

#### XIV.—IS SAWDUST INJURIOUS TO THE FISHERIES?

[From report of Mr. A. Landmark, inspector of fisheries, on the condition of the Norwegian fresh-water fisheries during the years 1876-1879.]\*

Before giving an account of the Norwegian river fisheries during the years 1876-1879 and reporting the result of the salmon fisheries during the same period, I must briefly dwell on some injurious influences to which our salmon and sea-trout fisheries are exposed, and which hitherto have either not at all or but insufficiently been reached by legislation.

Among these injurious influences I must first of all mention the very general custom of throwing sawdust and other refuse from the saw-mills into the river. It is well known that at present our fishery laws contain no provision prohibiting this practice. Those prohibitory regulations which have been made in the interest of navigation (laws of August 12, 1848, August 26, 1854, and March 24, 1860) are of no practical benefit to the fisheries, because they exempt the owners of saw-mills from the duty incumbent upon all other manufacturers of gathering their refuse, and merely compel them to contribute something towards the expenses of dredging the rivers, which benefits navigation only. This arrangement is very unsatisfactory as far as the fisheries are concerned, for the refuse from saw-mills, and more especially the sawdust proper, is, in various ways, injurious to the fisheries. Sawdust gradually sinks to the bottom, and thus fills the very place where the fish eggs are to develop with impure and injurious matter. Salmon eggs, to which we here have special reference, require for their development a clean bottom, covered with small stones, pebbles, or sand. When brought into contact with sawdust or any other rotting wooden matter for any length of time, the eggs are overgrown by a species of fungus, which invariably kills the germ contained in the egg, and is all the more injurious because it spreads very rapidly from one egg to the other. It is true that it is scarcely probable that very large masses of sawdust will gather in those parts of the rivers where the salmon spawn, because in these places the current is generally very rapid; but still a considerable

\* "Om Sagflisens Skadelighed for Fiskerierne." From "Iudberotning fra Fiskeri-Inspectören angaaende hvad der til Ferskvandsfiskeriernes Fremme er udført og om disses Tilstand i Aarene 1876-1879." Christiania, 1881.—Translated by Herman Jacobson.

quantity of it will gather between the small stones on the bottom, and will thus expose to the danger of destruction those eggs which have remained in the spawning places. Unfortunately, however, large masses of eggs, probably by far the larger portion, do not remain in the spawning places, but are carried away by the current and only find a resting place farther down the river, where the current is not so strong and where there are frequently such large piles of sawdust that the eggs are completely buried in them and are of course destroyed. This is all the more injurious to the eggs, as, owing to climatic reasons, the increase of the salmon is principally dependent on those eggs which are carried away from the spawning places and which settle down in the calm and deep portions of the river. The eggs which remain in the spawning places are, in our climate, frequently entirely destroyed by influences which are beyond human control.

It is well known that the quantity of water in our rivers is greatly diminished during winter, so that all the water contained in the river finds sufficient room in a narrow channel, whilst the greater portion of the river bed lies dry. As the salmon spawn in shallow waters, the greater portion of those eggs which are not carried away by the current into deep water will remain on the dry land for a longer or shorter period, exposed to the destructive influence of frost and ice, and will thus inevitably be destroyed. Those eggs which have escaped this danger are threatened by another and not less serious one, namely, the floating ice, which often scrapes the bottom, especially in shallow places, so violently as to change the bed of the river and carry away immense pieces of rock. It may well be imagined what destruction is thereby caused to the eggs lying in such places, and also to the newly-hatched fish.

In comparison with the impurities brought to the river-bottoms by the sawdust, and the consequent destruction of the fish eggs, its other injurious influences on the fisheries are hardly to be taken into account, although in themselves they are by no means inconsiderable. Thus there can be hardly a doubt, that when the water rises and causes the masses of sawdust which have gathered in the river to move, a large number of young fish are carried away with it and are gradually buried in the newly-formed piles of sawdust. This is particularly the case during spring, when the young fish are as yet very weak and cannot swim far. It is also highly probable that the sawdust floating about in the water kills a large number of young fish in the act of breathing, because they can hardly avoid swallowing particles of it which stick fast in the gills and thus eventually cause their death.\* I must finally also men-

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\*It is a very general opinion that this also applies to the grown salmon, as in those rivers which are full of sawdust dead salmon have often been found whose mouths and gills were completely filled with sawdust. I am not prepared to say whether this opinion is correct. Such cases as the one just mentioned are at any rate not so common as to deserve special attention. It has also been said that sawdust will drive the salmon entirely away from a river, but I think that this is very improbable, and could only be possible in cases where a river has been completely filled with it.

tion the circumstance, that the refuse from the saw-mills in many places interferes with the fisheries. We have instances (of which I shall have occasion to speak further on) of fishing-places being so completely filled with heaps of sawdust as to make the hauling in of the nets very difficult and even impossible. The larger pieces of wood which are frequently found among the refuse from saw-mills often interfere very seriously with the fisheries by tearing the nets.

