

## XXVIII.—REPORT OF OPERATIONS AT THE NORTHVILLE AND ALPENA (MICH.) STATIONS, FOR THE SEASON OF 1882-'83.

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The season just closed was a favorable one for the work of this department, and to this circumstance is due, in part, the fact that the volume of results more than double those of any previous corresponding period. The principal feature of the season's work was the propagation of whitefish, and this service was conducted on a very largely increased scale of operations as contemplated at the outset. In order to provide increased hatching and storage facilities, a new station was established at Alpena, Mich., a hatchery being built and equipped expressly for the treatment of eggs of whitefish. About 42,000,000 eggs were safely laid in at this point, during the month of November, resulting in the hatching of over 32,000,000 minnows the following spring, nearly all of which were planted in the great lakes.

At the Northville hatchery, about 30,000,000 whitefish eggs were received, principally from Lake Erie fisheries; from these nearly 12,000,000 eggs were shipped, and 16,000,000 minnows hatched and deposited in the great lakes. Other varieties of eggs were handled at Northville, as follows: 277,000 lake trout from Lake Huron fisheries; 473,000 brook trout from the stock of breeders held at the Northville ponds; 7,000 rainbow trout, also from the Northville ponds; 1,400 German trout, shipped to this station through favor of Mr. Fred. Mather; and 20,000 land-locked salmon transferred from Grand Lake Stream, Maine. Some 1,500 German carp from the national carp-ponds at Washington were distributed in lots of twenty, to applicants from various Northwestern States. Two new fish-ponds, one 10 by 60 feet, and the other 10 by 83, were added to the plant of the Northville station; and another pond, 30 by 100, designed for carp or bass propagation, was in process of construction at the close of the season.

The general plan of operations in the collection and manipulation of the eggs and treatment of the minnows varies but little from the methods of the preceding season, and need not, therefore, be dwelt upon at length. A more detailed statement of the results of the work, together with a few random notes and suggestions, directly or indirectly relating thereto, may, however, be worthy of record.

Alpena, where the new hatching station for whitefish was recently

established, is a rapidly growing city of nearly 10,000 inhabitants, situated at the head of Thunder Bay, an indenture of western Lake Huron. Its chief exports are the products of the adjacent forests and of the fisheries. Although having no railroad facilities, the Thunder Bay River affords a fine harbor, capable of receiving the largest lake craft; first class and frequent boat service is therefore supplied during the season of navigation. Although no fishing-grounds of any account are found within a radius of 15 miles of the mouth of the river, Alpena is the natural center for the fishing interests of a considerable section. Indeed, the products, not only of the Thunder Bay fisheries, but of the shore fisheries for miles above and below, are compelled to go there to find prompt and satisfactory shipping service, as it is the only first-class harbor in that region. The principal fishing-grounds are the island shoals, the shoals near the mouth of the bay, the shore grounds above and below, and the "big reef," a stretch of comparatively shoal grounds out in the lake about 45 to 50 miles nearly due east from the mouth of the river. These islands, as in many cases is the case with the immediate base of operations along the main-land, are mere rocky or sandy wastes, uninhabited except during the fishing season by the sailing-craft fishermen, who find it impossible to handle their nets daily and port at Alpena, 15 to 25 miles away. Special sailers or tugs are employed to make daily or tri-weekly visits to these points to collect the fish and carry them in. Trap or pound nets are the apparatus usually employed off the islands and along the shore, though many small gill-net boats run to these grounds during the best of the spawning season. By far the most extensive gill-net operations are conducted by the fishing tugs that port at Alpena, and make daily trips, weather permitting, to the shoals near the mouth of the bay or to the "big reef" outside. Fishing at the latter point is a very laborious occupation, as the nets are set in water many fathoms deeper than is found over the inner shoals, and, being so far out, there is usually more or less sea, even with leeward winds prevailing. Moreover, the crews are employed in favorable weather sixteen to eighteen hours out of twenty-four. The boats steam out of harbor about 2 a. m., arriving at the grounds at daylight; the work of lifting and resetting the nets then goes on until 4 or 5 o'clock in the afternoon, the time of the return trip being occupied in cutting and cleaning the fish, unless a heavy sea and pitching of the boat prevents, in which case this work is done by the same crew upon arrival at shore.

Whitefish and lake trout comprise the principal varieties of fish brought to Alpena, though there is a sprinkling of wall-eyed pike, and some few herring. The trout and whitefish seldom mingle to any extent, though schools of each may run to the same grounds at different times. Whitefish, however, are seldom caught from the "big reef" grounds—nothing but trout.

The methods of preparing the fish for shipment depend largely on

the weather and their condition when brought in; but they are usually either frozen in shallow pans, or dressed (the entrails removed), washed and packed in ice in fish cars holding from 1,000 to 2,500 pounds each. The cars are then shipped by steamer, in the refrigerator apartment, with which some of the vessels plying between Detroit and Lake Huron ports are supplied, especially for the accommodation of this trade. The cakes of frozen fish from the pans, packed in boxes of a convenient size for handling, are also shipped in the vessel's refrigerator. But few fish are salted; nearly everything is shipped fresh to the real base of operations at Detroit, and stored in large refrigerators to meet the demand of the local and other markets for fresh fish.

The capital required to operate these fresh water fisheries on a large scale will not, of course, compare with the requirements of the large ocean fisheries; still, there are several firms interested in the business on Lake Huron, with headquarters at Detroit, whose investments in fish-tugs, fish-cars, nets, refrigerators, ice and store houses, etc., will exceed \$100,000 each.

There is a noticeable difference between the spawning runs of white-fish of the island region of Lake Erie and the Thunder Bay region of Lake Huron, both in the fish themselves and their movements. The former include but one variety, while the latter are represented by two distinct types, each running to different grounds at different times. One of these runs, composed of fish nearly identical in appearance with the Lake Erie fish, though a little larger and coarser, sets in along the shore from Oscoda to Alcona and Scarecrow Island; the other, the dark-green-backed variety, follows about a week later on the shoals near the mouth of the bay. The run of spawning-fish to the Lake Erie islands is a steady flow, lasting, usually, from 25 to 35 days, the daily average being much lighter than at some of the Lake Huron grounds, but much better sustained. At Thunder Bay and the shore grounds approaching thereto the spawners suddenly appear in vast schools, the run lasting about a week, then dropping away quite as suddenly as they appeared.

#### THE ALPENA HATCHERY.

This hatchery was built, equipped, and filled with eggs under the immediate supervision of my chief assistant, Mr. S. Bower, and subsequently superintended by Mr. S. P. Wires, a former employé of the Northville hatchery. I repeat the following description of the Alpena hatchery, written for the London exhibition:

“This hatchery was built in the fall of 1882. It is a one-story frame building, 30 feet wide by 60 feet long, having front and rear entrances, and amply lighted by fourteen windows. The main floor includes the hatching-room and an office and sleeping apartment 10 feet wide by 18 long. The space between the office and the opposite side is conveniently utilized for storage of tools, cans, egg cases, etc. The hatchery

is arranged and equipped with especial reference to the manipulation of the embryos and minnows of whitefish (*Coregonus clupeiformis*), the most valuable commercial species of the great lakes. Its nominal capacity is 100,000,000 eggs.

"The water is furnished by the Alpena Water Company of Alpena, being forced through wooden mains from Thunder Bay, an arm of Lake Huron. A 2-inch stream, under an average pressure of 20 pounds to the square inch, connects with the hatchery, the discharge being regulated by globe valves. The inlet pipe is laid underneath the building, near the front, and is tapped by four perpendicular arms, each discharging into the top tank of one of the four systems of tanks for supplying water to the hatching apparatus. Each system comprises a series of four rows of tanks, one row above the other. There are two tanks to each row, making eight tanks in the series, or thirty-two in all, each of which is 15 feet long by 12 inches wide and 10 inches deep. One series is the exact counterpart of another. A row of faucets on either side of the top tank, into which the water first enters, supplies two rows of hatching-jars, or incubators, which stand on shelves placed across the second tank below and discharge into the tank between, which, in turn, feeds a second series of jars, and so on. In this way the four rows of a series operate three double rows of jars, the water being used three times over. Overflows are provided at the ends of the tanks, which discharge into the next below.

"Each of these series of reservoirs is connected with larger tanks, into which the minnows are carried by the current as soon as hatched.

"The outflow openings of the tanks for the reception and storage of the minnows are protected by finely perforated tin boxes of sufficient dimensions to keep the little fish away from the vortex formed by the escaping fluid, where they would be liable to injury from the strong current. There are ten of these receiving tanks, with an aggregate capacity of 7,000 gallons."

