

39.—NOTES ON THE HATCHERIES AND FRESH-WATER FISHERIES OF ICELAND.

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In 1883 the Icelanders began the first inquiry into the fisheries of their lakes and rivers. The first step in this direction was made by the assembly of Iceland (*Althing*) granting a total amount of 3,000 crowns (\$804) for these investigations. Mr. Arthur Feddersen, editor of the Danish *Fiskeritidende*, was engaged to examine the rivers and lakes of Iceland and to report upon their condition. Accordingly, in the summer of 1884 he traveled through the country and published descriptions of the fresh-water fisheries of Iceland and a report of his examinations.* Also, he advised the establishment of two hatcheries, one for salmon, at Reynivellir; the other for trout, at Thingvellir.

For the hatchery at Reynivellir a hut of earth and stones was built, 11½ by 8½ feet, with a small window at one end and a narrow and low door. This hut cost 140 crowns (\$37.52). It is situated at the foot of a slope, in boggy ground. The spring-water is conducted by a channel through the upper part of the wall into the hut, where it falls into a filtering box. The hatchery contains five California hatching-troughs, and it is not possible to hatch more than 30,000 eggs.

The person who conducted the hatchery, Mr. Nils Johanson, a Swedish farmer, kept a daily journal giving the temperature of the air and water. According to this journal, a partial table of the temperatures is as follows:

Partial temperatures during the hatching season.

| Date. | Air. | | Water. | | Date. | Air. | | Water. | |
|---------------|-------|-------|--------|-----------|---------------|-------|-----------|--------|-----------|
| | Cent. | Fahr. | Cent. | Fahr. | | Cent. | Fahr. | Cent. | Fahr. |
| | ° | ° | ° | ° | | ° | ° | ° | ° |
| Oct. 16, 1884 | 6 | 42.8 | 6.5 | 43.7 | Feb. 3, 1885 | -0.5 | 20.3 | ..... | ..... |
| Oct. 27, 1884 | 4 | 39.2 | ..... | ..... | Feb. 10, 1885 | -6 | 21.2 | ..... | ..... |
| Oct. 28, 1884 | -4 | 24.8 | ..... | ..... | Feb. 14, 1885 | -9 | 15.8 | ..... | ..... |
| Nov. 1, 1884 | ..... | ..... | 2-3 | 35.6-37.4 | Feb. 23, 1885 | -9 | 15.8 | ..... | ..... |
| Nov. 7, 1884 | 2 | 35.6 | ..... | ..... | Feb. 28, 1885 | -10 | 14 | ..... | ..... |
| Dec. 20, 1884 | -6 | 21.2 | ..... | ..... | Mar. 1, 1885 | -7.5 | 18.5 | 2.5-3 | 36.5-37.4 |
| Dec. 21, 1884 | 3 | 37.4 | ..... | ..... | Mar. 13, 1885 | 6 | 42.8 | ..... | ..... |
| Dec. 27, 1884 | ..... | ..... | 1-2 | 33.8-35.6 | Apr. 2, 1885 | -10 | 14 | ..... | ..... |
| Dec. 28, 1884 | -6 | 21.2 | ..... | ..... | Apr. 20, 1885 | 4-7.5 | 39.2-45.5 | ..... | ..... |
| Jan. 21, 1885 | 4 | 39.2 | ..... | ..... | Apr. 21, 1885 | ..... | ..... | 4 | 39.2 |
| Feb. 1, 1885 | ..... | ..... | 0 | 32 | | | | | |

At a waterfall in the Laxá River a box was placed in which to retain the salmon taken for spawning purposes. Fishing for these spawning fish began at the salmon fall (*Laxfoss*) on September 26 and lasted till

* For three articles by Mr. Feddersen on this subject, see Fish Commission Report for 1884, pp. 301 and 323, and Fish Commission Bulletin for 1886, p. 161.

October 7; 3 females and 5 males being caught. In the Bugda River, near by, the fishing lasted from October 1 to 19; 10 females and 13 males being caught. Thus altogether 13 females and 18 males were taken. This number diminished considerably before spawn was obtained, as the stream was too strong in the retaining boxes, and the fish were not sufficiently cared for. The first salmon eggs were artificially impregnated in Iceland on October 16, 1884. This was continued until November 8, there being fecundated in all from 26,000 to 27,000 salmon eggs.