Although the quantity of sawdust in some of our larger rivers has of late years been somewhat diminished by the establishment of steam saw-mills, which use most of their refuse as fuel, the evil is on the increase in many other places, to such a degree in fact as to endanger the very future of the salmon fisheries. The danger is greatest in the salmon rivers in the districts of List and Mandal, the districts where our most productive salmon fisheries are carried on. Many fishery-owners in these districts think the evil has assumed such dimensions that, as long as nothing is done to keep the sawdust out of the rivers, they consider it useless to take any steps for improving the salmon fisheries. At the many meetings for promoting the fishing interests which I have attended in these districts such discouraging opinions have again and again been advanced with more or less earnestness. Although I believe that the fears entertained by many persons in the above-mentioned districts are somewhat exaggerated, I cannot conceal from myself the fact that the evil is a very serious one, and that every year which passes without any preventive measures being taken increases the danger to the salmon fisheries of these districts to such a degree that it may take them a very long time to recover.

With a view of showing the actual state of affairs in this regard in the districts of List and Mandal, and the light in which it is viewed by people in these districts, I shall give some extracts from recent reports.

Mr. Baade, assistant superintendent of fisheries, whom I had commissioned during the summer of 1877 to visit the districts of List and Mandal and examine the condition of the salmon fisheries, says, among other things, in his report, under date of October 20:

"The authorities of these districts have given some attention to the question of the injurious influence of sawdust on the salmon. It seems strange that any doubt should ever have been entertained as to its injurious influence; and all doubts as to this question should have vanished, since most of the saw-mills have introduced circular saws, whose number is constantly increasing. This kind of saw makes the dust much finer, and it becomes all the more injurious to the fish, when—as is frequently the case now—the mills are employed in cutting staves, for which birch and coarser wood generally is used than for boards and planks; the sawdust which is thereby produced is more apt to sink to the bottom instead of being carried away by the current. The injurious influences of this change have become very strikingly apparent in these districts, for in all the salmon streams in this part of the country

large masses of sawdust have been noticed on the bottom; this applies to all the streams of these districts, but especially to those which do not have a swift current.

“As an illustration of the deplorable condition to which salmon streams can be reduced by an accumulation of sawdust, we may mention the Undal River, which in a few years will probably not have a single salmon. Its bed along its entire course is covered with sawdust to such a degree as to render many of the fishing stations entirely unprofitable, as the nets cannot be hauled ashore; and in those fishing stations which are still used, such large masses are hauled ashore with the nets that, after the nets have been landed with much difficulty, it becomes hard to determine whether there are fish in them or not, so that the net has first to be trodden on in order to ascertain the fact (!). All the people living along the banks of this stream have been obliged to dig wells, which was frequently a very difficult undertaking, because the water of the stream has become unfit for drinking purposes.\* When later in summer all this mass of sawdust commences to decay, there is no doubt that its effluvia will be injurious to public health.

“Under these circumstances it will not be surprising that there have recently been found in several streams dead salmon whose bodies were filled with sawdust, and that fresh spawn and young fish are exposed to special danger from this cause. This is probably also the reason why young salmon are no longer seen below the Melhus stream, which flows into Undal River about one (Norwegian) mile above its mouth. Even small flounders, which are among our hardiest fish and which formerly were abundant in the above-mentioned part of the river, have entirely disappeared, which seems to be sufficient proof of the fact that sawdust is injurious to the salmon, which of all fish can least stand impure water.

“In the other rivers of the district matters are not quite so bad as in Undal River, but still the condition of affairs is by no means satisfactory. Under these circumstances it would not seem advisable to establish hatching apparatus, for profitable as such apparatus might otherwise be, it is to be feared that here it would not answer its purpose, as a disproportionately large quantity of the newly-hatched fish would doubtless soon die in the poisoned water.

“From other places in this district complaints were received that the sawdust made the beds of rivers shallow to an inconvenient degree, and that during freshets the meadows and fields bordering on the rivers were injured by the deposits of sawdust.