Work on the building was begun October 1, and pushed rapidly forward to completion. The inside work was completed and jars placed in position in time for the first arrival of eggs, November 10. It should be stated that, although the capacity of the hatchery is 100,000,000 eggs, a partial equipment was decided on for its first season, in accordance with which only two hundred and eight jars were ordered and received.

The water is furnished free of cost by the company above referred to, which derives its supply, for ordinary purposes, through pipes tapping the bay a considerable distance above the city, where it is always perfectly clear and pure. Another inlet main, however, is laid to the river, just above the city limits; but this, fortunately, is opened only in case of fire. This water is generally murky with sediment and impurities, as the river is the vehicle for floating down vast numbers of logs from the pineries in the interior. Four fires occurred the past win-

ter while eggs were in the house, and though the influx of moss and sediment occasioned no loss of eggs, the greatest vigilance was demanded on each occasion to keep the faucets open and jars in operation. It was quite impossible to keep the flannel filters open, so they had to be removed until the influence of the river flushing had ceased to be felt. A repetition of this annoying feature is, however, hardly probable for more than another season, as the complaints of consumers and the increased consumption consequent upon a rapidly increasing population, must soon compel the company to increase their inlet capacity from the clear waters of the bay sufficient to meet the demands of all occasions.

Although the water company furnished water free of charge, and, in common with the citizens of Alpena, lent every encouragement to the work of the past season, it is possible that they may protest against granting further supplies on this basis when the work shall have been largely increased. In order, therefore, to insure a continuance of the present terms and relations with the company, I would recommend an early introduction of the McDonald system of hatchers, by which at least three times the hatching capacity of the apparatus now in use can be obtained with the same volume of water.

At the Northville station the question of water-power grows more and more important with each succeeding season, as the work increases. Although operations at the hatchery have not hitherto been sufficiently extensive to consume the entire flow from the supplying springs, the limit will soon be reached at the present rate of growth of the work, unless the apparatus now employed be supplanted by some system which shall include the McDonald repeating principle. Any system that combines maximum of capacity with minimum of water-power is, moreover, especially valuable for hatcheries supplied with spring water, which has first to be reduced in temperature by artificial processes or exposure.

#### PENNING WHITEFISH.

Our whitefish eggs were obtained, as usual, from the ripe fish found in the nets of the fishermen, men being sent out to take the eggs on the spot. While this plan is quite satisfactory under the most favorable circumstances, it is not very reliable, owing to the uncertainties of the weather at this season of the year. Moreover, the opportunities for getting eggs must, at the very best, be restricted to a narrow contingent, as it is well understood that not one fish out of a dozen is fit for use when caught, the rest being either unripe or spent. It is, therefore, important to note that experiments at the Northville hatchery, as well as at the Detroit hatchery of the Michigan commission, have demonstrated the perfect feasibility of holding the immature spawners in confinement until every egg has been secured, thus making it possible to save the entire crop of eggs not deposited by the fish themselves. The most of the stock of eggs at the Detroit hatchery the past season was obtained

in this way; and the very best eggs at the Northville hatchery were taken from fish brought from Lake Erie in casks and held in tanks in the hatchery from six to seventeen days, until they had matured. The high quality of the eggs in this particular instance may be credited to the fact that they could be taken with much greater care than is possible in the hurry and confusion of pound-net operations, and could be transferred at once to the hatching jars. For the approaching season we hope to apply this principle on a large scale for filling both the Alpena and Northville houses. Having found a suitable depth of pure water in some harbor, the immature fish can be conveyed thence from the fisheries in casks or tanks and held in pens, pools, or floating tanks until all have ripened.

#### THE LAKE TROUT WORK.

The lake-trout eggs brought forward at the Northville hatchery were obtained in the vicinity of Alpena, from fish taken in gill-nets set on the "big reef" and along the shoals at the mouth of the bay. Most of the eggs were taken by Mr. Wires, an expert, who at the same time initiated a force of men into the business, in order to be prepared for the collection of whitefish eggs, which was soon to follow on a much larger scale.

The weather was rather too warm at this time for shipping eggs, which accounts for the poor condition in which some of the cases arrived at Northville. Another season we hope to make a much better showing in quantity as well as quality. Plenty of experienced help can be obtained near the fisheries, and we now have a hatchery near by, in which the eggs can be stored until colder weather before shipping.

In all 277,000 of the lake-trout eggs were taken, as follows: October 18th, 5,000; 21st, 10,000; 23d, 12,500; 24th, 15,000; 27th, 37,500; 28th, 12,500; 30th, 32,500; November 3d, 50,000; 4th, 62,000, and 8th, 40,000.

The day the last trout eggs were taken (November 8) two ripe whitefish were brought in from the Partridge Point fisheries; the men were, therefore, transferred at once to whitefish operations.

Shipments of lake-trout eggs were made from Northville, as follows: November 26th, 50,000 to the central station at Washington, D. C.; December 27th, 100,000 to Fred. Mather, Newark, N. J., for reshipment to von Behr, Germany; December 30th, 50,000 to Fred. Mather, for the Société d'Acclimatation, Paris, France; and 3,000 (January 27th) to Fred. Mather for hatchery at Cold Spring Harbor, Long Island.

#### GERMAN TROUT.

Through favor of Messrs. Mather and Blackford some 5,000 trout eggs from Germany (species not stated) were shipped to Northville, arriving March 26. The eggs were so far advanced when shipped that about three-fourths of them hatched on the way; the remainder, in good condition, were placed at once in hatching-boxes and hatched in a few

days. The fry were treated the same as our native trout, but did not eat so readily at first, about one-fourth of them dying soon after the absorption of the umbilical sac, the most critical period of trout raising. Such, however, as commenced at once to take food have done very well, indeed, and are at the present writing (September 1) quite as large as the native trout of the same age.

#### RAINBOW TROUT.

In this connection I am compelled to record the first serious failure in the history of the Northville establishment. Our facilities being first-class, and having been uniformly successful in the propagation of trout, not excepting the preliminary experiments with rainbow trout for four seasons, I had confidently expected to embryonize from one to two hundred thousand eggs from the stock of *irideus* hatched and grown at this station; but we succeeded in getting only about 45,000 eggs (many of the females failing to mature their spawn), and in fertilizing but 15 per cent. of these, resulting in a hatch of 6,400 fish. The parent fish of both sexes were, and still are, perfectly normal, so far as conduct and appearances would indicate. The trouble, however, seems to have been entirely with the females, as the quantity and quality of the male principle was all that could be desired. Whatever the cause of the difficulty the effect was at once apparent in the abnormal character of the fluid surrounding the eggs. From most of the females the eggs would fall into the receiving pan like shot, accompanied by  $\frac{1}{2}$  to 1 fluid ounce of a watery substance, sufficient of which had been absorbed to prevent fertilization. If there was any doubt that absorption of water by a large percentage of the eggs had taken place before leaving the fish, it was dispelled by the fact that they were quite full and hard when taken and refused afterwards to take up more water. Moreover, the eggs from six females were found enveloped in the natural viscous fluid, and these were successfully fecundated.

Without attempting to account for the failure, I am inclined to think that the fish were overfed, and that the inflow to their pond gave them a current quite too slow and feeble, resulting for the most part in great inactivity and in their being in good condition for market at spawning time. As an experiment I propose to reduce their food allowance to the minimum, and place them in a good current of water in one of the long, narrow ponds lately constructed, the *irideus* being particularly fond of rapids and swift currents.

In appearance these eggs were almost identical with those of the *salvelinus*, being about the same size and fully as light colored. Though the most of them were a total loss, those that were fertilized produced exceedingly vigorous fry, which have since grown so rapidly that they are now larger than any of the species of same age heretofore grown at the hatchery.