On December 23, sixty-nine days after impregnation, the development of the embryo was so far advanced that the eyes were visible in those that were fecundated on October 16; on January 5 the eyes were perceived in eggs impregnated October 28; and the eyes of those impregnated November 8 appeared on January 28. It is worth noticing that Mr. Johanson put snow into the water in order to make it colder for the purpose of delaying the hatching, because he thought it unsafe to put out the fry into the rivers till May. It seems, also, that hatching was especially delayed during the latter part of the season.

The first fry appeared on March 4, so that the period of incubation for these was about one hundred and forty days; but the journal stated that on March 23, everything of the first lot of eggs impregnated had been hatched, so the whole period extended over one hundred and sixty days. By April 28 the whole number of fry were hatched.

Owing to heavy rains the filtering box often became unclean from the settling of mold and mud that fell into it. Ducks often stirred up the soil in the bog, which also caused the water to be muddy; and so both gravel and box had to be cleansed repeatedly.

The fry were kept in the hatching-boxes till May 23, when nearly 10,000 young fish were planted in Bugda River; and on the 25th of May 12,000 were planted in Laxá River, above Vindás. The temperature in the Bugda at this planting was 10° C. [50° F.], and 8½° C. [47½° F.] in the Laxá. Of the whole number fecundated (from 26,000 to 27,000), there died 1,030 eggs; while probably the total loss was about 13 per cent.

On March 1, when the embryos were well developed, Mr. Johanson transported 3,400 salmon eggs from Reynivellir to Thingvellir, to finish the hatching there, and plant the fry in the lake of Thingvallavatn, so as to see if the salmon (*Salmo salar*) could live in this lake. The temperature during transportation was very low, being at -17° C. [1.4° F.], but few eggs died.

During the same winter (1884-'85) an attempt was made to have a hatchery for mountain trout (*Salmo alpinus*) established at Thingvellir. Mr. Johanson went there on October 5 and impregnated about 10,000 eggs, which were placed in a wooden box 36 inches long, 16 wide, and 11 deep. They were kept in a cold spring, there being no hatching-house. On October 28 nearly 10,000 eggs more were impregnated and

placed in a similar box. At first very few died; but on November 11 there was a heavy rain-fall with a high southerly wind, which caused inundation. The contents of one box were entirely destroyed, while those of the other suffered slightly by an overflow from the Oxará River. On December 24 the eyes of the embryos were first seen; in the middle of February hatching began, and it was completed by the end of the month; so the period of incubation lasted from one hundred and thirty to one hundred and forty days. Very few of the young fish died; and on April 29 all the fry, amounting to about 7,000, were planted in the Oxará River, connected with the lake of Thingvallavatn.

Most of the salmon eggs brought over from Reynivellir hatched, and the fry were deposited in the lake of Thingvallavatn on May 9. These were the first salmon in this lake. A year later one salmon was caught weighing one pound, but no others have been seen.

The lake of Thingvallavatn is the largest in Iceland, as it is from 4 to 5 square miles* in area; and its northern part is 70 fathoms deep. The bottom consists partly of sand and gravel, but mostly of lava, as it is formed by volcanic eruptions. Around it is a great tract of lava and range of craters. Considerable animal life and vegetation are found in it. Trout (*Salmo trutta*) in this lake grow very large, up to 20 and 22 pounds; while mountain trout in several varieties reach the weight of from 1 to 7 pounds. Many trout are caught in this lake at all seasons; during the winter numbers being hooked through the ice.

Mr. Johanson, after superintending this hatching in the winter season of 1884-'85, returned to Sweden. Since then the work at Reynivellir and Thingvellir has been kept up very poorly. In 1885-'86 about 6,000 eggs were hatched at Reynivellir; and in 1886-'87 somewhere between 9,000 and 20,000 eggs were hatched. At Thingvellir a few thousand eggs have been hatched each season. A third attempt to establish a hatchery was made in the autumn of 1886 at Hjardarholt in Dalir, where several thousand eggs were hatched. All of these hatcheries are insignificant and badly managed. They have no suitable apparatus for such work, not a tank nor box being on hand for the transportation of fry or spawning fish. Last spring 2,000 salmon fry were brought from Reynivellir to Thingvellir in a pail. The young fish were said to be living on reaching Thingvellir, but they were not transferred to the Lake of Thingvallavatn that day, and being left in the hatching-trough over night, in the morning all were dead. The hatching-boxes are un-serviceable for hatching; it is not possible to breed the fry successfully in such apparatus as there is; and there are no basins for rearing the young fish. Consequently, the fry are turned out into the rivers and lakes before they have entirely consumed their yelk-sacks, and this probably results in the death or destruction of a great part of them, especially as sudden changes of temperature frequently occur in the water about this season from the presence of ice in the rivers. Then,

* Danish square miles, which would make its area about 100 English square miles.

too, animal and vegetable life has not yet roused from its winter sleep, so as to supply these fry with their needed food. It is therefore my opinion that at present the hatcheries, under the circumstances, are of very little use. It would be much better if the hatcheries were properly situated in Iceland, as many rivers are suitable for salmon and trout.