“In view of the dangerous dimensions which the above-described evil has assumed in this district, and in consideration of the fact that circu-

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\* It seems that this observation is, in part at least, based on a misunderstanding. According to a written report by the largest landed proprietor in Northern Undal, the water of the river is at times not fit to drink on account of the sawdust. But the wells in this district were, as far as he knew, dug before sawdust got into the river in any considerable quantity. In Southern Undal the condition of the river was, according to oral reports from the same man, very much the same.

lar saws are constantly coming into more general use, I consider it absolutely necessary to compel the owners of saw-mills by law, no matter whether they use circular or other saws, to collect their sawdust, instead of throwing it into the river. Such a prohibitory law should apply not only to the main stream, but to all its tributaries, and in fact to all the saw-mills in the district, as there is no doubt that the development of all the fresh-water fisheries is greatly retarded and injured thereby."

Under date of September 30, 1879, the governor of the districts of Mandal and List has transmitted to me a number of reports on the sawdust question made to him by the authorities of the various townships, from which I shall give a few extracts:

The authorities of Tveit declare that sawdust has for a long time been considered injurious to the growth and development of the salmon.

The authorities of Oddernos strongly indorse a report from 26 fishery-owners, in which sawdust and other refuse from the many saw-mills on Torrisdal River is declared to be the principal impediment in the way of the increase of the salmon, as both the young and the farther advanced fish are destroyed by it.

The authorities of Vennessland declare that all the owners of salmon fisheries are fully convinced that the throwing of sawdust into rivers is highly injurious to the salmon fisheries.

The authorities of Sogne declare that, although there are few if any salmon fisheries in their district, it is desirable to keep the sawdust out of the salmon rivers as much as possible.

The authorities of Holme are unanimous in their opinion that sawdust injures the fisheries in Mandal River.

The authorities of Southern Undal declare that sawdust in the rivers is the principal cause of the decline of the fisheries, and that as long as no steps are taken to remedy the abuse of throwing it into the rivers, all protective measures will prove unavailing.

All the above-mentioned authorities have moreover strongly insisted on the desirability of some law prohibiting the throwing of sawdust into rivers. Similar declarations have been made by the authorities of Northern Undal, Lyngdal, Vanse, Herads, Krinesdal, Næs and Hitterö.

The district authorities to whom these reports were made have, under date of June 27, 1879, declared unanimously that "they consider it absolutely necessary to pass a law, as soon as possible, prohibiting the throwing of sawdust and other injurious matter into salmon rivers and their tributaries".

The governor also considers it highly desirable to limit, or better still, to prevent entirely, the pollution of the rivers by sawdust or any other impure matter.

To these declarations I shall add an extract from notes taken by me during a visit made in the summer of 1878 to the salmon streams of the List and Mandal districts:

"The fishery-owners on the Torrisdal River, with whom I discussed this question, were all agreed that the increasing quantity of sawdust is one of the principal causes of the decrease of the salmon. The number of common saws has not been much changed during the last ten or twelve years, nor has the annual quantity of wood cut by them been very much increased; but the number of circular saws, of which about ten years ago there were hardly any, has been increased very considerably. In Vennesland, where ten years ago there were only two circular saws there are now twelve to fourteen. The saw-mills with circular saws make both boards and planks and staves, probably as many of the former as of the latter. Probably one-half of the wood used for staves (which were not made at all before the introduction of circular saws) is foliaceous wood, and the rest is principally pine. None of the circular saws collect the sawdust, and its quantity in the rivers is therefore considerably increased. In some still places it is piled up to the depth of several yards, and this is often the case just below the spawning places, while these places are, on account of the greater swiftness of the current, hardly ever covered with sawdust. Decayed fish eggs and dead young fish are also often found in the piles of sawdust."

With regard to the condition of the Undal River, I have made the following observation:

"The principal complaint of all the fishery-owners along this river is the constantly increasing quantity of sawdust. This is particularly noticeable below the Melhus Falls, close above which there are three large saw-mills, all of which empty their sawdust into the river. An old fishing place above the falls is completely filled with sawdust, so that now the water is shallow where formerly it was several fathoms deep. The fishing places below the falls are also suffering from large quantities of sawdust, which fills the stationary nets to such a degree that they have to be kept at some distance from the bottom, so that many fish pass below them. During my visit the sawdust did not give so much trouble as usual, as the water had for some time been exceptionally high, and the current had in consequence carried most of it farther down the river. In quiet nooks and on the banks, however, piles of it could be seen. One of the large landed proprietors in Northern Undal informed me that in the portion of the river nearest to him (and therefore far above the Melhus Falls) the quantity of sawdust was so considerable that after a freshet it would cover the banks to the depth of several inches, and in some places even to the depth of one foot (!). On his own property (Spillinggard) several acres of land are covered in this way. Among the localities which had suffered in this manner he mentioned Einersmoen, Löland, and Vigmostad. After every freshet the sawdust had to be removed in order that the grass might not suffer."