The following table may be of value as showing the time of spawn-

ing, and the great variance of yield from fish of same age, all being three years old, with the exceptions noted. The eggs were counted at the rate of 400 to the fluid ounce, the accuracy of this standard having been determined by actual count:

Date eggs were taken.	Number females spawned.	Number eggs obtained.	Remarks.
1883.			
Feb. 13.....	2	2,400	
Feb. 14.....	1	300	Partly spent.
Feb. 15.....	6	4,800	One partly spent.
Feb. 16.....	3	1,100	
Feb. 19.....	4	2,575	
Feb. 20.....	5	3,250	6 ounces of water from the 5 fish.
Feb. 21.....	2	1,200	1 nearly spent.
Feb. 24.....	1	1,000	
Feb. 25.....	1	600	
Feb. 26.....	2	1,600	
Mar. 2.....	4	3,100	1 5 year-old.
Mar. 4.....	1	600	
Mar. 5.....	1	600	
Mar. 6.....	1	600	
Mar. 10.....	1	600	Partly spent.
Mar. 11.....	2	1,100	
Mar. 13.....	3	900	
Mar. 15.....	3	2,500	
Mar. 16.....	4	1,850	2 nearly spent.
Mar. 17.....	2	2,000	1 5-year old; eggs more highly colored.
Mar. 18.....	1	1,200	
Mar. 22.....	2	1,500	
Mar. 23.....	1	500	
Mar. 29.....	2	1,400	
Mar. 30.....	1	2,875	Large 5-year old; eggs all impregnated.
Mar. 31.....	1	1,000	
Apr. 2.....	1	300	
Apr. 6.....	1	300	
Apr. 8.....	2	8,000	1 5-year old; eggs in good condition.
Apr. 10.....	6	800	
Apr. 14.....	1	100	Nearly spent.
Apr. 19.....	1	300	
Total.....	68	45,150	

#### LAND-LOCKED SALMON.

A case of 20,000 eggs of this species was shipped to the station from Grand Lake Stream, Maine, arriving March 12 in most excellent condition. The loss while in the hatching boxes was very trifling, being less, in fact, than the subsequent loss of fish in the nursery tanks. The fry were disposed of as follows: May 28, delivered to Messrs. E. K. Simonds and A. M. Randolph 10,000, of which 8,000 were planted in Union Lake, Oakland County, and the remainder in Cooley Lake, same county; June 13, delivered 7,000 to same parties, who planted them all in Union Lake; June 14, delivered the remaining fry, about 1,800, to the Michigan Fish Commission. Total results, 18,800 fry.

Union Lake is a fair type of the many beautiful inland lakes dotting Oakland, and many other counties of the Lower Peninsula. It is about 8 miles in circumference, is deep and clear, and is fed principally by springs from the bottom, having no inlet except a small stream from Green Lake, near by, which has no visible inlet. A good plant of land-locked salmon was made in Union Lake last year, and this with the



recent liberal plants will, I have every reason to believe, permanently establish the species in these waters. The experiment is not without a successful precedent, the species having already been introduced and acclimatized, in this way, in waters of the same character in Kalkaska County, this State. Quite a number of adult specimens were taken from the waters referred to during the past year.

#### BROOK TROUT.

Our brook trout work was, on the whole, quite satisfactory. In all, 473,000 eggs were obtained, from which 357,000 eggs were shipped, and 50,000 fry hatched. Of the latter, 15,000 were delivered to the Ohio Fish Commission, April 10; the remainder were on hand at the hatchery at the close of the period covered by this report, though a few small shipments have since been made.

Between twenty and twenty-five thousand eggs were obtained from wild trout running up the waste stream from the ponds, which forms a natural raceway connecting with a branch of the River Rouge, a small stream well stocked with trout. Over 300 of these fish, of various sizes, and mostly males, were captured.

From the tables which follow it will be seen that 97,150 eggs were obtained from 422 spawners, 20 months old, an average of 230 eggs each; 184,660 eggs from 274 spawners, 30 months old, an average of 674; 168,700 eggs from 120 spawners, 42 and 54 months old and upwards, an average of 1,406; and 22,500 from 43 wild trout, an average of 524.

Eggs were shipped as follows:

Date.	Number.	Consignee.	Remarks.
1882.			
Nov. 26	50,000	Central hatching station, Washington, D. C.	Shipped in United States Fish Commission car No. 1; arrived in good condition.
Dec. 27	25,000	Fred Mather, Newark, N. J.	Arrived in good condition and reshipped to Herr von Behr, Germany.
1883.			
Jan. 9	10,000	E. G. Blackford, Fulton Market, New York.	Arrived in fair condition and reshipped to Bogota, South America.
26	50,000	Fred Mather, Cold Spring Harbor, New York.	Arrived in good condition.
27	50,000	Fred Mather, Cold Spring Harbor, New York.	Arrived in good condition.
29	50,000	Fred Mather, Cold Spring Harbor, New York.	Arrived in good condition.
31	20,000	Fred Mather, Newark, N. J.	Arrived in good condition and reshipped to the Deutsche Fischerel Verein, Berlin.
31	20,000	Fred Mather, Newark, N. J.	Arrived in good condition and reshipped to Société d'Acclimatation, Paris.
31	10,000	Fred Mather, Newark, N. J.	Arrived in good condition and reshipped to Mr. W. Oldham Chambers, England.
Feb. 3	72,000	Central hatching station, Washington, D. C.	Arrived in good condition.
	357,000	.	.

Mr. Mather reports that the shipments to Germany, France, and England arrived in first-class order.

Below are the tables of brook-trout eggs obtained, showing the daily results for the spawning season :

*From trout forty-two and fifty-four months old and upwards.*

Date.	Females spawned.	Eggs obtained.	Date.	Females spawned.	Eggs obtained.	Date.	Females spawned.	Eggs obtained.	Date.	Females spawned.	Eggs obtained.
1882.			1882.			1882.			1882.		
Oct. 26	1	2,000	Nov. 13	2	2,000	Nov. 24	3	8,800	Dec. 9	1	900
Nov. 2	1	1,000	14	6	9,000	25	2	2,200	10	1	1,100
3	2	2,400	15	3	2,400	26	4	5,200	12	2	2,900
4	1	1,300	16	5	10,000	27	2	3,600	15	2	2,400
5	1	1,500	17	5	7,200	28	3	3,200	18	1	1,200
7	5	8,200	18	2	3,300	29	5	5,000	19	1	800
8	3	5,100	19	1	1,100	30	1	1,200	21	1	900
9	4	4,800	20	5	6,400	Dec. 1	2	3,000	29	1	1,300
10	2	2,100	21	4	4,800	2	3	5,800	30	1	800
11	3	9,500	22	7	8,500	3	4	5,000	Totals	120	168,700
12	5	8,700	23	5	10,500	4	4	5,400			

*From trout thirty months old.*

Date.	Females spawned.	Eggs obtained.	Date.	Females spawned.	Eggs obtained.	Date.	Females spawned.	Eggs obtained.	Date.	Females spawned.	Eggs obtained.
1882.			1882.			1882.			1882.		
Oct. 29	1	410	Nov. 14	3	1,700	Nov. 30	6	5,200	Dec. 16	1	500
30	1	350	15	6	3,800	1	8	3,000	17	5	1,100
Nov. 31	2	1,400	16	20	13,400	Dec. 2	14	3,800	18	2	3,200
1	2	1,100	17	14	3,600	3	4	3,600	20	2	1,000
3	6	3,100	18	2	1,000	4	4	4,200	21	4	4,100
4	2	950	20	5	3,950	5	3	3,500	22	3	2,700
5	1	450	21	9	5,800	6	2	2,000	25	2	800
6	8	3,900	22	5	4,400	7	8	900	26	1	850
7	1	500	23	7	6,600	8	1	800	27	4	2,600
8	9	3,700	24	3	1,600	9	10	4,400	28	1	900
9	13	7,800	25	3	1,700	10	1	1,100	29	1	1,100
10	11	4,700	26	12	3,100	11	4	4,200	30	1	550
11	6	3,050	27	6	3,700	12	6	5,400	Totals	274	184,660
12	9	1,700	28	8	7,600	13	1	1,300			
13	8	1,100	29	6	5,500	14	1	7,200			

*From trout twenty months old and from the wild trout.*

Twenty months old.			Wild trout.		
Date.	Females spawned.	Eggs obtained.	Date.	Females spawned.	Eggs obtained.
1882.			1882.		
Nov. 2	15	2,000	Nov. 15	5	1,200
3	1	200	16	3	400
4	1	600	17	60	14,000
5	25	6,000	20	50	13,000
6	25	5,500	24	46	11,000
7	1	250	28	32	7,000
10	1	14,000	Totals	422	97,150
11	24	6,000			
12	65	16,000			
1882.			1882.		
Oct. 17	1	200	Nov. 17	2	8
18	2	450	18	1	350
19	1	300	19	2	550
22	1	1,500	20	4	1,200
23	1	1,200	21	1	250
24	1	500	22	2	650
25	1	300	23	4	1,800
26	1	750	24	1	300
29	3	1,500	25	1	800
31	0	1,800	26	1	300
Nov. 1	4	2,400	Totals	48	22,500

## THE WHITEFISH WORK.

At Northville the first lot of whitefish eggs was received November 16 and the last December 8. The first eggs were taken at North Bass Island, Lake Erie, November 11, and the last at the same place, December 7. With the exception of a small lot furnished by Alpena after the hatchery there was filled, the Northville supply was obtained wholly from fisheries at North Bass, Middle Bass, and Put-in Bay Islands, Lake Erie. The total receipts at Northville from all sources amounted to 30,200,000. Some three or four million of these arrived after the hatching jars were all filled; but they were very successfully carried forward in the shipping cases, at a temperature of 32° to 35°, until shipments and losses in the jars had made room for them. The eggs began hatching February 20, and completed April 1; average period of incubation, 106 days.

