the month of August, 1872, the bottom temperature at 1 p.m. was never below 70°, and on six days was found to be 71°.

During and after the hottest term of each summer (the month of August) very few died.

The supply of salmon was obtained mainly, as in 1871, from the weirs in the southern part of Verona. They were placed in cars, specially fitted for the purpose; and towed to Bucksport on the flood tide. From the river to the inclosure they were hauled on drays in wooden tanks 3 feet long, 2 feet wide and 2 feet deep, half a dozen at once. From the weirs to the boats and from the boats to the tanks they were dipped in great canvas bags. From all this handling but few losses ensued.

In the establishment at Bucksport village the work was carried on for four years, from 1872 to 1876, with a fair degree of success. Then ensued a suspension till 1879, when the reappearance of salmon in the Merrimack, Connecticut, and some other rivers renewed the hopes of final success, and encouraged the commissioners to reopen the station. It had, however, been found that the old location had serious defects.

The inclosure was costly to maintain, and the recapture of the fish involved a great deal of labor and trouble. The water supplied to the hatchery was liable in seasons of little rain to be totally unfit, causing a premature weakening of the shell and very serious losses in transportation. After a careful search through the neighboring country it was found that the most promising site for an inclosure was in Dead Brook, near the village of Orland (though within the limits of the town of Bucksport), and for a hatchery no location was equal to Craigs Pond Brook, the spot where the original experiments were tried in 1871. The only serious drawback was the separation of the two by a distance of some 2 miles, which could not offset the positive advantage of the hatchery site. Accordingly the necessary leases were negotiated, an inclosure made in Dead Brook, and a stock of breeding salmon placed therein in June, 1879. Since then the work has been continued without interruption.

It is still found most convenient to obtain the stock of breeding salmon, as in the early years of the enterprise, from about a dozen weirs in the Penobscot River along the

shores of the island of Verona. The fishermen are provided with dip-nets or bags with which to capture the fish in their weirs, with tanks or cars in which to transport them to the collecting headquarters, whither they are brought immediately after capturing, about low water.

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The collection is in the hands of a fisherman of experience, who receives the salmon as they are brought in, counts and examines them, adjudges their weight, and dispatches them in cars to the inclosure at Dead Brook. The cars are made out of the common fishing boats of the district, called dories, by providing them with grated openings, to allow of a free circulation of water in transit, and covering them with netting above to prevent the fish from escaping over the sides. The car is ballasted so that it will be mostly submerged. Ten to fifteen salmon are placed in a single car, and from one to four cars are taken in tow by a boat with two to four oarsmen.

From the collecting headquarters to Orland village, a distance of about 5 miles, the route is in brackish water, and the tow is favored by the flood tide. At Orland is a dam which is surmounted by means of a lock, and thence, two miles further to Dead Brook, the route is through the tide less fresh water of Narramissic River. The sudden change from salt to fresh water does not appear to trouble the fish except when the weather is very hot and the fresh water is much the warmest. The cars are towed directly into the inclosure, where the fish are at once liberated.

The inclosure is formed by placing two substantial barriers of woodwork across the stream 2,200 feet apart. The lower barrier is provided with gates which swing open to admit boats. Within the inclosure the water is from 3 to 8 feet deep, the current very gentle, the bottom partly muddy, partly gravelly, supporting a dense growth of aquatic vegetation. The brook has two clean lakes at its source, and its water is purer than that of ordinary brooks.

The collection of salmon usually continues from the first ten days of June until the beginning of July. During the early weeks of their imprisonment the salmon are extremely active, swimming about and leaping often into the air. After that they become very quiet, lying in the deepest holes and rarely showing themselves. Early in October they begin to renew their activity, evidently excited by the reproductive functions. Preparations are now made for catching them by constructing traps at the upper barrier. If the brook is in ordinary volume, these means suffice to take nearly all, but a few linger in the deeper pools and must be swept out with seines. About October 25 the taking of spawn begins. After that date the fish are almost always ripe when they first come to hand, and in three weeks the work of spawning is substantially finished.

Although the salmon are taken from the fisherman without any attempt to distinguish between males and females, it is always found at the spawning season that the females are in excess, the average of four seasons being about 34 males to 66 females. This is a favorable circumstance, since the milt of a single male is fully equal to the impregnation of the ova of many females.

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The experiment has several times been tried of marking the salmon after spawning and watching for their return in after years. After some experiments, the mode finally fixed upon as best was to attach a light platinum tag to the rear margin of the dorsal fin by means of a fine platinum wire. The tags were rolled very thin, cut about half an inch long and stamped with a steel die. The fish marked were dis missed in the month of November. Every time it was tried a considerable number of them was caught the ensuing spring, but with no essential change in their condition, indicating that they had not meanwhile visited their spawning grounds. In no case was a specimen caught in improved condition during the first season succeeding the marking.

But the following year, in May and June, a few of them were taken in prime condition—-none otherwise—and it several times occurred that female salmon were a second time committed to the inclosure and yielded a second litter of eggs. The growth of the salmon during their absence had been very considerable, there being always an increase in length and a gain of twenty-five to forty per cent. in weight. The conclusion seems unavoidable that the adult salmon do not enter the Penobscot for spawning oftener than once in two years.

The method of impregnation employed has always been an imitation of the Russian method introduced into America in 1871. The eggs are first expressed into tin pans, milt is pressed upon them, and after they are thoroughly mixed together, water is added. The result has been excellent, the percentage of impregnated eggs rarely falling so low as 95.

After impregnation the eggs are transferred to the hatchery at Craig's Pond Brook, where they are developed, resting upon wire-cloth trays in wooden troughs, placed in tiers ten trays deep, to economize space, and at the same time secure a free horizontal circulation of water.

The hatchery is fitted up in the basement of an old mill, of which entire control has been obtained. The brook is one of exceptional purity, and a steep descent within a few feet of the hatchery enables us to secure at pleasure a fall of 50 feet or less. The brook formerly received the overflow of some copious springs within a few hundred feet of the hatchery, which so affected the temperature of the water that the eggs were brought to the shipping point early in December, an inconvenient date. This has been remedied by building a cement aqueduct 1,600 feet long, to a point on the brook above all the springs, which brings in a supply of very cold water.

The shipment of eggs is made in January, February, and March, when they are sent by express, packed in bog-moss, all over the northern States, with entire safety, even in the coldest weather.

In the following statement is embraced a general summary of the results of each season's work:

[*Image* orlandeggs.png in html file—table in text file]

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Year	Salmon bought	Females spawned	Eggs obtained	Eggs distrib'd
1871-72	111	11	72,071	70,500
1872-73	692	225	1,560,000	1,241,800
1873-74	650	279	2,452,638	2,291,175
1874-75	601	343	3,106,479	2,842,977
1875-76	460	237	2,020,000	1,825,000
1879-80	264	19	211,692	200,500
1880-81	522	227	1,930,561	1,841,500
1881-82	513	232	2,690,500	2,611,500
1882-83	560	256	2,075,000	2,000,000
Total	4,373	1,829	16,148,941	14,924,952

ARTICLE III

Penning of salmon in order to secure their eggs.

By C. J. Bottemanne M.D. [From a letter to Prof. S. F. Baird.]

