

that definite ideas could have been formed of what might be accomplished by using them. I am satisfied, however, that, so far as the prosperity of the fisheries is concerned, little could have been gained of practical value. The fact that red snappers are gregarious in a marked degree, congregating in schools of limited extent on small patches of bottom, and the additional fact that they bite a hook with the utmost eagerness, makes it possible to capture them more readily and easily with hand-lines than in any other way. And when we consider how trifling is the expense of fitting with hand-lines compared with other forms of apparatus, it will be seen that there is little probability of the old methods being superseded, particularly when enough are caught now to make a serious drain on the resources of the fishing grounds.

KEY WEST, FLA., *March 20, 1885.*

31.—OPINIONS CONCERNING THE DESIRABILITY OF A HATCHERY FOR SALT-WATER FISH IN NORWAY.*

By H. RASCH, A. LANDMARK, and G. O. SARS.

OPINION OF PROF. H. RASCH.

The cause of the steady decrease of fish on the coast of Arendal, which has been noticed during the last few years, is undoubtedly excessive fishing. It will appear improbable to most persons that fisheries such as have been carried on in the Arendal district should have had an injurious influence on so fertile a fish as the cod, each healthy female of which contains several millions of eggs; but since the investigations of Professor Sars have taught us the conditions necessary for impregnating the roe of the cod, we can easily understand that if there are not a large number of male fish on the spot when the female fish eject the roe, the greater portion will not become impregnated.

The best remedy for this lack of spawning fish is, as far as I can see, artificial impregnation, by which all the roe becomes impregnated, whilst at the same time one can transfer the roe to localities where it and the newly hatched fish are protected against their enemies.

There is no doubt that in this way young fish can be produced by the million; but this is not sufficient. The growing fish must not be caught before they become fit for food. I therefore entirely approve of the measures proposed by Captain Dannevig for the Arendal district.

CHRISTIANIA, *October 31, 1882.*

OPINION OF MR. A. LANDMARK.

Owing to the steady decrease which has been generally noticed of the common salt-water fish in many places on our coasts, and especially

* From a pamphlet entitled *Indbydelse til Tegning af Bidrag til en Udvlækningsanstalt af Saltvandsfisk efter amerikansk Mønster, samt Erklæringer i Anledning af samme.* Arendal, 1884. Translated from the Danish by HERMAN JACOBSON.

in the neighborhood of Arendal, Captain Dannevig has requested me to give my opinion whether this deplorable state of affairs can be successfully remedied by means of the artificial hatching of the roe of cod, and possibly of other kinds of fish. He also states that he has selected a place in the neighborhood of Arendal for an establishment of this kind.

In regard to this matter I take the liberty to state that it appears from the official reports of Prof. Spencer F. Baird, United States Commissioner of Fish and Fisheries, that the artificial hatching of the roe of cod, and some other salt-water fish, is not only possible, but also entirely practicable, without any very great outlay. How far the artificial hatching of salt-water fish produces a noticeable increase of the quantity of fish in the sea, and especially what it amounts to as compared to the vast scale on which the natural reproduction of fish goes on in the sea, has not yet been shown by experience, and may, therefore, justly be considered a disputed question. If, however, we consider the enormous destruction of roe caused by the many injurious influences to which it is exposed in the sea, and that these injurious influences may almost be entirely removed from the artificially impregnated roe, and that, therefore, there can be no doubt that roe of a certain number by being artificially hatched will yield infinitely more young fish than if left to nature; then we may well assume that there is not only a possibility, but even a certain degree of probability, that practical results for the fisheries may be reached. It is provided, of course, that the matter is taken in hand energetically. We must call special attention to the circumstance that Norway, on account of the peculiar character of its coast and coast waters, offers greater chances for favorable results than almost any other country. Our coast, broken by innumerable fiords and sounds, possesses a very large number of comparatively sheltered basins, whose stock of fish, as experience seems to show, is stationary, as the fish do not, to any great extent, seem inclined to migrate to the open sea. We must also consider that the deep furrow or trough at the bottom which separates the greater portion of our coast from the outer and shallower sea is in all probability the main cause which deters the fish which are born near our coast from migrating to the open sea. These geographical conditions, therefore, seem to justify the belief that the increase in the number of fish which would result from artificial hatching would really benefit our country, and not be scattered over all the neighboring seas. And yet it can by no means be considered as settled that artificial hatching will to any noticeable degree increase the yield of our every-day sea-fisheries. This is certain, however, that vast interests are at stake, and that no means should be left untried which, without disproportionate sacrifices, may reasonably be supposed to aid this important industry. It would be difficult to point out any other means which could be employed for reaching the end in view with greater hope of success.

I therefore take the liberty to express my opinion to the effect that, in spite of all the uncertainty which still seems to be connected with artificial hatching as a means of aiding the sea fisheries, it is in the highest degree desirable that experiments in this direction should be made, and the sooner the better. But if good results are expected, these experiments should be made on a great scale. We should not rest satisfied to hatch a few hundred thousand fish, but many millions. On account of the great fecundity of salt-water fish, hatching on such a scale is by no means an impossibility.

CHRISTIANIA, *October 31, 1882.*

OPINION OF PROF. G. O. SARS.