The water temperature varied from 32° to 54°, averaging about 40 $\frac{3}{4}$ °.

At Alpena, the first eggs were taken November 10 and the last November 27, chiefly, however, from the 12th to the 20th. Most of the supply came from the pound-net fisheries at Scarecrow Island and Alcona and the gill-nets of the tug Wayne Isbell, which was fishing on the shoals at the mouth of the bay, though eggs were obtained from the tugs Minna, Lida, and McKinnon, and the fisheries at Oscoda, Ossineke, North Point, Misery Bay, Sugar Island, and Partridge Point.

The water temperature was quite high—50° to 55°—when the first eggs arrived, but soon went down below 40°, and remained uniformly low throughout the season, the average being about 35°. The eggs began hatching April 8, and all were out May 16. Average period of incubation, 160 days.

Eggs were shipped from Northville, as per the following table:

Date.	Number of eggs.	C consignee.	Remarks.
1882.			
Nov. 20	1,000,000	Central hatching station, Washington, D. C.	Shipped by United States Fish Commission car No. 1, in charge of G. H. H. Moore.
Dec. 27	50,000	Thomas Hughlett, Druid Hill hatchery, Baltimore, Md.	Arrived in good order; loss, 748 eggs.
27	100,000	Thomas Hughlett, Easton, Md.	Arrived in good order; loss, 48 eggs.
27	500,000	Fred Mather, Newark, N. J.	Arrived in good condition, and forwarded to the Deutsche Fischerel Verein, Berlin, arriving there in excellent condition.
27	200,000	.....do.....	Arrived in good condition, and forwarded to the Société d'Acclimatation, Paris, arriving there in excellent condition.
27	10,000	.....do.....	Received in good order and forwarded to G. Ebrocht, Geestemunde, Germany. Not heard from.
28	1,000,000	R. O. Sweeney, Saint Paul, Minn.	Arrived in "most excellent condition."
30	1,000,000	.....do.....	Do.
1883.			
Jan. 1	250,000	S. R. Throckmorton, San Leandro, Cal.	Not heard from.
3	200,000	E. B. Hodge, Plymouth, N. H.	Arrived in good order and placed in water of a temperature of 33° to 34°; hatched April 15 to 17; planted April 19; 193,000 in Newfound Lake, Grafton County, New Hampshire.
8	1,000,000	R. O. Sweeney, Saint Paul, Minn.	Received in good condition; loss very small.
9	250,000	S. R. Throckmorton, San Leandro, Cal.	Not heard from.

Date.	Number of eggs.	Consignee.	Remarks.
1883.			
Jan. 10	250,000	S. G. Worth, Raleigh, N. C. . . . .	Received in good order; loss very small.
11	1,000,000	R. O. Sweeny, Saint Paul, Minn. . . . .	Arrived in good order; loss very light.
12	1,000,000	do . . . . .	Do.
20	2,000,000	Seth Weeks, Cory, Pa. . . . .	Do.
Feb. 12	1,000,000	Fred Mather, Cold Spring Harbor, N. Y. . . . .	Arrived in good condition, though so far advanced that a few hatched on the way.
22	1,000,000	Charles G. Atkins, Bucksport, Me. . . . .	General condition on arrival good, but a small percentage hatched on the way.
Total . . . . .	11,810,000		

The fry from Northville were distributed by car No. 2, of the United States Fish Commission, in charge of J. F. Ellis, and assistants N. Simmons, C. H. Ellis, and J. H. Horan. The Alpena fry were distributed by car and boat, the former connecting with the latter at Bay City and Saint Ignace, Mich. In all, the car was run over 7,000 miles. No charge for dispatching service was made by any of the railroad companies excepting the New York Central and Chicago and Northwestern. In making deposits care was taken to convey the minnows to a point not less than 2 miles from shore, tugs being employed for this purpose when procurable. Thirteen trips were made by the car, as follows:

*Trip No. 1.*—Left Northville February 24, at 4 p. m., with 2,000,000 minnows in eighty cans having a total capacity of 600 gallons; proceeded to Toledo by the Flint and Père Marquette Railroad; thence by the Lake Shore and Michigan Southern to Cleveland, where the fish were deposited in Lake Erie, at 7.30 p. m., February 25. The fish were taken from water at a temperature of 40°, held in the car twenty-seven hours in water varying from 35° to 43°, and deposited, in good condition, in water at 34°. The car returned to Northville by same route as outward trip, arriving February 27.

*Trip No. 2.*—Left Northville at 3 p. m., February 28, with 3,000,000 minnows in seventy-six cans; proceeded to Detroit by the Flint and Père Marquette Railroad; thence to Niagara Falls by the Great Western Division of the Grand Trunk; thence by the New York Central to Charlotte; thence, by the Rome, Watertown and Ogdensburg, to Oswego, where the fish were deposited, in good condition, at 1.30 p. m., March 2, in Lake Ontario. Temperature of water from which the fish were taken, 44°; average temperature of water in the can, 37°, varying from 35½° to 39°; temperature of lake at time of deposit, 34°. The car returned by same route as outward trip, arriving at Northville March 5. Arrangements had been made with the Rome, Watertown and Ogdensburg Railroad Company for free dispatching service between Suspension Bridge and Lake Ontario points, but the loss of a bridge near Charlotte made it necessary to take another route as far as Charlotte.

*Trip No. 3.*—Car left Northville at 3 p. m., March 7, with 3,000,000 minnows in seventy-six cans; proceeded to Charlotte, N. Y., by same

route as preceding trip, and deposited the fish in Lake Ontario, near Charlotte, in good condition at 5 p. m., March 8. Temperature of water from which the fry were taken,  $45^{\circ}$ ; temperature of water in car, from  $35\frac{1}{2}^{\circ}$  to  $39^{\circ}$ ; temperature of lake at time and place of deposit,  $33^{\circ}$ . On the return trip the car met with a slight accident at Charlotte, and another, with more serious results, near Suspension Bridge, on the Canada side. While switching to the main track at Charlotte, the engineer in charge of the yard engine very carelessly took a side track flanked with piles of ties, and, in turning a curve, the car received a severe raking along one side, sustaining considerable damage. Repairs were made by the company at their shops at Rochester. The accident near Suspension Bridge occurred while the car was side-tracked. Another car was backed against it with such violence that both platforms were broken and one end stove in. Mr. Ellis was in his state-room at that end of the car when the crash came, but escaped with slight injuries. The car was repaired by the Grand Trunk Company, at their car-shops, at London. The company also replaced broken crockery, etc. The car was detained nearly five days.

*Trip No. 4.*—This trip was an exact duplicate of trip No. 2, in regard to the number of cans used, the number of minnows carried, the route taken, and point of deposit. The car left Northville at 3 p. m., March 15, and arrived at Oswego about 3 p. m. the day following. The fish went through in good order, and were placed in Lake Ontario at 4 p. m. Temperature of water at the hatchery when the fish were removed,  $43^{\circ}$ ; temperature of water in the car,  $37^{\circ}$  to  $41^{\circ}$ ; temperature of lake at time of deposit,  $35^{\circ}$ .

*Trip No. 5.*—Car left Northville at 2 a. m., March 20, with 3,000,000 minnows in seventy-six cans; proceeded to Toledo over the Flint and Père Marquette Railroad; thence to Monroeville by the Lake Shore and Michigan Southern; thence by the Baltimore and Ohio to Sandusky, arriving at 10 a. m. on the same day. The car was transferred to the boat-landing an hour later. At 2 p. m. the fish were all placed in six cylinder and six ordinary cans and carried aboard the steamer *Eagle*, which left at 3 p. m. for the islands. Two hours later, when near Kelley's Island, the largest of the group, one-half the fish were deposited, the captain very kindly slacking the boat for this purpose. The remainder of the fish were planted off the west side of Put-in-Bay. Temperature of water at hatchery when fish were moved,  $39^{\circ}$ ; temperature of water in car, from  $35^{\circ}$  to  $37^{\circ}$ ; temperature of lake,  $35^{\circ}$ .