Natural circumstances have at many places destroyed the fishing without any intervention of man. In autumn frequently heavy rains occur during the spawning season, and the rivers increase in volume and tear up their beds, while early in winter the streams freeze unexpectedly, thaw suddenly, and the ice sometimes changes the whole beds of the rivers, especially where they consist of sand and gravel. In those parts of the country where the river-beds are of lava formation the spawn may be saved from destruction by the holes and heavy rocks. Thus the fisheries in these rivers are preserved; but natural hardships and bad methods of fishing prevent the increase of salmon in the rivers, and almost entirely stop the fishing in many of them. Most of the fishing in Iceland is done during the spawning season of salmon and trout; and formerly dams were built across the streams where possible. In 1876 a law was introduced that nobody be permitted to capture any salmon later in the year than September 15, or to obstruct any river; but nothing was said about trout.

In all the large rivers salmon are caught in wedge-shaped nets, which are set in the rivers and on the places where the water is quiet. They are fastened in place either by stone-piles built out into the stream from the shores or by means of large baskets loaded with stones. In the smaller streams salmon boxes are used of different sizes. They are triangular in shape and made of wooden rails. One angle points up the stream, and the rails composing the sides of this angle are arranged horizontally, while the rails on the opposite side are perpendicular, with an opening between them for the entrance of the salmon. In many of the little rivers salmon are caught by means of sharp iron hooks attached to poles. Hauling-nets are used in all rivers, especially in their mouths and across them, in which the fishermen catch all salmon, large and small.

The trout are taken by means of set nets, drag-nets, and trout-boxes. All nets for trout have too small meshes, and catch even the smallest fish. They are badly made, ill fixed, and of very little worth. Often white bones are used on these nets as sinkers, as also on the salmon nets, which tend to drive the fish away. In lakes fishing-lines are used.

Many wealthy salmon-fishermen come to Iceland annually and rent the salmon rivers for a year or a period of years. They fish with hooks, staying in Iceland from the beginning of June to about the middle of September. The salmon which they catch and do not use are generally given to the neighboring farmers, who thus sometimes get both fish and rents. In 1876 and 1877 an Englishman (Mr. Richey) was in the southern part of the island and did a considerable business in putting up and exporting canned salmon.

The attention of the legislative assembly was not specially directed to this matter of protecting the fisheries, nor were laws enacted on this subject before 1885; and the present laws are in many instances primitive, imperfect, and inconvenient, according to the conditions of the country. One of the worst features is that in regard to seals, which are so injurious to the salmon fisheries. This is contained in section 4. of the following statute. The defective point about this bit of legislation is that in all salmon rivers (with one exception) and their mouths, where there are seals, there are also seal-catching places; so that the law is of little or no benefit to the salmon, as it is forbidden to disturb the seals in the places where they are at all easily accessible. The statute referred to was passed February 19, 1886, and is as follows:

“SECTION 1. It is unlawful to catch salmon in the sea, or in rivers or lakes, except during three months each summer. The county board shall in each jurisdiction fix definite rules as to the beginning and end of the fishing for that locality. During the season the salmon shall be entirely protected for thirty-six hours each week, from 9 p. m. Saturday to 9 a. m. Monday, during which time all salmon nets shall be taken up and all fishing apparatus be kept open, so that the salmon may have free passage. Nets so constructed that the salmon can not be entangled therein are to be considered as a fixed mechanical fishing apparatus.

“SEC. 2. It is illegal to set nets, dikes, or any other fixed fishing apparatus in a river farther out from the bank than the middle of the river; and even this is allowed only if the other half of the stream is no less deep than the half through which the dike, etc., extends. If it is desired to set nets, or have dikes or other apparatus extend from both sides of the river, there must be an interval of at least 30 fathoms of the length of the river between the apparatus extending from opposite sides. If there is only one owner of the fishing rights in a river, he is allowed to use cross-dikes; but if the river has affluents or separate arms, he is allowed to cross-dike only one of those arms, and this only when the setter of the dike is sole owner of the fishing right in that arm and when the salmon go in greater numbers up the other arms.