Bulletin of the United States Fish Commission, Vol. 4, Page 169, 1884.

In the Dutch "Economist" of 1874 I gave a description of the fish breeding establishment of the State of New York, and therein I mentioned the United States salmon-breeding establishment on the Penobscot, principally for the penning of the salmon from June till breeding time. As you are likely aware, the Dutch Government pays yearly $4,800 to salmon breeders for young salmon delivered in spring, at the rate of 10 cents for yearlings, and not quite (4/5) one dollar per hundred for those that are about rid of the umbilical sac, and ready to shift for themselves. For the latter they receive payment only if there is money left after delivering the yearlings.

The breeders get their eggs from Germany from Schuster in Freiburg, and from Gloser in Basel; but complain always that the eggs are from too young individuals, that there is always too much loss in transportation, that the eggs are so weak that after the fish have come out there is great mortality in the fry, &c.

In this month's "Economist" I published the results on the Penobscot, and figured out that if breeders here set to work in the same style they would get at least four eggs to one, at the same price, and be independent.

We have an association here for promoting the fresh-water fisheries, of which the principal salmon fishermen are members, and also several gentlemen not in the business, including myself. In the December meeting I told them all I knew about the Penobscot; and one breeder got a credit for $200 for getting ripe salmon and keeping them in a scow till he had what he wanted, and he has succeeded pretty well. Still this is only on a limited scale. I want to put up larger pens and in the style of the Penobscot. In order to do this I must know exactly what is done on the Penobscot, and how.

What is the size of the pen, how large area, how deep? Is it above tidal water? (This I take for granted.) What is the situation of the pond compared with the river? What kind of failures were there, and the probable reasons therefor? In short, I would like a complete description of the place, with the history of it. I hope you will excuse my drawing on you for such an amount, but as the United States is the authority in practical fish-breeding, we are obliged to come to you.

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I am sorry to say that I cannot report the catch of any *S. quinnat*, yet three fish have been sent in for the premium we held out for the first fifteen caught, but they proved not to be quinnat. Lately I heard that there were so many salmon caught in the Ourthe, near Liege, Belgium (the Ourthe is one of the feeders of the Maas), which was an astonishing fact, as salmon are seldom taken there.

Bergen op Zoom, Netherlands, January 12, 1884

ARTICLE IV

Memoranda relative to inclosures for the confinement of salmon drawn from experience at Bucksport, *Penobscot river*, *Maine*.

By Charles G. Atkins

[In response to request of Dr. C. J. Bottemanne.] April 7, 1884.

Bulletin of the United States Fish Commission, Vol. 4, Pages 170-174, 1884.

The Penobscot salmon-breeding establishment was founded in 1872, at Bucksport; in the State of Maine, near the mouth of the Penobscot River. The location was primarily determined by the necessity of being near a supply of living adult salmon, to be used for breeders.

After an exploration of the headwaters of the Penobscot, which lie mostly in an uninhabited wilderness, the conclusion was reached that the chances of securing a sufficient stock of breeders were much greater at the mouth of the river, where the principal salmon fisheries are located; but to avail ourselves of the supply here afforded we must take the salmon at the ordinary fishing season, May, June, and July, and keep them in confinement until the spawning season, which is here the last of October and first of November. As the salmon naturally pass this period of their lives in the upper parts of the rivers, it was thought essential to confine our captives in fresh water.

Later experiments in Canada indicate that they will do as well in salt water, but the construction and maintenance of inclosures is much easier when they are located above the reach of the tide, to say nothing of the proximity of suitable fresh water for the treatment of the eggs. In the precise location of the inclosures several changes have been made, but they have always been in fresh water, and within convenient distance (5 to 10 miles) of the place where the salmon were captured.

In our experiments and routine work we have made use of four inclosures, which I will now describe.

No. 1. In Craig's Pond Brook, a very pure and transparent stream, an artificial pond 40 square rods in area and 7 feet in extreme depth, was formed by the erection of a dam. The bottom of this pond was mainly a grassy sod newly flooded. About half the water came from springs in the immediate vicinity, and the rest from a very pure lake half a mile distant. The water derived from the lake was thoroughly aerated by its passage over a steep rocky bed. The transparency of the water in the pond was so great that a pin could be seen at the depth of six feet.

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This inclosure was a complete failure. The salmon placed therein were after a day or two attacked by a parasitic fungoid growth on the skin, and in a few days died. Out of 59 impounded not one escaped the disease and only those speedily removed to other waters recovered. Several, removed in a very sickly condition to the lake supplying the brook, recovered completely, from which it is safe to infer that the cause of the trouble did not lie in the lake water.

Of the spring water I have some suspicions, and should not dare to inclose salmon in it again.

No. 2. After the failure of the above experiment an inclosure was made in the edge of an ordinary lake by stretching a stout net on stakes. This water was brown in color, and objects 4 feet beneath the surface were invisible. The bottom was gravelly and devoid of vegetation.

The depth was 7 and one half feet in early summer, and about 4 feet after the drought of August and September. The area inclosed was about 25 square rods in June, and perhaps half as much at the end of summer. This inclosure was entirely successful, very few salmon dying in it except those that had been attacked by disease before their introduction, and all the survivors were found to be in first-rate condition in November. This site was not afterwards occupied, because it was inconveniently located, and was exposed to the full force of violent winds sweeping across the lake, and therefore unsafe.

No. 3. The inclosure in use for the confinement of the stock of breeding fish for the four years from 1872 to 1875, inclusive, was made by running a barrier across a narrow arm of a small lake (mentioned in official reports as “Spofford’s Pond”) near Bucksport village. This body of water, about 60 acres in area in the summer, receives the drainage of not more than 5 square miles of territory through several small brooks, that are reduced to dry beds by an ordinary drought. About a quarter of the shores are marshy and the rest stony. The water is highly colored by peaty matters in solution, and all objects are invisible at a depth of 2 feet: The bottom is composed mostly of a fine brown peaty mud of unknown depth. Aquatic vegetation of the genera, *Nuphar*, *Nymphaea*, *Bragenia*, *Potamogeton*, &c., is abundant. The water is nowhere more than 16 feet deep in the spring, and 11 feet in midsummer. The portion inclosed is 2 feet shoaler.

The inclosure occupied sometimes 8 or 10 acres, and sometimes less. The barrier was from 400 to 600 feet long, and was formed the first year of brush; the second and third years of stake-nets, weighted down at the bottom with chains; and the fourth year of wooden racks, 4 feet wide and long enough to reach the bottom, which were pushed down side by side. The brush was unsatisfactory. There were holes in it by which the fish escaped. A single net would not retain its strength through a whole season, the bottom rotting away and letting the fish out, unless before the autumn was far advanced

its position were reversed, the stronger part that had been above water being placed now at the bottom. This method was therefore rather expensive and not perfectly secure. The wooden racks were costly and heavy to handle, but quite secure.

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The salmon placed in this inclosure had to be carted in tanks of water overland about a mile in addition to transportation in floating cars from 3 to 5 miles; they were transferred suddenly from the salt water of the river (about two-thirds as salt as common sea-water) into the entirely fresh water of the lake. To all the supposed unfavorable circumstances must be added the high summer temperature of the water. During August the mean was generally above 70 degrees Fahrenheit at the bottom and several degrees warmer at the surface. Occasionally there was observed a midday temperature of 74 degrees F. and once 75 degrees at the bottom. Yet this proved an excellent place for our purpose, a satisfactory percentage of the salmon remaining in perfect health from June to November.