*Trip No. 6.*—The car left Northville at 2 a. m., March 29, with 2,000,000 minnows in sixty-four cans, and proceeded to Sandusky by same route taken in trip No. 5. As the regular daily boat to the islands was too crowded with freight to take the cans, the captain furnished a tug, which answered the purpose well. The fish were planted near Put-in-Bay Island at 7 p. m. Temperature of water at hatchery when the fish were moved,  $45^{\circ}$ ; temperature of water in the car,  $37^{\circ}$  to  $39^{\circ}$ ; tempera-

ture of lake at time of deposit, 34°. This trip cleared the tanks of the Northville hatchery, with exception of a few hundred retained for experiments in feeding.

*Trip No. 7.*—The starting-point for the car in the first four trips with fish from Alpena was at Bay City, and for the remaining three trips, Point Saint Ignace, the extreme southeastern point of the Upper Peninsula.

The fish for this trip, 2,000,000 in number, were shipped from Alpena in charge of two messengers, per steamer Arundell, leaving at 3 p. m., April 24, and arriving at Bay City the following morning. They were then hauled to the car, nearly one-half mile, and placed in fifty of the automatic cans. The fish were in fine condition when the boat arrived, the water having been replaced with a fresh supply from the lake every two hours since leaving Alpena, but some were lost before delivery to the car, too few cans being employed in making the transfer from the boat. The car left Bay City at 11 a. m., going to Holly over the Flint and Père Marquette Railroad; thence by the Detroit, Grand Haven and Milwaukee road to Grand Haven, the fish being deposited about 5 miles southwest of this point, in Lake Michigan, at 10 a. m., April 26. Temperature of water at hatchery when fish were moved, 39½°; temperature of water used between Alpena and Grand Haven, 36° to 44°; temperature of lake at time and place of deposit, 38°. About 500 pounds of ice were used by the car on this trip.

*Trip No. 8.*—The fish for this trip, 2,000,000 in number, were delivered to the car and placed in sixty-four automatic cans on the morning of April 27, having been shipped from the hatchery about noon the day previous. The car left Bay City at 2.40 p. m., and was run direct to Ludington, the point of deposit, over the Flint and Père Marquette Railroad. The fish were deposited about 3 miles from Ludington, in Lake Michigan, at 10.30 a. m., April 28. Temperature of water at hatchery when fish were moved, 38½°; of the water on fish in transit, 38° to 45°; of the lake, where the fish were released, 38°. Five hundred pounds of ice were used on this trip.

*Trip No. 9.*—The car left Bay City at 7.15 a. m., May 1, with 2,000,000 minnows, shipped from Alpena the day before; proceeded to Reed City by the Flint and Père Marquette road; thence to Petoskey, the point of deposit, by the Grand Rapids and Indiana road. The fish were deposited in Lake Michigan at 8 a. m., May 2. Temperature of water at hatchery when fish were moved, 40°; of the water in transit, 38° to 45°; of the lake where the fish were set free, 35°. Ice used, 1,000 pounds.

*Trip No. 10.*—The car left Bay City at 8.45 p. m., May 4, with 4,000,000 minnows in 74 automatic cans; was dispatched to Flint over the Flint and Père Marquette road, thence to Chicago over the Chicago and Grand Trunk; thence by the Chicago and Northwestern to Kenosha and Milwaukee, the fish being planted one-half at the former and one-half at the latter place, in Lake Michigan, at 2 and 5 p. m., respectively,

May 5. Temperature of water at the hatchery when fish were moved, 40°; of the water in transit, 38° to 45°; of the lake where fish were planted, 42° at Kenosha and 39° at Milwaukee. Ice used, 1,200 pounds. The car proceeded from Milwaukee to Negaunee by the Chicago and Northwestern; thence by the Marquette, Houghton and Ontonagon to Marquette; thence by the Detroit, Mackinac and Marquette road to Point Saint Ignace.

*Trip No. 11.*—Left Saint Ignace at 9 a. m., May 10, with 2,000,000 minnows in 50 automatic cans, going over the Detroit, Mackinac and Marquette road to Marquette, where the fish were deposited in Lake Superior, 2 miles out, at 7.30 p. m., same day. Temperature of water at hatchery, 43½°; of the water in transit, 38° to 46°; of the lake at point of deposit, 34°. Large fields of ice were observed in the lake near Marquette.

*Trip No. 12.*—Left Saint Ignace at 8 p. m., May 14, with 2,000,000 minnows in 50 automatic cans, going to Marquette as before, and connecting there with the Marquette, Houghton and Ontonagon road for L'Anse, where the fish were deposited in Lake Superior, 3 miles out, at 7.30 p. m., May 15. Temperature of water at hatchery, 43½°; of the water in transit, 38° to 41°; of the lake where the fish were released, 35°.

*Trip No. 13.*—Left Saint Ignace by the usual route to Marquette, at 8 a. m., May 19, with 2,000,000 minnows in 50 cans; proceeded from Marquette by the Marquette, Houghton and Ontonagon road to Lake Michigamme, where 1,000,000 fish were deposited at 9.30 p. m., same day. The car then returned by the last-named road to Negaunee and proceeded thence by the Chicago and Northwestern road to Milwaukee, where the remaining million fish were planted in Lake Michigan, at 8 a. m., May 22. Temperature of water at hatchery, when fish were moved, 43½°; of the water in transit, 42° to 50°; of Lake Michigamme, 40°; of Lake Michigan, 43°. Number of pounds of ice used, 1,500. The Michigamme plant was made at the request of the Michigan Fish Commission. This trip closed the season at Alpena. The car then went on to Chicago by the Chicago and Northwestern; to Toledo by the Lake Shore and Michigan Southern, arriving May 23; thence to Washington by the usual route.

While the car-work in connection with the Alpena distribution was in progress seven lots of fish were run out by boat from Alpena, and deposited in the bay and down the shore of the lake (Huron) as follows:

April 23, near Sulphur Island .....	2, 000, 000
April 28, near Alcona .....	3, 000, 000
April 29, near North Point .....	2, 000, 000
May 2, near Black River.....	2, 000, 000
May 6, near Ossineke . . . . .	3, 000, 000
May 7, near Oscoda . . . . .	2, 000, 000
May 16, near Partridge Point.....	2, 000, 000

On May 12, 100,000 fish were deposited in Long Lake, an inland sheet of considerable dimensions, near Alpena; 15,000 were also deposited in Lake Huron, near Oscoda, to the credit of the Michigan commission, to offset a like number delivered from the Detroit hatchery to Hiram Lindsey, April 25, for deposit in Lindsey Lake, Indiana, to the credit of the United States Commission; making, in all, 32,115,000 whitefish as the result of the season's work at Alpena.

For experiment a few hundred of the fry were left in one of the tanks when the hatchery was closed, May 16. From one of the inlet pipes the tank containing the fry was supplied with a small dribblet of water, sufficient, perhaps, to amount to 200 gallons per day. It was expected that all would die soon after the absorption of the sac, as the young of this species almost invariably do when confined in this way, even when supplied with the water of their natural habitat, as they were in this instance; but on visiting the hatchery, August 18, I found some fifty to sixty specimens, active and vigorous, varying from 1 to 3 inches in length. These fish had derived their food supply wholly from the water, no artificial aid or food having been given them.

The experiment of growing young whitefish in confinement, with the aid of artificial feeding, is now being successfully conducted at the Northville hatchery. We started in with 1,200 to 1,500 of the fry, hatched March 15, and to-day (September 1) have 276 fish, the least of which is not less than 3, and the greatest not less than 6, inches in length. So far as I am aware this eclipses any attempt of the kind hitherto recorded. They were treated much the same as the young trout, being fed wholly on liver reduced to various degrees of fineness, according to the size of the fish. Although very small and frail at first, they grow very rapidly when once started.

RECAPITULATION.

Whitefish were distributed to the great lakes as follows:

To Lake Ontario.....	9, 000, 000
To Lake Erie.....	7, 000, 000
To Lake Huron.....	16, 000, 000
To Lake Superior.....	4, 000, 000
To Lake Michigan.....	11, 000, 000
	47, 000, 000

The following table combines the results of both stations for the season:

	Eggs received.	Eggs shipped.	Fish hatched.	Fish shipped.
German trout.....	1, 400		1, 330	
Rainbow trout.....	45, 150		6, 400	
Brook trout.....	473, 000	357, 000	50, 000	15, 000
Land-locked salmon.....	20, 000		19, 800	18, 800
Lake trout.....	277, 000	203, 000		
Whitefish.....	71, 800, 000	11, 810, 000	48, 118, 000	48, 115, 000



Record of temperature and weather observations made at the United States Fish Hatchery, Northville, Mich., from November 1, 1882, to July 1, 1883.