“SEC. 3. No one may set nets or other fishing apparatus out in lakes, or in the sea near the mouths of salmon rivers, in such a manner that the passage of the salmon is obstructed. It is allowed to use drag-nets in rivers only between 9 a. m. and 9 p. m., and in river mouths only before the shoaling of the fish at every other flood tide. Salmon may be caught by means of rods and lines, but not by stabbing instruments or spears. For scientific or breeding purposes salmon may be taken at any time of the year.

“SEC. 4. In rivers and their mouths where there are salmon, it is allowed to shoot or frighten seals with the restriction that the inviolability of breeding and seal-catching places, which are thus especially proclaimed, must not be infringed upon, except with the penalty of full damages, according to the estimate of good men nominated by the judge and sworn in court.

"SEC. 5. No fishing apparatus may be used which will catch small salmon. Meshes in a salmon net, when wet, must have a circumference of at least 9 inches. No nets may be double. In every apparatus there must be openings so large that salmon not measuring more than 9 inches in greatest circumference can not be detained therein. If the apparatus is provided with grates, the rails must be perpendicular with intervals of at least 1½ inches.

"SEC. 6. If the majority of the owners of the fishing right in any river wish the fishing to be carried on by all the owners jointly in order to protect the salmon better than according to the provisions of the present act, they must submit the case to the county board. If this board is of the opinion that no one's rights will be infringed, it may enact rules for the mode of fishing and the division of the catch, which rules shall be binding upon all persons concerned. In such cases the main river and its tributaries are to be considered as one river.

"SEC. 7. If local circumstances make it necessary to have more definite regulations than are provided for in the present act, one or more county boards may make additional regulations; but such regulations must in no way interfere with the principles of the present act warranting the free passage and protection of salmon. Such regulations, as well as those named in section 6, must have the sanction of the provincial governor, and be then valid as law for the next ten years after they are made.

"SEC. 8. Transgressions of this act are punishable by a fine of not more than one hundred crowns (\$26.80), while all the unlawful catch and all unlawful apparatus may be confiscated."

The tables that follow show the amounts of salmon exported from Iceland, going chiefly or entirely to Denmark, the bulk of the export being salted and of not great value for exportation. There are no regular smoke-houses in Iceland, so the little smoking of fish that is done is carried on in the kitchens in a primitive manner. Canned salmon and salmon packed in ice are also exported in small quantities.

TABLE I.—*Exportation of salted salmon from Iceland to Denmark.*

[The pounds in the following tables are all Danish. One Danish pound = 500 grams about 1.1 English pounds avoirdupois.]

| Place from which exported. | 1630. | 1743. | 1784. | 1806. | 1816. | 1840. | 1855. | 1858. | 1859. | 1861. |
|----------------------------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|---------------|
| | <i>Lbs.</i> | <i>Lbs.</i> | <i>Lbs.</i> | <i>Lbs.</i> | <i>Lbs.</i> | <i>Lbs.</i> | <i>Lbs.</i> | <i>Lbs.</i> | <i>Lbs.</i> | <i>Lbs.</i> |
| Húsavík ¹ | | | | | | 4,800 | 5,712 | 2,368 | 6,400 | |
| Akureyri ¹ | | | | | | | | | | |
| Siglufjörður ¹ | | | | | | | | | | |
| Sandárkrúkur ¹ | | | | | | | | | | |
| Blönduós ¹ | | | | | | | | 2,384 | | |
| Skagaströnd ¹ | | | | | | | | | | |
| Reykjavík ² | | | | | | 480 | 480 | | | |
| Eyrafjörður ² | | | | | | | | | | |
| Akranes ² | | | | | | | | | | |
| Bordeyri ² | | | | | | | | 448 | | 19,080 |
| Stykkishölmur ² | | | | | | | | 672 | | |
| Brakarpottur ² | | | | | | | | | | |
| Ísa fjörður ² | | | | | | | | | | |
| Total⁴..... | 5 | 3 | 17 | 28 | 104 | 5,280 | 6,192 | 5,872 | 6,400 | 19,080 |