No. 4. The inclosure in use since 1870 at Dead Brook, Bucksport. It is located in a gently running stream bordered by marshy ground, with a bottom in part of gravel but mostly of mud, crowded with aquatic vegetation. The water, supplied by two small lakes among the hills, is cleaner than the average of Maine rivers, but does not in that respect approach the water of inclosure No. 1. The greatest depth is about 8 feet, but in the greater part of the inclosure it is from 3 to 5 feet. The width of the stream is from 2 to 4 rods, and the portion inclosed is 2,200 feet long. The barriers to retain the fish are in the form of wooden gratings, with facilities for speedily clearing them of debris brought down by the stream.

Better results were expected from this inclosure than from No. 3, but have not been realized. The percentage of salmon dying in confinement has been greater, amounting commonly to about 25 percent of those introduced, and this notwithstanding the salmon are conveyed to the inclosure by water carriage the entire distance (7 miles) instead of being carted in tanks.

The cause of the trouble has not yet been discovered, but there is good reason for thinking that it lies in some of the circumstances attending the transfer of the fish from the place of capture, and that the inclosure itself is perfectly suited to its purpose. This view is supported by the fact that nearly all the losses occur within a few weeks after the introduction of the salmon and almost wholly cease by the end of July. If the cause of disease was located in the inclosure, we should expect it to be more fatal after a long than a short duration of the exposure of the fish to its action, and that with the smaller volume and higher temperature of August it would be more active than in June and July.

The above description will, I think, give Dr. Bottemanne a sufficiently correct idea of the character of the inclosures we have tried. There are, however, several other points to be touched upon to put him in possession of the practical results of our experience.

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The facilities for the recapture of the salmon when the spawning season approaches must be considered. In the lake at Bucksport village (No. 3) we hoped at first that their desire to reach a suitable spawning ground would induce them all to enter the small brook that forms the outlet, which was within the limits of the inclosure. In this matter our expectations were but partially realized. Many of the fish refused to leave the lake through the narrow opening that was afforded them, and were only obtained by pound-nets, seines, and gill-nets, all of which involved a considerable expenditure of labor and material.

The drawing of a seine in a large body of fresh water is likely to be a serious undertaking unless the bottom has been previously cleared of snags. In this respect the long and narrow inclosure at Dead Brook possesses great advantages, since it can be swept with a comparatively short seine. However, the influx and efflux of a considerable volume of water is of great advantage in enticing the gravid fish into traps that can readily be contrived for them by any ingenious fisherman.

The existence of a gravelly bottom in the inclosure must be considered a positive disadvantage, inasmuch as it affords the fish a ground on which they may lay their eggs before they can be caught; but the danger of such an occurrence is less as the bounds of the inclosure are more contracted and the facilities for capturing the fish are better.

As to the number of fish to a given area, I think we have never approached the maximum. I should have no hesitation in putting 1000 salmon in the inclosure at Dead Brook, which covers an area of less than 3 acres. Of course the renewal of the water supply, or its aeration by winds, is of importance here.

The capture and transport of the fish in June involves methods requiring some explanation. The salmon fisheries about the mouth of the Penobscot River are pursued by means of a sort of trap termed a “weir.” It is constructed of fine-meshed nets hung upon stakes, arranged so as to entrap and detain the fish without insnaring them in the meshes. They swim about in the narrow “pound” of the weir until the retreating tide leaves them upon a broad floor.

Just before the floor is laid bare, the salmon destined for the breeding works are dipped out carefully with a cloth bag or a very fine bag-net and placed in transporting cars or boats, rigged specially for the purpose, sunk deep in the water, which fills them, passing in at two grated openings above, and passing out at two others astern, and covered with a net to prevent escape. In a boat 13 or 14 feet long (on the bottom) we put 10 or 15 salmon, to be towed a distance of 7 miles. If the water is cool, twice as many can go safely, but there must be no delay. It is very important that this car be smooth inside, with no projections for the salmon to chafe on, and the gratings must be so close that they cannot get their heads in between the bars.

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If conveyance overland is necessary, a wooden tank 3 feet long, 2 feet wide, and 2 feet deep, with a sliding cover, will take six salmon at a time for a mile and perhaps farther, and they may be jolted along over a rough road in comparative safety.

It has been our uniform experience that all the salmon that survive till autumn were in normal condition as to their reproductive function, and yielded healthy spawn and milt. On two occasions we suffered serious losses of eggs. In neither instance could the loss be attributed to any defect in the inclosure, but on one occasion the conclusion was reached that the water which was well suited to the maintenance of the fish was injurious to the eggs, rendering the shell so soft that they could not be transported safely.

With the exception of the disasters enumerated above, there has been but one that I can recall, and that was caused by the bursting of our barriers at Dead Brook under the pressure of a flood.

BUCKSPORT, ME, April 7, 1884.

ARTICLE V

REPORT ON THE SCHOODIC SALMON WORK OF 1884-85

By Charles G. Atkins.

Bulletin of the United States Fish Commission, Vol. 5, Pages 324-325, 1885.

The measurement of the stock of Schoodic salmon eggs at Grand Lake Stream at time of packing and shipment, and the record of previous losses, enable me to complete the statistics, as follows:

Original number taken 1,820,810
The total losses up to that time, including the
unfertilized, which were removed before packing.....254,410
Net stock of sound eggs.....1,566,400
Reserved for Grand Lake.....397,400
Available for shipment to subscribers 1,169,000

These were divided among the parties supplying the funds for the work in proportion to their contributions, as follows:

Allotted to the United States Commission.....608,000

Allotted to the Maine Commission.....234,000
Allotted to the Massachusetts Commission.....187,000
Allotted to the New Hampshire Commission.....140,000

Total.....
..1,169,000

The share of the United States Commission was assigned and shipped, under orders, as follows:

A. W. Aldrich, commissioner, Anamosa, Iowa.....50,000
E. A. Brackett, commissioner, Winchester, Mass.....25,000
H. H. Buck, Orland, Me, to be hatched for
Eagle Lake, Mount Desert.....20,000
Paris, Mich., for Michigan commission.....50,000
Madison, Wis., for Wisconsin commission.....50,000
R. O. Sweeny, commissioner, Saint Paul, Minn 50,000
South Bend, Nebr., for Nebraska Commission.....20,000

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E. B. Hodge, commissioner, Plymouth, N.H.....40,000
Cold Spring Harbor, N. Y., for New York Commission.....60,000
Plymouth, N. H., for Vermont Commission 25,000
Plymouth, N. H., for Lake Memphremagog 25,000
Central Station, Washington, D.C. 10,000
R. E. Earll, World's Exposition, New Orleans 5,000
G. W. Delawder, commissioner, Baltimore 5,000
Myron Battles, North Creek, N.....5,000
A. R. Fuller, Meacham Lake, N. 20,000

F. Mather for transmission to Europe as follows:
For Herr von Behr, Germany.....40,000
For Tay Fishery Board, Scotland.....20,000
For National Fish Culture Association, England.....30,000

Total to Europe.....
.....90,000

Enfield, Maine for Maine Commission.....58,000

Total.....
....608,000

A few of the shipments have been heard from, and these all reached their destinations safely.