Date.	Temperature of-					Wind.						Condition of-			
	Air, 8 a. m.	Water, 8 a. m.	Air, 12 m.	Water, 12 m.	Air, 5 p. m.	Water, 5 p. m.	Direction, 8 p. m.	Intensity, 8 p. m.	Direction, 12 m.	Intensity, 12 m.	Direction, 5 p. m.	Intensity, 5 p. m.	Skyl, 8 p. m.	Skyl, 12 m.	Skyl, 5 p. m.
Nov. 1 1882.	56	50	42	44	51		N. E.	Briak	N. W.	Mild	N. E.	Light	Clear	Clear	Clear
Nov. 2	32	47	43	46	40		N. E.	do	N. E.	do	N. E.	do	do	Cloudy	do
Nov. 3	31	45	43	46	38		N. E.	Mild	S. E.	do	S. E.	Calm	Cloudy	Clear	Hazy
Nov. 4	36	45	43	46	38		S. E.	Light	S. E.	Light	S. E.	do	Cloudy	Cloudy	do
Nov. 5	40	44	46	47	45		S. E.	do	S. E.	do	S. E.	do	do	do	do
Nov. 6	42	46	47	47	44		S. E.	do	S. E.	do	S. E.	do	do	do	do
Nov. 7	38	48	50	50	50		S. S. W.	Calm	W.	Briak	W.	do	Foggy	do	do
Nov. 8	32	46	54	49	50		N. W.	do	S. W.	Calm	S. W.	do	do	do	do
Nov. 9	47	48	52	48	52		N. S. E.	Mild	S. E.	do	E.	do	Foggy	do	do
Nov. 10	48	50	53	50	52		S. E.	do	S. E.	Mild	W.	do	do	do	do
Nov. 11	58	51	66	53	63		S.	Light	W. W.	Briak	W. W.	do	Cloudy	do	do
Nov. 12	57	52	52	54	50		S. W.	Briak	W. W.	do	W. W.	do	do	do	do
Nov. 13	32	46	30	45	28		N. W.	Light	N. W.	do	N. W.	Briak	Clear	do	do
Nov. 14	28	42	37	46	33		W. W.	do	N. W.	do	N. W.	do	Cloudy	do	do
Nov. 15	27	42	42	46	40		N. W.	do	W.	Briak	W.	Calm	do	do	do
Nov. 16	36	47	47	46	42		W.	Calm	W.	Calm	S. W.	do	Cloudy	do	do
Nov. 17	32	45	40	46	32		W.	Briak	E.	Light	E.	Light	do	do	do
Nov. 18	28	44	40	46	31		E.	Calm	N.	Calm	N. W.	Calm	Clear	do	do
Nov. 19	36	44	40	46	34		N. E.	Calm	N. E.	Calm	N. W.	do	do	do	do
Nov. 20	19	42	39	45	32		N. W.	Calm	S. E.	do	E.	do	Clear	do	do
Nov. 21	30	43	40	45	38		N. W.	Light	S. E.	do	S. W.	Light	Cloudy	do	do
Nov. 22	32	44	40	46	38		W.	do	S. W.	do	S. W.	Calm	do	do	do
Nov. 23	34	44	35	44	35		S. E.	do	S. W.	Briak	Strong	do	do	do	do
Nov. 24	30	40	33	41	32		N. W.	Strong	N. W.	Light	S. W.	Light	do	do	do
Nov. 25	26	40	36	42	33		W.	Mild	S. W.	Strong	S. W.	Calm	Clear	do	do
Nov. 26	28	40	36	42	32		S. E.	Light	W.	do	W.	do	Cloudy	do	do
Nov. 27	28	40	34	42	30		N. W.	Calm	W.	do	W.	do	Cloudy	do	do
Nov. 28	28	40	28	40	28		N. E.	Light	E.	Briak	E.	Light	do	do	do
Nov. 29	19	38	32	40	28		N. E.	do	N. E.	Light	N. E.	do	do	do	do
Nov. 30	19	38	32	40	28		N. W.	do	N. W.	Briak	N. W.	Strong	do	do	do
Nov. 1	28	39	30	40	32		S. W.	do	W.	Mild	S. W.	Mild	do	do	do
Dec. 2	30	42	24	40	23		N. W.	Briak	N. W.	do	N. E.	do	do	do	do
Dec. 3	20	38	27	40	22		N. W.	Mild	S. W.	do	S. W.	Calm	do	do	do
Dec. 4	26	38	37	40	37		S. W.	do	W.	Mild	S. W.	Fresh	do	do	do

Record of temperature and weather observations made at the United States Fish Hatchery, Northville, Mich., &c.—Continued.

Date.	Temperature of—						Wind.						Condition of—			
	Air, 8 a. m.	Water, 8 a. m.	Air, 12 h.	Water, 12 h.	Air, 5 p. m.	Water, 5 p. m.	Direction, 8 a. m.	Intensity, 8 a. m.	Direction, 12 h.	Intensity, 12 h.	Direction, 5 p. m.	Intensity, 5 p. m.	Sky, 8 a. m.	Sky, 12 h.	Sky, 5 p. m.	
	° F.	° F.	° F.	° F.	° F.	° F.										
1882.																
Dec. 5	38	34	36	40	30	33	N. W.	Brisk	W. W.	Light	W. W.	Light	Cloudy	Cloudy	Cloudy	
Dec. 6	27	38	34	40	22	33	N. W.	Brisk	W. W.	Strong	W. W.	do	do	do	do	
Dec. 7	4	32	8	33	9	38	N. W.	Strong	N. W.	Strong	W. W.	Brisk	Clear	Clear	Clear	
Dec. 8	0	34	10	36	6	38	N. W.	Brisk	N. W.	Brisk	W. W.	do	Cloudy	Cloudy	do	
Dec. 9	12	36	23	33	20	38	S. W.	Light	S. W.	Light	W. W.	do	do	do	do	
Dec. 10	30	37	32	38	24	39	S. W.	do	S. W.	do	S. W.	do	do	do	do	
Dec. 11	31	38	35	38	21	39	N. W.	Brisk	S. W.	do	S. W.	do	do	do	do	
Dec. 12	30	38	38	38	34	40	S.	Light	S. E.	do	S. E.	do	do	do	do	
Dec. 13	83	40	23	40	18	38	W.	Light	W.	Brisk	S. E.	Strong	do	do	do	
Dec. 14	20	38	24	40	21	40	N. W.	do	N. W.	Light	N. W.	Light	do	do	do	
Dec. 15	11	35	20	35	17	34	N. W.	do	N. W.	Calm	N. W.	do	do	do	do	
Dec. 16	17	35	24	32	22	36	N. W.	Brisk	N. W.	Brisk	N. W.	do	do	do	do	
Dec. 17	4	36	18	37	20	36	S. W.	Light	S. W.	Light	S. W.	do	Cloudy	Cloudy	do	
Dec. 18	15	37	28	38	28	38	W.	do	E.	do	S. E.	do	Clear	Clear	do	
Dec. 19	28	37	29	37	30	38	E.	do	E.	do	S. E.	do	Clear	Clear	do	
Dec. 20	38	38	32	39	33	39	E.	do	S. E.	do	S. E.	do	Cloudy	Cloudy	do	
Dec. 21	34	40	42	42	42	42	E.	do	S. E.	do	S. E.	do	do	do	do	
Dec. 22	30	43	35	44	35	44	S. W.	Calm	S. E.	Calm	S. E.	do	do	do	do	
Dec. 23	21	42	32	41	34	41	W.	Light	W.	Light	W. W.	do	do	do	do	
Dec. 24	28	40	35	41	41	41	S. W.	do	W.	do	W.	do	do	do	do	
Dec. 25	32	42	45	42	43	43	S. W.	do	S.	do	S.	do	do	do	do	
Dec. 26	32	42	42	42	41	43	E.	do	E.	do	E.	do	do	do	do	
Dec. 27	39	41	33	44	44	44	E.	Mild	E.	do	E.	do	do	do	do	
Dec. 28	28	44	35	44	33	44	N. E.	Calm	S. E.	Calm	S. E.	do	do	do	do	
Dec. 29	27	42	34	43	30	42	W.	Light	S. W.	do	W.	Light	do	Clear	Clear	
Dec. 30	24	41	32	41	28	42	S. W.	do	S. W.	do	S. W.	Brisk	do	Cloudy	do	
Dec. 31	22	40	28	40	26	41	W.	do	N. W.	do	N. W.	Light	do	do	do	
1883.																
Jan. 1	18	35	24	38	19	38	W.	do	W.	do	W.	Calm	Cloudy	Cloudy	Cloudy	
Jan. 2	18	37	22	38	28	38	N. W.	Brisk	N. W.	do	N. W.	do	do	do	Clear	
Jan. 3	18	37	27	37	18	37	S. W.	do	W.	Light	W.	Light	do	do	do	
Jan. 4	6	36	17	37	19	37	N. W.	Light	N. E.	Light	N. E.	do	Cloudy	Cloudy	do	
Jan. 5	17	36	18	36	18	37	E.	do	N. E.	do	N. E.	Calm	do	do	do	
Jan. 6	18	38	18	38	25	38	S.	Calm	N. W.	Calm	S. W.	do	do	do	do	
Jan. 7	24	38	30	39	21	40	W.	Brisk	N. W.	Light	W.	do	do	Clear	Clear	



Record of temperature and weather observations made at the United States fish hatchery, Northville, Mich., f.c.—Continued.