After having conferred with Captain Dannevig relative to his plan of counteracting the steady decrease of fish noticed during the last few years in the neighborhood of Arendal and on other parts of our coast, by the artificial hatching of salt-water fish, especially cod, I shall, as requested, express my opinion as to the practicability and the possible results of such experiments. I have already, in the first report made to the department on the practical and scientific investigations made by me near the Loffoden Islands, during the winter of 1864, expressed the opinion that possibly the artificial hatching of cod roe might yield important practical results; and in the following report, for 1865, I have treated this subject more fully and have given various hints for the guidance of persons who might desire to make experiments in this direction. It is my opinion that this matter deserves our undivided attention, and that, under certain circumstances, the artificial hatching of salt-water fish will have the same practical importance for our coast fisheries as the hatching of fresh-water fish for the fresh-water fisheries. With a view to obtaining greater certainty as regards this matter it will be necessary that a first attempt should be made, and that this attempt should be on so large a scale as to give some reasonable hope of visible results. Hitherto no such attempt has been made in Norway, and probably for the reason that no one has been found willing to devote his entire energy, talents, and time to the subject. I therefore consider it exceedingly fortunate that a gentleman has come forward who has seriously determined to solve this important problem in a practical manner. Captain Dannevig, is a gentleman of intelligence, who combines a deep interest in the cause with great energy and a practical knowledge of everything pertaining to the fisheries, and who therefore offers all the requisite conditions for making the experiment in an entirely satisfactory manner, provided he can secure the necessary assistance and guidance. As regards the practicability of this experiment, I have—as will be seen from my reports referred to above—by experiments of my own, made on a small scale, proved beyond a doubt that the artificial hatching of cod roe is not only entirely practicable, but even connected with comparatively less difficulty than the

hatching of salmon roe. The apparatus can be arranged in a much simpler manner, and the time used for hatching is much shorter. As the matter is of great interest both from a scientific and practical point of view, and as the question relates to an enterprise which, if it meets the expectations, will exercise the most powerful influence on one of the most important industries of our country, I deem it entirely proper that the Government should extend some aid, so that Captain Dannevig's experiments can be made according to the most approved method.

According to my observations, the tender young of the cod in the beginning keep near the surface of the water, but after a while seek the bottom and during the first year stay near the coast. Later they go farther out into deep water, but nevertheless during the first two or three years keep principally in the fiords and sounds, partly on sandy and partly on rocky bottom. Not until they have become sexually mature (in the fifth or sixth year) do most of them go to the outer banks of the sea, to return in spring for the purpose of spawning.

CHRISTIANIA, *November 1, 1882.*

CIRCULAR INVITING CONTRIBUTIONS TOWARDS A HATCHING ESTABLISHMENT FOR SALT-WATER FISH ON THE AMERICAN PLAN.

It may be considered as sufficiently well known that during the last twenty or thirty years our coast fish have steadily decreased, and that during the last few years this decrease has even been more rapid than formerly; so much so, in fact, that many of our fiords where formerly large masses of fish were found are now comparatively deserted. It may also be considered as well known that the number of fish along the entire coast of Norway from Christiania to Cape Lindesnæs has likewise decreased to an alarming degree, especially in places where a dense population and the high price of fish make the fish more sought after. Such is the case in the neighborhood of Arendal.

The probable cause of this decrease is undoubtedly excessive fishing, which takes away more fish than nature can produce; and if this state of affairs continues for any length of time, the consequence will be, that some of our more important kinds of fish will become extinct.

The natural character of our coast justifies this supposition, for although the bottom is particularly adapted to maintain large masses of fish, in must be remembered that on our coast the fish are crowded together within a comparatively narrow space, viz, the narrow channel—hardly 1 Norwegian mile (7.01 English miles)—along the coast, and that therefore excessive fishing will exterminate the fish sooner on this coast than on the other coasts of the North Sea, where the coast waters are connected with the great fishing-banks in the open sea, and where the loss is soon made up again by fish immigrating from the sea.

If we ask which apparatus must be considered as particularly destructive, the proper answer will be that it is not one apparatus in particular, but all the different apparatus combined which have brought about this result.

As we must consider it as absolutely certain that excessive fishing is the cause of the decrease of fish, it will be evident that in order to remedy the evil it will be necessary either to limit fishing, so that the natural increase of fish exceeds in number those which are caught, or to endeavor by the artificial production of fish to raise the increase to such a degree that it shall at all times exceed the number of fish caught.

As regards the first-mentioned plan, it must, from various causes, be considered as impracticable; and no other way is left but the artificial production of fish, which can no longer be considered merely as a scientific experiment, but as an industry which, without involving great expense, can be conducted on a large scale. The artificial hatching of fish may be considered as the only means of raising our coast fisheries to their former flourishing condition, and as these fisheries are of the most vital importance to our coast population, we venture to hope that such an undertaking will meet with general interest. It is a question of preserving a large capital for the benefit of our coast population. In the city of Christiania alone, live fish to the amount of several hundred thousand crowns are sold every year; and if we take the entire coast from Frederikshald to Lindsnæs, the sum amounts to several millions of crowns per annum. To preserve this revenue to our country will not only prove a great advantage to the present generation, but it actually becomes a duty which we owe to posterity.

The Arendal division of the "Society for Promoting the Norwegian Fisheries" is fortunate enough to have among its members Capt. G. M. Dannevig, who takes a deep interest in the artificial hatching of salt-water fish as a means of aiding our coast fisheries. He has carefully studied the entire subject of starting a hatchery on the American plan, and has consulted some of the most prominent scientific authorities in our country, Professor G. O. Sars, Professor H. Rasch, and Mr. A. Landmark, inspector of fisheries, whose opinions regarding this matter are quoted.

A hatchery on the American plan will, according to very careful estimates, cost about 4,400 crowns (\$1,179.20), and the current expenses during the first year of 3,000 crowns (\$804) will make a total of 7,400 crowns (\$1,983.20). It is our intention to start a hatchery as soon as we have secured the necessary funds.*

SOCIETY FOR PROMOTING THE NORWEGIAN FISHERIES,
Arendal Division, December 2, 1882.

* This circular is signed by L. Holmboe, Oscar Herlofson, Ole J. Herlofson, Andr. E. Johannesen.