BUCKSPORT, ME. March 31, 1885

ARTICLE VI

METHODS EMPLOYED AT CRAIG BROOK STATION IN REARING YOUNG SALMONID FISHES

By Charles G. Atkins, Superintendent U. S. Fish Commission Station at Craig Brook, Maine.

Bulletin of the United States Fish Commission, Vol. 13, Pages 221-228, 1893.

The station of the U. S. Fish Commission at Craig Brook was founded in 1889, on the same site where, in 1871, the first attempt at the artificial spawning of salmon in the

United States was made. This site had been selected by the commissioners of fisheries of the States of Maine, Massachusetts, and Connecticut for that experiment because of its proximity to the salmon fisheries of the Penobscot River and the facilities presented for the maturing of the spawn that might be obtained.

The collection of spawn has been carried on in the vicinity annually from 1871 to the present time, with the exception of the three years 1876,1877, and 1878, and since 1879 the development of the spawn has been conducted constantly at Craig Brook. No attempt was, however, made to rear the fry of any species until 1886. Two years later it was definitely determined to found a permanent station at Craig Brook, and in 1889 the purchase of the grounds was effected and permanent improvements begun.

The station is located in the town of Orland, Me., 7 miles east of Bucksport, a seaport on the Penobscot River. Its territory embraces a tract of land extending between Allamoosook Lake and Craig Pond and embracing within its limits the entire length of Craig Brook, which connects those two bodies of water. Its latitude is about 44 degrees 42' N. The mean annual temperature and precipitation are believed

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to approximate those of Orono, 25 miles distant, namely, 42.48° F. [5.8° C.] and 45.44 inches [116 cm.]. The range of air temperature observed at the station is from 18° F. below zero to 92.5°F. above [-27.7° C. to 33.6° C.]. Frosts not infrequently occur as late as the 1st of June and as early in autumn as the first week in September. The lakes in the vicinity are commonly covered with ice before the end of November, and they are not often released until near the end of April.

The water supply is derived from Craig Brook and from three large and several lesser springs. The source of the brook is Craig Pond, which affords a constant supply of exceedingly transparent water, warm in summer and cold in winter, moderated, however; in both extremes by the water from the springs, which mingles with the brook in its lower course, forming about a third of its volume. It is this mixed water which is mainly used in the rearing of fish. Its temperature ranges from 34° F. [1.1° C.] to 70°F. [21.1°C.]. The lowest monthly mean in 1893 was 35.8° F. [2.1° C.] in February. The highest was 64.6°F. [18.1°C.] in August. The total volume is variable, ranging from 875 to 3,000 gallons and averaging about 1,200 gallons per minute.

The difference of level between the source and mouth of the brook is about 190 feet. The sharpest descent is just above the hatchery and rearing troughs, which therefore receive well-aerated water. The conformation of the ground offers good facilities for the distribution and utilization of the water.

The leading motive in the foundation of this station was the desire to apply to the Atlantic salmon the system of rearing fish to the age of at least several months before liberating them. This motive has determined not only the principal subjects of the work, but also to a considerable extent the fixtures and methods. The scheme of work was determined in outline several years before the acquisition of full title to the premises, and, circumstances rendering it desirable to enter at once on its development, it became necessary to have recourse to movable apparatus, pending authority for permanent improvements.

Hence the erection of a series of small troughs in the open air, which gave such excellent satisfaction that enlargement took the same direction; and it has thus come about that the rearing operations of the station down to the present time have been almost exclusively conducted in open-air troughs. A series of ponds has been constructed, but with the exception of a few small ones none of them have been as yet brought into use.

The troughs are for the most part such as are used in the hatchery for the maturing of spawn, and their form and size have been adapted to the hatching apparatus which has been in use at the Maine station for many years. The eggs are developed on wire-cloth trays measuring 12 and one half inches in width and length, and the troughs are

therefore 12 and three quarter inches wide. Their depth is 9 inches and their length is 10 feet 6 inches. Such short troughs were adopted for two reasons:

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(1) It was thought that a greater length might involve the exposure of the eggs near the lower end to the danger of a partial exhaustion of the air from the water by the eggs above them;

(2) these short troughs are very convenient to cleanse and to move about for repairs or other purposes. They are made of pine boards seven-eighths inch thick. On the inside they are planed and varnished with asphaltum. When used for rearing fish each trough is fitted with a pair of thin wooden covers reaching its entire length hinged to the sides and meeting each other, when closed, at a right angle, forming; as it were, a roof over the trough. When closed they protect from predatory birds and other vermin; when open they are fixed in an upright position, in effect adding to the height of the sides and preventing the fish jumping out. The time spent in opening and closing the troughs is by this arrangement reduced to a minimum.

Water is fed through wooden tubes, and the volume admitted is regulated by slides The exit of the water is through another tube or hollow plug standing upright near the lower end of the trough, and by its height governing the depth of the water. The outlet tube is movable and is taken out in cleaning. A wire-cloth screen just above the outlet tube prevents the fish escaping.

In a trough of standard size 2,000 fry are generally placed, and to accommodate the large numbers of fish reared we bring into use sometimes nearly 200 troughs which are of necessity placed in the open air. They are arranged in pairs with their heads against the feed troughs, supported by wooden horses at a convenient height from the ground. They are given an inclination of about 2 inches to facilitate cleaning.

The volume of water fed to each trough has varied from time to time, but is ordinarily about 5 gallons per minute, which renews the water every four minutes. The ordinary arrangement is to use the water but once in the troughs, letting it waste into some small ponds in which yearling and older fish are kept; but there is one system of 52 troughs arranged in four series, which use in succession the same water. From these we have learned that young salmon thrive quite as well in the fourth series as in the first. Indeed, by an actual test, with fish of like origin and character in each series, the fish reared in the fourth series were found to grow faster, to an important degree, than those in the first. This phenomenon probably resulted from a somewhat higher temperature which the water acquired in passing through the several series. A like observation has been made on a few salmon maintained for a few weeks, in the warmer water of a neighboring brook.

As already stated, the activity of the station has been mainly occupied with Atlantic salmon, but there have been reared each year a few landlocked salmon and brook trout, and occasional lots of other salmonoids, such as Loch Leven, Von Behr, Swiss-lake, rainbow, and Scotch sea trout. All these have received the same treatment. With

the exception of the rainbow trout, they are all autumn-spawning fishes, and their eggs hatch early in the spring.