Date.	Temperature of—				Wind.				Condition of—							
	Air, 8 a. m.	Water, 8 a. m.	Air, 1 p. m.	Water, 1 p. m.	Air, 5 p. m.	Water, 5 p. m.	Direction, 8 a. m.	Intensity, 8 a. m.	Direction, 1 p. m.	Intensity, 1 p. m.	Direction, 5 p. m.	Intensity, 5 p. m.	Sky, 8 a. m.	Sky, 1 p. m.	Sky, 5 p. m.	
1883.																
Mar. 1	32	37	44	48	39	51	S. W.	Light.	S. W.	Light.	S. W.	Light.	Clear.	Clear.	Clear.	
Mar. 2	33	44	39	48	34	48	N. E.	do	N. W.	do	N. W.	do	do	do	Cloudy.	
Mar. 3	12	40	26	42	27	44	N. W.	Brisk	N. E.	Brisk	N. W.	Brisk	Cloudy	Cloudy	do	
Mar. 4	20	42	30	44	26	44	N.	Light.	N.	Light.	N. E.	Light.	Hazy.	Hazy.	do	
Mar. 5	5	40	34	44	21	44	S. E.	do	S. E.	do	S. E.	do	do	do	do	
Mar. 6	24	40	34	44	21	44	N. E.	Brisk	S. E.	Brisk	S. E.	Brisk	do	do	do	
Mar. 7	24	40	34	44	20	42	S. E.	do	S. E.	do	S. E.	do	Clear.	Clear.	do	
Mar. 8	8	38	31	41	20	44	N. W.	Light.	N. W.	Light.	N. W.	Light.	do	do	do	
Mar. 9	4	38	26	44	20	45	S. W.	do	S. W.	do	S. W.	do	Hazy	Hazy	do	
Mar. 10	14	40	48	46	42	48	E.	do	S.	do	S. W.	do	do	do	do	
Mar. 11	34	44	33	47	29	47	W.	Brisk	W.	Brisk	W.	do	Cloudy	Cloudy	Cloudy	
Mar. 12	16	40	29	42	24	42	N. W.	Light.	N. W.	Light.	N. W.	Light.	Clear	Clear	do	
Mar. 13	24	40	29	48	26	42	W.	Brisk	W.	Strong	W.	Brisk	Cloudy	Cloudy	do	
Mar. 14	32	44	42	44	48	44	W.	Light.	S. W.	Light.	W.	Light.	Clear	Clear	do	
Mar. 15	24	42	44	43	46	46	W.	Light.	S. W.	do	W.	do	Clear.	Clear.	do	
Mar. 16	14	40	30	48	20	46	N. W.	do	N. W.	do	W.	do	do	do	do	
Mar. 17	30	44	46	46	42	48	W.	do	W.	do	W.	do	Cloudy	Cloudy	do	
Mar. 18	44	45	24	38	16	44	S. W.	do	S. W.	do	S. W.	do	do	do	do	
Mar. 19	8	38	16	42	12	40	N. E.	Brisk	N. E.	Brisk	N. E.	do	Cloudy	Cloudy	do	
Mar. 20	12	38	20	46	17	44	N. W.	Light.	N. W.	Light.	N. W.	Light.	Clear	Clear	do	
Mar. 21	2	40	29	46	24	47	S. W.	do	S. W.	do	S. W.	do	do	do	do	
Mar. 22	2	40	26	45	22	43	S. W.	do	S. W.	do	S. W.	do	Cloudy	Cloudy	do	
Mar. 23	4	40	26	45	22	43	S. W.	Brisk	N. W.	Strong	S. E.	Light.	Clear	Clear	do	
Mar. 24	4	44	40	48	36	48	E.	Light.	S. E.	Light.	E.	Light.	Cloudy	Cloudy	do	
Mar. 25	24	44	40	48	36	48	E.	do	S. E.	do	N. E.	do	do	do	do	
Mar. 26	34	44	41	48	33	50	N. W.	do	N. W.	do	N. W.	do	do	do	do	
Mar. 27	26	44	32	48	30	48	S. E.	Strong	N. W.	Light.	S. W.	Light.	do	do	do	
Mar. 28	24	42	34	49	29	46	S. W.	Light.	S. W.	do	S. E.	do	do	do	do	
Mar. 29	24	46	39	47	32	50	S.	do	S.	do	S. E.	do	do	do	do	
Mar. 30	26	44	34	46	31	49	N. E.	Brisk	N. E.	do	N. E.	do	do	do	do	
Mar. 31	24	44	34	46	32	48	N. E.	do	N. E.	do	N. E.	do	do	do	do	
Apr. 1	20	44	30	45	30	47	N. E.	do	N. E.	do	N. E.	do	do	do	do	
Apr. 2	22	42	34	48	37	49	N. E.	Light.	N. E.	Light.	E.	do	do	do	do	
Apr. 3	32	48	48	48	34	47	W.	Brisk	W.	Brisk	W.	do	do	do	do	
Apr. 4	40	48	48	47	28	48	N. W.	Light.	N. W.	Light.	S. W.	do	do	do	do	
Apr. 5	41	47	49	48	30	48	N. W.	Brisk	N. W.	Light.	S. W.	Light.	Clear.	Cloudy	Clear.	