Outside of the districts of List and Mandal the complaints regarding the injuries done by sawdust are not so loud and frequent, and it is proba-

ble that in no other part of Norway are the injuries as serious as in the above-mentioned districts. But there is hardly any timbered region where the refuse from the saw-mills is entirely without injurious influence on the salmon and trout fisheries, and in many places these injuries are very considerable. Aside from the Tistedal River, which has almost entirely been depleted of its formerly numerous salmon, we must mention, among the rivers suffering from the same evil, the Glommen, the Sandvik, the Lier, and the Stenkjær.

The above-mentioned facts are, in my opinion, urgent reasons why the owners of salmon fisheries should endeavor to have this important matter regulated by law in the near future. Such legislation should aim at putting a stop to the habit which now prevails to an alarming degree of throwing sawdust or other refuse from the saw-mills into the river. It was therefore a great satisfaction to learn that the commission for examining the condition of our rivers, appointed by royal order of January 22, 1876, has, in its preliminary draft of a law, from other reasons than regard for the fisheries, arrived at the belief that legislation in this matter is urgently demanded (see articles 21 to 25 of draft). With regard to the minority report of the committee, which expresses the opinion that any law compelling the mills to collect their sawdust should (when applied to saw-mills which are not already compelled to do so by the law of August 12, 1848) become applicable only when a new saw-mill is put up, or any of those at present in operation undergo a change, I must express a difference of opinion. I think that such a law by no means meets the wants of the salmon fisheries, as in some places the evil has assumed such dimensions that a law which merely prevents its spreading any more will, in those districts which suffer most, be of little or no use. What the salmon fisheries need are regulations which can be immediately applied to the existing saw-mills, therefore regulations like those proposed by the majority of the commission. The difficulties and expenses connected with the proposed collecting of the sawdust are very small, as will appear from a circumstance reported to me during the summer of 1879 by a very reliable man, namely, that one of the owners in part of a large saw-mill on the Undal River has made an offer to the other owners to gather and carry away, at his own expense, all the sawdust from this mill, on condition that he may consider the sawdust as his undisputed property, and this man, as I was told, has no other use for sawdust than that to which it is put by every farmer.

It is to be feared, however, that the draft of a law prepared by the above-mentioned commission, which, so far, is only preliminary, will not become a fixed law and be enforced for a long time to come on account of the many and great difficulties in the way of its execution. But on account of the threatening dimensions which the pollution of the rivers by sawdust has assumed, especially in our most important salmon districts, it will be dangerous to let more time than is absolutely necessary go by before attempts are made to regulate this matter by legislation.

There is all the less reason to wait for the final report of the commission, since any law prepared by them is sure to be unsatisfactory and not calculated to reach the true interests of the fisheries, as during the parliamentary discussions regarding the appointment of such a commission it was strongly insisted upon that the fisheries be kept out of the range of the commission's work. It therefore seems to me to be very desirable to insert, as soon as possible, in the law on the salmon fisheries a provision prohibiting the pollution of the salmon rivers by sawdust.

By a resolution of the Norwegian Parliament, passed in 1878, I have been commissioned to prepare the draft of a law regulating the salmon and sea trout fisheries, and it is my intention to insert a clause with regard to the injurious influences of sawdust. This whole question is also of considerable importance with regard to the trout and other fresh-water fisheries, and it may therefore be desirable to extend any future legislation on this question to all the rivers, as was proposed by the commission. This whole "sawdust question," although of great importance to the fresh-water fisheries, is, at present at least, of much greater importance to the salmon and sea-trout fisheries, but a provision relating to all the rivers of Norway, and not merely to the salmon and sea-trout rivers, does not seem to be in its proper place in a law regulating the salmon and sea-trout fisheries. It is understood, however, that any law prohibiting the throwing of sawdust into the rivers, if it is not to miss its aim entirely, must be worded in such a way as to include within certain districts the tributaries of the salmon rivers, even if they do not contain any salmon. It is not necessary, however, in this place, to enter into details regarding the provisions of such a law.