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The embryos of salmon begin to burst the shell in the month of March, and the 1st of April may be stated as the mean date of hatching. If the open-air troughs are in order—and we aim to have them so—the eggs are counted out into lots of 2,000 or 4,000 each and placed before hatching in their summer quarters. The water is at that time very cold, the development of the alevins is slow, and it is not until the latter part of May that the yolk sack is fully absorbed. June 1 is, therefore, the date when feeding is ordinarily begun. The growth of the fish is at first slow, the water being still cool, but is accelerated as the summer passes away. In October and November, beginning commonly about the middle of October, most of the fish are counted out and liberated, but a small number, rarely more than 15,000, being carried through the winter at the station. The reserved fish are sometimes left until midwinter in their summer quarters, and with a careful covering of the conduits and banking of the troughs themselves each with coarse hay and evergreen boughs it is possible to keep them there the year round; but for ordinary winter storage there is provided a system of sunken tanks covered by a rough shed with a constant water supply. These tanks are molasses hogsheads, securely hooped with iron, sunk nearly their entire depth into the ground, each with an independent water supply and waste, the perforation for the latter being near the surface. They have a capacity of from 100 gallons of water upward, and will carry safely each 500 to 700 fish in their first winter, that is, just approaching the age of one year.

This arrangement has answered its purpose fairly well, and in a very rigorous climate or where the water is very cold it is to be recommended; but since its construction it has been discovered that at Craig Brook it is not at all difficult to protect the ordinary troughs in such a way as to insure their safety from freezing, and their attendance through the winter is less troublesome than that of the sunken tanks.

A list of the articles employed for food at the station since its foundation, if designed to include those used on an experimental as well as a practical scale, would be a long one, and I will content myself with naming the following: On a practical scale we have used butcher’s offal, flesh of horses and other domestic animals by the carcass, fresh fish, maggots; and on an experimental scale, pickled fish, fresh-water mussels, mosquito larvae, miscellaneous aquatic animals of minute size.

In the production of maggots we have also made use of large quantities of stale meat from the markets and some barrels of fish pomace, in addition to the articles mentioned above.

The butcher’s offal comprises the livers, hearts and lights of such animals as are slaughtered in Orland and Bucksport—mainly lambs and veals. These are collected from the slaughter-houses twice or thrice weekly, and preserved in refrigerators until used. The quantity of such material to be had in the vicinity has been inadequate to our needs and we have been compelled to look in other directions for food.

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The flesh of horses has been used only during the season of 1893. Old and worn out horses and those hopelessly crippled or dying suddenly have been bought when offered, and used in the same way as the butcher's offal; the parts that could be chopped readily have been fed direct to the fish so far as needed; and other parts have been used in the rearing of maggots. The season's experience has been so satisfactory that greater use will be made of horse flesh hereafter.

Next to the chopped meat, maggots have constituted the most important article of food, and their systematic production has received much attention. A rough wooden building has been erected for the accommodation of this branch of the work and one man is constantly employed about it during the summer and early autumn months. The maggots thus far employed are exclusively flesh-eaters, mainly those of two undetermined species of flies—the first and most important being a small smooth, shining green or bluish-green fly occurring at the beginning of summer and remaining in somewhat diminished numbers until October, and the other a large rough, steel-blue fly that makes its appearance later and in autumn becomes the predominating species, having such hardiness as to continue the reproduction of its kind long after the occurrence of frosts sufficiently severe to freeze the ground.

In outline the procedure is to expose the flesh of animals in a sheltered location during the day, and when well stocked with the spawn of the flies to place it in boxes which are set away in the "fly house" to develop; when fully grown the maggots are taken out and fed at once to the fish. The materials used for the enticing of the flies and the nourishment of the maggots have been various. Stale meat from the markets has been perhaps the leading article, but we have also used such parts of the butcher's offal and of the horse carcasses as were not well adapted to chopping; fish, fresh dried or pickled; fish pomace from herring-oil works, and any animal refuse that came to hand.

Fresh or slightly tainted meat has been used to greater extent than any other material, and has proved itself equally good with any. Fresh fish is very attractive to the flies, and when in just the proper condition may be equally good with fresh meat, but some kinds of fish are too oily, for instance, alewives and herring, and all sorts thus far tried are apt to be too watery.

A very limited trial of fish dried without salt or smoke indicates that it is, when free from oil, a very superior article; it has, of course, to be moistened before using. Its preparation presents some difficulties, but in winter it is easily effected by impaling the whole fish on sticks and hanging them up, (after the manner of alewives or herring in a smokehouse) under a roof where they will be protected from rain without hindering the circulation of air; in this way we have dried many flounders and other refuse fish from the smelt fisheries, which are conducted with bag nets in the vicinity of Bucksport.

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Doubtless a centrifugal drying machine might be successfully used for this purpose in summer. Pickled alewives, freshened out in water, have been found to answer fairly well, when other materials are lacking, at least to give growth to maggots otherwise started. Fish pomace has not thus far given satisfaction, but seems worthy of further trial.

It is commonly necessary to expose meat but a single day to obtain sufficient fly spawn; the larvae are hatched and active the next day, except in cool weather, and they attain their full growth in two or three days. To separate them from the remnants of food and other debris was at first a troublesome task. It is now effected as follows: the meat bearing the fly spawn is placed on a layer of loose hay or straw in a box which has a wire-cloth bottom, and which stands inside a slightly larger box with a tight wooden bottom. When full grown the maggots work their way down through the hay into the lower box, where they are found nearly free from dirt.

When young salmon or trout first begin to feed they are quite unable to swallow full-grown maggots. Small ones are obtained for them by putting a large quantity of fly spawn with a small quantity of meat, the result being that the maggots soon begin to crowd each other and the surplus is worked off into the lower box before attaining great size. No attempt is, however, made to induce the young fish to swallow even the smallest maggots until they have been fed a while an chopped liver.

In the above methods maggots are produced and used in considerable numbers, sometimes as many as a bushel in a day. Through September, 1893, although the weather and some other circumstances were not very favorable, the average daily production was a little over half a bushel.

They are eagerly eaten by the fish, which appear to thrive on them better than on dead meat. Having great tenacity of life, if not snapped up immediately by the fish they remain alive for a day or two, and, as they wriggle about on the bottom, are almost certain to be finally eaten; whereas the particles of dead flesh that fall to the bottom are largely neglected by the fish and begin to putrefy in a few hours. In the fish troughs there are, therefore, certain gains in both cleanliness and economy from the use of maggots which may be set down as compensating the waste and filthiness of the fly-house.

As the growth of maggots can be controlled by regulation of the temperature, it is possible to keep them all winter in a pit or cellar, and advantage is taken of this to use them during winter as food for fish confined in deep tanks not easily cleaned.

The offensive odors of decaying flesh may be largely overcome by covering it, on putting it away in the boxes, after the visits of the flies, with pulverized earth, and it is not improbable that by this or some other method the business may be made almost wholly inoffensive, but in its present stage of development it is too malodorous to admit

of practice in any place where there are human habitations or resorts within half a mile of the spot where the maggots are grown.

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As remarked above, only flesh-eating maggots have yet been tried. It would be well worth while to experiment with the larvae of other species, such as the house fly, the stable fly, *etc*. There is also a white maggot known to grow in heaps of seaweed. Should the rate of growth of either of these species be found to be satisfactory they might be substituted for the flesh maggots with advantage.

Occasional use has been made of fresh fish for direct feeding. When thrown into the water after chopping it breaks up into fibers to such an extent that it is not very satisfactory, and I do not suppose we shall use it in the future, unless in a coarsely chopped form for the food of large fish. A few barrels of salted alewives have been used, and if well soaked out and chopped they are readily eaten by the larger fish and can be fed to fry, but are less satisfactory with the latter, and like fresh fish they break up to such an extent that they are only to be regarded as one of the last resorts.