Apr.	6	42	48	48	48	34	49	W.	Light.	N.W.	do	do	do	Cloudy	Clear	Cloudy
Apr.	7	30	44	50	50	35	49	N.E.	do	W.	do	do	do	do	do	Cloudy
Apr.	8	32	48	50	50	36	56	W.	Briek	W.	do	do	do	Clear	do	do
Apr.	9	30	50	54	54	35	56	W.	Light	W.	do	do	do	Clear	do	do
Apr.	10	48	49	50	50	40	53	S.W.	Calm	S.W.	do	do	do	Cloudy	do	do
Apr.	11	40	48	50	56	52	52	S.W.	Light	S.W.	do	do	do	Cloudy	do	do
Apr.	12	40	48	54	54	53	53	E.	do	S.E.	do	do	do	do	do	do
Apr.	13	48	48	48	48	48	47	E.	do	S.E.	do	do	do	do	do	do
Apr.	14	50	48	49	47	48	48	W.	do	W.	do	do	do	Clear	do	do
Apr.	15	50	43	40	52	51	52	N.W.	Strong	N.W.	Briek	do	do	Clear	do	do
Apr.	16	65	54	57	52	61	54	N.E.	Briek	N.E.	Strong	do	do	Clear	do	do
Apr.	17	44	48	48	54	55	55	S.W.	Calm	N.E.	do	do	do	Clear	do	do
Apr.	18	46	48	48	48	52	52	N.W.	do	S.E.	do	do	do	Cloudy	do	do
Apr.	19	48	50	50	50	48	54	N.E.	do	S.E.	do	do	do	Cloudy	do	do
Apr.	20	45	50	52	50	50	53	E.	do	E.	do	do	do	do	do	do
Apr.	21	38	46	52	56	54	54	N.E.	Calm	S.E.	do	do	do	Clear	do	do
Apr.	22	46	50	44	44	47	36	N.W.	Briek	N.W.	do	do	do	Cloudy	do	do
Apr.	23	42	48	44	44	47	36	N.W.	Strong	N.W.	do	do	do	Cloudy	do	do
Apr.	24	34	44	39	39	47	38	N.W.	Light	S.W.	do	do	do	do	do	do
Apr.	25	20	43	43	52	50	52	N.	do	S.W.	do	do	do	do	do	do
Apr.	26	31	42	50	50	50	50	N.	do	W.	do	do	do	do	do	do
Apr.	27	42	48	48	48	46	46	N.E.	Calm	W.	do	do	do	do	do	do
Apr.	28	44	46	46	44	46	48	N.E.	Light	N.W.	Briek	do	do	do	do	do
Apr.	29	44	42	42	51	52	51	E.	Calm	N.W.	do	do	do	do	do	do
Apr.	30	40	43	63	63	64	60	W.	Light	N.W.	do	do	do	do	do	do
May	1	39	48	67	64	60	56	E.	do	S.	do	do	do	do	do	do
May	2	49	50	72	62	64	64	N.E.	Calm	W.	do	do	do	do	do	do
May	3	46	50	66	62	48	54	S.E.	Light	S.E.	do	do	do	do	do	do
May	4	46	50	58	50	54	52	S.W.	do	S.E.	do	do	do	do	do	do
May	5	46	48	58	50	53	52	N.W.	Briek	W.	do	do	do	do	do	do
May	6	46	48	60	56	54	55	N.W.	Calm	W.	do	do	do	do	do	do
May	7	45	52	76	68	70	59	W.	Light	S.W.	Briek	do	do	do	do	do
May	8	54	50	59	63	58	54	N.W.	do	S.W.	Calm	do	do	do	do	do
May	9	50	55	62	58	62	54	N.E.	do	S.W.	Briek	do	do	do	do	do
May	10	42	52	59	54	58	54	N.W.	do	S.W.	Light	do	do	do	do	do
May	11	57	48	49	54	53	50	N.W.	do	S.W.	Briek	do	do	do	do	do
May	12	30	49	48	52	49	49	N.W.	Calm	W.	do	do	do	do	do	do
May	13	32	48	39	57	47	52	S.W.	do	S.W.	Light	do	do	do	do	do
May	14	34	49	49	38	49	38	N.E.	Strong	N.W.	do	do	do	do	do	do
May	15	32	48	50	54	48	48	N.E.	do	S.E.	do	do	do	do	do	do
May	16	34	48	48	56	49	49	N.E.	Calm	N.W.	Briek	do	do	do	do	do
May	17	33	48	62	56	46	58	W.	do	N.W.	Calm	do	do	do	do	do
May	18	42	52	70	54	54	58	S.E.	Light	S.W.	Briek	do	do	do	do	do
May	19	60	52	60	66	62	64	S.E.	do	S.W.	do	do	do	do	do	do
May	20	52	54	54	56	48	56	N.W.	Light	W.	do	do	do	do	do	do
May	21	80	47	36	46	35	44	S.W.	Strong	N.W.	Briek	do	do	do	do	do
May	22	34	42	44	44	44	38	N.E.	do	N.E.	Light	do	do	do	do	do
May	23	38	44	44	44	44	38	N.W.	do	N.E.	Light	do	do	do	do	do
May	24	42	49	54	44	44	44	N.W.	Light	S.W.	Strong	do	do	do	do	do
May	25	57	62	79	62	58	62	W.	do	W.	Light	do	do	do	do	do
May	26	58	58	58	58	58	58	N.W.	do	N.W.	do	do	do	do	do	do
May	27	58	56	56	56	56	56	N.E.	do	N.E.	do	do	do	do	do	do
May	28	58	56	56	56	56	56	S.W.	do	S.W.	do	do	do	do	do	do
May	29	58	56	56	56	56	56	S.W.	do	S.W.	do	do	do	do	do	do
May	30	50	49	49	49	49	49	S.	do	S.	Briek	do	do	do	do	do



Record of water-temperature observations made at the United States hatchery, Alpena, Mich., from November 10, 1882, to May 16, 1883.

Date.	8 a. m.	8 p. m.	Date.	8 a. m.	8 p. m.	Date.	8 a. m.	8 p. m.	Date.	8 a. m.	8 p. m.
1882.	°F.	°F.		°F.	°F.		°F.	°F.		°F.	°F.
Nov. 10	52	54	Dec. 28	55½	85	Feb. 13	34½	85	Apr. 2	34	84
Nov. 11	50	51	Dec. 29	35	85	Feb. 14	34½	85	Apr. 3	34	84
Nov. 12	51	52	Dec. 30	34½	84½	Feb. 15	34½	84½	Apr. 4	34	84
Nov. 13	48	49	Dec. 31	35	85	Feb. 16	84	84	Apr. 5	34	84
Nov. 14	46	47	1883.			Feb. 17	84	84½	Apr. 6	34	84
Nov. 15	47	50	Jan. 1	84	34½	Feb. 18	84	84½	Apr. 7	34½	84½
Nov. 16	48	50	Jan. 2	84	34½	Feb. 19	84	84½	Apr. 8	34½	84½
Nov. 17	41	43	Jan. 3	84	34½	Feb. 20	84	84½	Apr. 9	35	85
Nov. 18	43	45	Jan. 4	84	34½	Feb. 21	84	84	Apr. 10	35½	85½
Nov. 19	41	42	Jan. 5	84	34	Feb. 22	84	84½	Apr. 11	35	85
Nov. 20	40	41	Jan. 6	84	34½	Feb. 23	84	84½	Apr. 12	36	86
Nov. 21	41	43	Jan. 7	85	35	Feb. 24	84	84	Apr. 13	36	86
Nov. 22	42	43	Jan. 8	35	85	Feb. 25	84	84	Apr. 14	36	86
Nov. 23	39	40	Jan. 9	35	84½	Feb. 26	84	84	Apr. 15	36	86
Nov. 24	40	41	Jan. 10	35	85	Feb. 27	84	84	Apr. 16	36	86
Nov. 25	38	39	Jan. 11	35	85	Feb. 28	84	84	Apr. 17	36	86
Nov. 26	38	38	Jan. 12	34½	84½	Mar. 1	84	84	Apr. 18	36	86
Nov. 27	38	37	Jan. 13	35	85	Mar. 2	84	84	Apr. 19	36	86
Nov. 28	38½	36	Jan. 14	35	85	Mar. 3	84	84	Apr. 20	36	86
Nov. 29	35	36	Jan. 15	35	85	Mar. 4	84	84	Apr. 21	36	86
Nov. 30	35	35½	Jan. 16	34½	85	Mar. 5	84	84	Apr. 22	36	86
Dec. 1	36	36	Jan. 17	34	85	Mar. 6	84	84	Apr. 23	41	41
Dec. 2	35	35	Jan. 18	35	85	Mar. 7	84	84	Apr. 24	39	40
Dec. 3	34½	35	Jan. 19	34½	85	Mar. 8	84	84	Apr. 25	38½	38½
Dec. 4	35	35	Jan. 20	35	85	Mar. 9	84	84	Apr. 26	38½	39
Dec. 5	35	36	Jan. 21	35	85	Mar. 10	84	84	Apr. 27	38	39
Dec. 6	35	34½	Jan. 22	34½	84½	Mar. 11	84	84	Apr. 28	39	40
Dec. 7	35	35	Jan. 23	34½	85	Mar. 12	84	84	Apr. 29	40	40
Dec. 8	34	34	Jan. 24	35	85	Mar. 13	84	84	Apr. 30	40	40
Dec. 9	35	35	Jan. 25	35	85	Mar. 14	84	84	May 1	40	40
Dec. 10	35½	35½	Jan. 26	34½	85	Mar. 15	84	84	May 2	40	40
Dec. 11	36	35½	Jan. 27	35	85	Mar. 16	84	84	May 3	40	40
Dec. 12	34	35	Jan. 28	34½	85	Mar. 17	84	84	May 4	40	40
Dec. 13	34	35	Jan. 29	35	85	Mar. 18	84	84	May 5	40	41
Dec. 14	35	35	Jan. 30	35	85	Mar. 19	84	84	May 6	41	41
Dec. 15	34½	35	Jan. 31	35	85	Mar. 20	84	84	May 7	42	42
Dec. 16	35½	35	Feb. 1	34½	84½	Mar. 21	84	84	May 8	43	43
Dec. 17	35	35	Feb. 2	35	85	Mar. 22	84	84	May 9	44	44
Dec. 18	35	35	Feb. 3	34½	84½	Mar. 23	84	84	May 10	43	44
Dec. 19	34½	35	Feb. 4	34	84½	Mar. 24	84	84	May 11	43	44
Dec. 20	35	35½	Feb. 5	35	85	Mar. 25	84	84	May 12	43	45
Dec. 21	34	34	Feb. 6	35	85	Mar. 26	84	84	May 13	43	43
Dec. 22	34½	34	Feb. 7	35	85	Mar. 27	84	84	May 14	43	44
Dec. 23	35	35	Feb. 8	35	85	Mar. 28	84	84	May 15	43	44
Dec. 24	35	35	Feb. 9	35	85	Mar. 29	84	84	May 16	43	44
Dec. 25	35	35	Feb. 10	35	84½	Mar. 30	84	84			
Dec. 26	35	35	Feb. 11	34½	84	Mar. 31	84	84			
Dec. 27	35	35	Feb. 12	34½	84½	Apr. 1	84	84			





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