TABLE I.—*Exportation of salted salmon from Iceland to Denmark—Continued.*

| Place from which exported. | 1864-5. | 1866. | 1867. | 1868. | 1869. | 1870. | 1871-2. | 1873. | 1874. | 1875. |
|----------------------------------|-------------|-------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|---------------|
| Husavik ¹ | Lbs. 414 | Lbs. 808 | Lbs. 3,808 | Lbs. 2,816 | Lbs. 3,808 | Lbs. 2,464 | Lbs. 10,304 | Lbs. 34,650 | Lbs. 22,550 | Lbs. 1,750 |
| Akureyri ¹..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Siglu fjörður ¹..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Sandárkrókur ¹..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Blönduós ¹..... | ..... | 6,720 | 13,620 | 324 | 1,344 | 1,904 | 6,944 | ..... | ..... | ..... |
| Skagaströnd ¹..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 9,714 | 8,879 | 5,743 |
| Reykjavík ² | 3,912 | 2,016 | 1,312 | 896 | 2,464 | 61,376 | 18,144 | 28,875 | 22,200 | 22,750 |
| Eyrarbakki ³..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 215 | 7,525 |
| Akranes ²..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Borðeyri ³ | 448 | 1,120 | 2,010 | ..... | 448 | 179,648 | 1,568 | 4,950 | 4,675 | 3,300 |
| Stykkishólmur ²..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Brakarpottur ²..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Isafjörður ²..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Total..... | 4,774 | 10,752 | 25,756 | 4,036 | 8,064 | 245,392 | 36,960 | 78,189 | 58,319 | 41,068 |

| Place from which exported. | 1876. | 1877. | 1878. | 1879. | 1880. | 1881. | 1882. | 1883. | 1884. |
|----------------------------------|----------------|----------------|---------------|-------------|---------------|---------------|-------------|---------------|-------------|
| Husavik ¹ | Lbs. 19,600 | Lbs. 12,200 | Lbs. 6,000 | Lbs. 846 | Lbs. 1,060 | Lbs. 7,648 | Lbs. 858 | Lbs. 4,530 | Lbs. 919 |
| Akureyri ¹..... | ..... | ..... | ..... | ..... | ..... | 230 | ..... | ..... | ..... |
| Siglu fjörður ¹..... | ..... | ..... | 100 | ..... | ..... | ..... | ..... | ..... | ..... |
| Sandárkrókur ¹..... | ..... | 400 | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Blönduós ¹ | 2,000 | 3,000 | 1,227 | ..... | ..... | 10,737 | 724 | 1,354 | 362 |
| Skagaströnd ¹ | 8,120 | 5,121 | 1,286 | 564 | 3,688 | 7,598 | ..... | ..... | ..... |
| Reykjavík ² | 21,400 | 16,800 | 32,022 | 1,787 | 2,028 | 14,264 | 20,227 | 705 | 28,866 |
| Eyrarbakki ³ | 9,400 | 9,200 | 15,162 | 2,823 | 12,073 | 21,108 | 23,858 | 4,760 | 3,563 |
| Akranes ²..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 3,774 |
| Borðeyri ³ | 1,732 | 3,400 | 700 | ..... | 2,011 | 2,866 | ..... | 541 | 283 |
| Stykkishólmur ²..... | ..... | 33,513 | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Brakarpottur ²..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 3,000 | 4,770 |
| Isafjörður ² | 800 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Total..... | 63,052 | 83,634 | 56,497 | 6,020 | 20,800 | 64,451 | 45,662 | 14,890 | 42,537 |

¹In north part of Iceland.²In south part of Iceland.³In west part of Iceland.⁴No place of exportation is assigned for the first five totals.TABLE II.—*Exportation of other preparations of salmon from Iceland.*

| Place from which exported. | Canned. | | | Smoked. | | | Ice-packed. |
|----------------------------|----------------|------------|---------------|---------------|---------------|---------------|---------------|
| | 1876. | 1877. | 1880. | 1877. | 1880. | 1883. | 1877. |
| Reykjavik..... | Lbs. 20,038 | Lbs. 28 | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. 3,207 |
| Akranes..... | 22,600 | ..... | ..... | ..... | ..... | ..... | ..... |
| Siglu fjörður..... | ..... | ..... | 419 | ..... | ..... | ..... | ..... |
| Stykkishólmur..... | ..... | ..... | ..... | 140 | ..... | ..... | ..... |
| Blönduós..... | ..... | ..... | ..... | ..... | 1,664 | ..... | ..... |
| Borðeyri..... | ..... | ..... | ..... | ..... | ..... | 162 | ..... |

REYKJAVIK, ICELAND, September 20, 1887.