Fresh-water mussels have been occasionally gathered in the lake close to the station when there has been a scarcity of food. Those employed belong almost wholly to a species of Unio which abounds over a considerable area of soft bottom, under a depth of 2 to 10 feet of water. Many were taken with a boat dredge; more were scooped up with long-handled dip nets of special construction. Finally a wide, flat dredge was made, to be drawn by a windlass on the shore and manipulated by means of poles from a large boat.

When needed for food the mussels were opened with knives—a great task—and chopped. The meat is readily eaten by all fishes, and appears to form an excellent diet. Being more buoyant than any other article tried, it sinks slower in the water and gives the fish more time to seize it before it reaches the bottom, a consideration of considerable practical importance. The labor involved in dredging and shelling is a serious drawback, but were the colonies of unios sufficiently extensive or their reproduction rapid enough to warrant expenditure of time in experimentation; improved methods might be devised, which would put this food-source on a practicable basis.

During the seasons of 1886 and 1888 some use was made of mosquito larvae. Near the station is an extensive swamp where these insects breed in great numbers. From the pools of water the larvae were daily collected by means of a set of strainers specially devised for this use. Barrels filled with water were also disposed in convenient places near the rearing troughs, and were soon swarming with larvae from the eggs deposited by the mosquitoes on the surface of the water. When near the completion of their growth, which was only some ten days after the deposit of the eggs, the larvae (or pupae) were strained out and fed to the fish. No kind of food has been used this station that has been more eagerly devoured, and so far as our observation has gone no other food has contributed more to the growth of the fish; indeed, I am inclined to put them at the head in both respects. It was found, however, that the time expended in collecting them was out of all proportion to the quantity of food secured, and pending opportunity for further experiment their use was discontinued.

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I think it quite possible that an arrangement might be devised whereby the greater part of the labor might be saved. Perhaps a series of breeding tanks arranged in proximity to the fish troughs, into which the water containing the larvae might be drawn when desirable by the simple opening of faucet, would solve the problem.

Various methods of serving the food have been tried, but at present everything is given with a spoon. The attendant carries the food with the left hand—in a 2-quart dipper if chopped meat, in a larger vessel if maggots—and, dipping it out with a large spoon, strews it the whole length of the trough, being careful to put the greater portion at the head, where the fish nearly always congregate. Finely chopped food, for very young fish, is slightly thinned with water before feeding. At one time the finest food was fed through perforations in the bottom of a tin dish; the food was placed in the dish, which was dipped into the water a little and shaken till enough of the food had dropped out of the perforations; this practice was laid aside because it was thought that the food was too much diluted.

In feeding maggots it was, at first, the practice to place them on small “feeding boards” of special construction suspended over the water in the troughs and let them crawl off into the water; but whatever advantage this method may have had in furnishing the meal to the fish slowly was more than counterbalanced by the extra labor of caring for the boards and by the offensive odor, and it was abandoned. For use in feeding fish in a pond a box containing a series of shelves, down which the maggots slowly crawl, was found sufficiently useful to be retained.

It is the common practice to feed all meat raw except the lights, which chop better if boiled first, except also occasional lots of meat that are on the point of becoming tainted and are boiled to save them. All meats fed direct to the fish are first passed through a chopping machine. The machine known as the “Enterprise” is the one now in use. It forces the meat through perforated steel plates. The plate used for the smaller fish has perforations 2 inch in diameter, and for coarser work there are two plates 3/16th inch and 3/8th inch, respectively. It is operated by a crank turned by hand.

Food is given to those fish just beginning to eat four times a day (in some cases even six times). As the season progresses the number of rations is gradually reduced to two daily. In winter such fish as are carried through are fed but once a day. The cleaning of the troughs has been a troublesome matter, and the subject of much study and experiment, but nothing more satisfactory has been found than the following practice: The troughs are all to be cleaned daily—not all at one time, but as time is found for it in the intervals of other work. To facilitate cleaning, the troughs are inclined about 2 inches. The outlet is commanded, as already explained, by a hollow plug.

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When this is drawn the water rushes out rapidly and carries most of the debris against the screen. The fishes are excited, and, scurrying about, they loosen nearly all dirt from the bottom; what will not otherwise yield must be started with a brush, but after the first few weeks the brush has rarely to be used except to rub the debris through the outlet screen. Owing to the inclination of the trough the water recedes from the upper end until the fishes lying there are almost wholly out of water, but, although they are left in that position sometimes for 10 or 15 minutes, no harm has ever been known to result.

It has been the common rule at the station to count all the embryos devoted to the process of rearing, either before or after hatching; to keep an accurate record of losses during the season, and to check the record by a recount in the fall. When eggs are counted they are lifted in a teaspoon.

The counting of small fish is effected in this way: The fish are first gathered in a fine, soft bag-net, commonly one made of cheese-cloth, and from this, hanging meanwhile in the water, yet so that the fish cannot escape, they are dipped out a few at a time, in a small dipper or cup, counted, and placed in a pail of water or some other receptacle.

This counting is generally preliminary to weighing, and in this case the fish, after counting, are placed in another bag-net, in which they are lowered, several hundred at a time, into a pail of water which has been previously weighed, and the increase noted. With care to avoid transferring to the weighing pail any surplus water, this is a correct method and very easy and safe for the fish.

In conclusion, I submit some estimates of cost. In September, 1893, we fed fry that were estimated at the close of the month to number 238,300. There were also a few hundred larger fish.

From the known total outlay for food, attendance, and superintendence a suitable allowance is made for the maintenance of the older fish, and the balance is charged to the fry. By this method we arrive at the following results:

Cost.....	Total.....	Per fish.
Food	$155.00	$0.00065
Attendance	99.79	.00042
Superintendence	205.96	.00086
Total	460.75	0.00193

Applied to the rearing operations of 1891, a similar calculation gives us this result: The fry that were carried through the season from June to October, inclusive, cost, for food, attendance, and superintendence, $0.0081 each; that is, about four-fifths of a cent each for the term of five months.

ARTICLE VII

NOTES ON THE CAPTURE OF ATLANTIC SALMON AT SEA AND IN THE COAST WATERS OF THE EASTERN STATES

By Hugh M. Smith, M. D., Assistant in charge of Division of Statistics and Methods of the Fisheries.

Bulletin of the United States Fish Commission, Vol. 14, Page 95, 1894.

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In carrying out its most important function—the maintenance and increase of the supply of food fishes—the U.S. Commission of Fish and Fisheries, in addition to direct efforts to increase the abundance of fishes naturally inhabiting our various rivers, lakes, and coast waters, has given considerable attention to the experimental introduction of fishes into regions or streams to which they were not native.

The wonderful success which has followed the planting of shad and striped bass fry in the waters of the Pacific coast is well known. The results attending the recent attempts of the Commission to establish a run of salmon (*Salmo salar*) in some of the large rivers of the Atlantic coast have been so noteworthy in the case of the Hudson as to afford reasonable ground for expecting the early inauguration of a regular fishery, should the present rate of increase in the abundance of the fish be maintained. Similar striking results may also be anticipated in all the more northern streams of the east coast, including the Housatonic, Connecticut, and Merrimac, in which salmon were at one time found in abundance and are now taken in small numbers, if the ascent of the adult fish to the headwaters for the purpose of spawning is permitted and if sufficiently extensive fish-cultural operations are continued.

The primary purpose of this paper is to record some of the apparent results of salmon propagation in our rivers as shown by the occurrence of the fish at points on the coast or at sea more or less remote from the places where fry have been deposited.

While an interesting and instructive compilation might be made of the instances of the capture of salmon in the Hudson, Delaware, Susquehanna, Potomac, and other rivers in which the fish has been acclimated, such a work is not necessary in view of the notice which has already been accorded the matter in the public press and in the reports of several of the State fish commissions, notably the New York commission.

So much yet remains to be learned regarding the lines of migration of the salmon to and from the rivers, its winter habitat, the existence of an “instinct of nativity” which is supposed to impel the return of the fish to the place where hatched, the extent of the coastwise distribution of salmon originally belonging in a given river, and numerous other practical and scientific questions, that the presentation of any data bearing on the occurrence of the fish outside of the rivers may be regarded as acceptable and timely.

In an interesting article on “Salmon at Sea,” communicated to the issue of *Forest and Stream* for February 18, 1892, Mr. A. N. Cheney, the well-known angling expert and writer on fish-cultural matters, discusses the question of the whereabouts of salmon after they leave the rivers, and quotes the following from a previous contribution by himself on the subject:

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“There is a certain mystery about the habits and movements of the sea salmon, after it has left the fresh-water rivers in which it spawns and gone down to the sea, that never has been satisfactorily explained. One theory is that all the salmon of the rivers along a coast may journey down to the sea, and then move ultimately in one great body southward along the coast until they find water of suitable temperature, with an abundance of food, in which to spend their time in growing fat until the spawning instinct warns them to return, when they proceed northward, each river school entering its own particular river as the main school arrives opposite the river month.

“Another theory is that the salmon of each river, as they arrive at its mouth after descending from its headwaters, go out to sea sufficiently far to find the conditions of temperature and food which suit them, and there they remain, separate from the salmon of other rivers, until it is time for them to return to fresh water. Considering the certainty with which the salmon of any particular river return again to the stream of their birth, the latter theory seems the more tenable of the two.”

Another object of this paper is to solicit correspondence from fishermen, especially those engaged in the coast and offshore fisheries, concerning the circumstances of the capture of salmon in their nets, and to bring to their attention the opportunity they will thus have of increasing the knowledge of the movements of the salmon, of aiding in the determination of the results of fishcultural operations, and of ultimately if not immediately benefiting themselves by supplying information that will conduce to the most effective application of artificial methods.

To this end it is the intention to send the paper to fishermen engaged in the mackerel, menhaden, and other sea fisheries, and to operators of pound nets, traps, and other shore appliances, with the hope that instances of the capture of salmon may be communicated to this Commission and notes on the size, condition, movements, *etc*., of the fish be furnished.

To aid in the identification of the salmon when caught by fishermen who have not previously met with the fish, a figure is presented.

In this connection mention may be made of the chinook or quinnat salmon of the Pacific coast (*Oncorhynchus chouicha*), fry of which have been extensively planted in eastern waters by the U. S. Commission of Fish and Fisheries. Up to and including the year 1880, about 12,000,000 fry were deposited in rivers and other waters tributary to the Atlantic. While a few relatively large examples have been taken, this office has no information to show that the attempts to acclimate this species on the Atlantic coast have as yet been successful. In 1891 a few thousand yearling salmon were placed in New York waters tributary to the sea. The possibility of the survival and growth of some of these and of the large early colonies prompts this reference to the matter and suggests the publication of the accompanying figure of the species, to afford a basis for

distinguishing the two kinds of salmon, which closely resemble each other. To further aid in the identification of the two species the following key has been prepared:

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Rays in anal fin, 9; scales between gill opening and base of tail, 120; branchiostegals (false gill openings), 11 .....ATLANTIC SALMON.

Rays in anal fin, 16; scales between gill opening and base of tail, 150; branchiostegals, (false gill openings) 15 to 19.....PACIFIC SALMON.

Numerous instances might be cited of the taking of salmon in the waters of the Atlantic coast in recent years. Their occurrence in the traps and pound nets is in fact so common that it would hardly be entitled to notice at this time were it not for the circumstance that in regions in which salmon were already known there has been a decided increase in the number observed outside the rivers, and that the fish is now being taken in localities in which it was not previously found.

Instances of the capture of salmon in the coast waters of Maine are naturally numerous, and without significance so far as the purposes of the present paper are concerned. The existence of two important salmon rivers, the Kennebec and the Penobscot, affords an easy explanation of the presence of salmon on the shores of either side of the mouths of those streams. In the report of the U. S. Commission of Fish and Fisheries for 1873-73 Mr. Charles G. Atkins, now superintendent of the salmon-rearing establishment at East Orland, Me., and an authoritative writer on the Atlantic salmon, contributes some notes on its occurrence in the sea adjacent to Penobscot Bay and at Richmond Island, near Portland. These cases, however, have little bearing on the subject in hand, as Mr. Atkins suggests in a recent letter.

A special inquiry, personally conducted on Matinicus, Monhegan, and other islands lying far off the Maine coast, and special researches there made with appropriate apparatus, would doubtless disclose many interesting facts regarding the salmon of a practical and scientific nature. A few apparently unrecorded notes concerning the fish among islands off the island of Mount Desert may be given, which are probably indicative of what may be expected in other sections.

Mr. W. I. Mayo, who has fished herring brush-weirs at the Cranberry Isles for many years, and is a life-long fisherman in that section, communicates the intelligence that salmon were first observed about those islands in 1888. On June 17 a salmon, weighing 20 pounds, was taken in a herring weir, and on June 19 another, weighing 19 pounds, was caught. On July 14 of the same year 6 salmon, weighing 4 to 6 pounds apiece, were secured, but were liberated on account of their size. During the four years intervening between 1888 and 1893 none was taken around these islands, but in June of the latter year they reappeared. On June 11 a salmon weighing 15 pounds was taken in a weir, and on various occasions during that month a number weighing 12 to 15 pounds each were caught by boat fishermen on trawl lines fished for cod.

The trawls were baited with herring and set on the bottom in rather deep water. Mr. Mayo states that these were the first salmon ever taken on trawl lines in that region. The Cranberry Isles lie off the southeastern part of Mount Desert Island, and are about 25 miles east from Penobscot Bay and about 35 miles in a straight line from the mouth of the Penobscot River.

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On the Massachusetts coast salmon are now regularly taken each year at most of the important pound-net and trap fisheries. The largest numbers are caught in Cape Cod Bay. A State law prohibits the taking of salmon in nets and requires the return to the water alive of all fish so caught. This makes the fishermen diffident about giving information and renders difficult the determination of the abundance of the fish. On June 6, 1879 the *Cape Ann Advertiser*, of Gloucester, contained the following note:

"A 10-pound salmon was taken from a weir off Magnolia Thursday night. This is the first salmon caught off Cape Ann for over thirty years. On Saturday morning three more large salmon were taken. The fishermen are highly elated at the prospect of salmon-catching."

During the past five or six years a few salmon have been taken almost every season in the vicinity of Gloucester, the average annual catch being 4 to 6 fish. In 1888 the State fish commissioners reported the capture of 18 salmon in traps at Manchester and Gloucester. In 1893, 13 traps in the neighborhood of Gloucester took 5 salmon.

In December, 1891, a salmon weighing 28 pounds was caught on a cod trawl line set near Halfway Rock, off Salem Harbor, Mass.; Mr. William Dennett, of Gloucester, who secured the fish, reports that he sold it for $46. Mr. Samuel Wiley, of Gloucester, in September 1893, caught a salmon at sea off Gloucester on a trawl line fished for hake. These are the only instances that have been reported of the capture of salmon on a hook in the vicinity of Gloucester. As the trawl lines in question were set on the bottom at a depth of 20 or 25 fathoms, the fact that these two fish at least were swimming on the bottom may be considered established.

Relatively large numbers of salmon have recently been taken in the pound nets of Cape Cod Bay. Capt. Atkins Hughes, of North Truro, one of the best-informed and most reliable fishermen in the region, informs us that at North Truro, the principal pound-net center in the bay, about 70 large salmon have been annually caught for two or three years. The fish are taken throughout the entire pound-net season, but are most common in the early part of the fishing year (May and June). Some fish weighing 25 to 28 pounds have recently been caught. For two or three years he has noticed in the pound nets in October large numbers of young salmon, about 6 inches long; each net probably takes one or two barrels of these annually; he had never observed these small fish before in his long fishing career in that region. In 1893, however, rather less than the usual number of large salmon were observed, and very few of the small fish mentioned were taken.

Mr. Vinal N. Edwards, of the Fish Commission station at Woods Holl, Mass., states that in September, 1892, when he visited the Cape Cod region, a great many salmon were being taken in the pound nets. They weighed 4 or 5 pounds apiece. At one pound-net fishery in Provincetown he saw enough salmon to fill two sugar barrels.

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Concerning the occurrence of salmon in the Cape Cod region, Mr. Cheney, in the article previously mentioned, quotes Hon. Eugene G. Blackford, of New York, as follows:

“We get every winter a few fish from the Atlantic coast that are evidently part of the schools of fish that run up into the Kennebec, Penobscot, and other eastern rivers. During November and December we had about 15 to 20 fish, weighing from 12 to 24 pounds each, that were caught in the mackerel nets in the vicinity of Provincetown and North Truro, Mass. These nets are set out from the Cape in very deep water.

“During the past two or three weeks we have received several specimens of very handsome salmon from Maine, where they have been caught by the smelt fishermen in their nets when they have been fishing for smelt. I think these catches of salmon go very far to prove that the schools of fish are not very far off from our shores during the time that they are not found in the rivers, and that both shad and salmon, when they leave our rivers, do not go either east or south, but are within 100 miles or so of the rivers where they were spawned. The fish are remarkable in being in splendid condition and perfect in form and appearance.”

Mr. Cheney thinks the salmon taken off Cape Cod belong in either the Merrimac River or the Penobscot River; and, as in the year in question fish were being caught at the mouth of the Penobscot at the same time they were being taken at Cape Cod, he thinks it probable that the fish in the latter region were from the Merrimac.

In the pound-net fishery of the northern coast of New Jersey the recent capture of salmon has been a subject of much interest to the local fishermen and of considerable importance to fish-culturists and naturalists.

For a number of years a few salmon have, from time to time, been taken in Sandy Hook Bay, but within the past two or three years there has been an increase in the number caught. At Belford, the principal fishing center in the bay, Mr. M. C. Lohsen states that some have been taken weighing from 12 to 40 pounds, and that in the spring of 1893 more than the usual number were caught in the pound nets. Mr. Harry White, of the same place, never took salmon in pound nets prior to 1891; he secured 1 that year and 2 in 1892, but failed to get any in 1893. Other fishermen, however, obtained one or two fish. The average weight of the salmon taken here is 12 to 15 pounds; the largest caught by Mr. White weighed 17 and one half pounds. Small ones, weighing half a pound each, are sometimes observed. It is only during the month of May that salmon are noticed on this shore. One weighing 16 pounds, taken in a pound net at this place in 1891, sold for $11; the following year two, with a combined weight of 23 pounds, sold for $15.95.

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In the vicinity of Long Branch, we are informed of the recent capture of a number of salmon in the pound nets set directly in the ocean. Mr. Ed. Hennessey, of North Long Branch, reports that in 1892 two salmon and in 1893 one salmon were taken in his pound; they weighed from 10 to 15 pounds each. In April, 1891, Messrs. Gaskins and Hennessey, of the same place, secured a salmon in their pound; this was the only one they ever took. Messrs. W. T. Van Dyke & Co., pound-net fishermen of Long Branch, communicate the following instances of the taking of salmon by them in 1893: May 10, 1 salmon weighing 9 1/2 pounds; May 11, 1 salmon weighing 13 1/2 pounds; May 17, 1 salmon, and May 18, 1 salmon, weight not given. Messrs. West and Jeffrey, pound-net fishermen at Long Branch, report that in 1892 they caught 2 small salmon.

In 1893, 3 fish were taken, as follows: May 10, a salmon weighing 19 pounds; May 18, 1 weighing 12 pounds; May 20, 1 weighing 10 pounds. Mr. Henry F. Harvey, who fishes a pound net at Mantoloking, N. J., about 35 miles south of Sandy Hook, communicates the information that in May, 1893, 2 salmon weighing 10 or 12 pounds each were taken at that place. None had ever before been caught there.

One of the most interesting facts at hand concerning the oceanic occurrence of the salmon has been noted in a previous paper in this Bulletin, (*) but may be again referred to in order to make the present article more complete. Instances of the capture or observation of salmon far out at sea or even at relatively short distances from land are very rare and are entitled to publication whenever noted.

About April 10, 1893 the mackerel schooner *Ethel B. Jacobs*, of Gloucester, Mass., was cruising for mackerel off the coast of Delaware. When in latitude 38 degrees, at a point about 50 miles ESE. of Fenwick Island light-ship, the vessel fell in at night with a large body of mackerel, and the seine was thrown round a part of the school. Among the mackerel taken was an Atlantic salmon weighing 16 pounds, which Capt. Solomon Jacobs, who was in command of the schooner, sent home to Gloucester. Capt. Jacobs informs us that the fish was fat and in fine condition. Some of the crew told the captain that there was another salmon in the seine, but it escaped over the cork line as the seine was being “dried in.” The light-ship mentioned is about 10 miles off the coast, so the place where these salmon were taken was about 60 miles from the nearest land.

The foregoing is the only instance known to this Commission of the capture of salmon so far at sea on the coast of the United States or of the taking of salmon in a purse seine with mackerel under any circumstances. Capt. S. J. Martin, the veteran fisherman of Gloucester, Mass., has never known of another such occurrence, and a special inquiry conducted by him among the mackerel fishermen of that port failed to disclose the knowledge among them of a similar case.

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Footnote: * Extension of the Recorded Range of Certain Marine and Freshwater Fishes of the Atlantic Coast of the United States.