

RECENT INVESTIGATIONS CONCERNING THE REDFISH, *ONCORHYNCHUS NERKA*,
AT ITS SPAWNING GROUNDS IN IDAHO. BY BARTON W. EVERMANN AND
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Of the 130 or more families of fishes now recognized as constituting the fish-fauna of North America, the one of greatest and most general interest is the *Salmonidae*, the family to which belong the whitefish, the salmon, and the trout.

Whether we consider beauty of form and color, activity, gaminess, quality as food, or abundance and size of individuals, the different members of this family stand easily with the first among fishes.

Confined to the north temperate and arctic regions, they abound wherever suitable waters are found. In North America alone no fewer than sixty-two species are found. Some of these species are confined to the smaller rivers and running brooks, entering lakes or the sea as occasion serves, but not habitually doing so. Such are some of the species of trout of the genera *Salvelinus* and *Salmo*. Others again are lake fishes, approaching the shores or entering the tributary streams only at spawning time and then retiring again to deeper waters. These are the whitefishes and lake herrings.

Then there is another group made up of species that are marine and anadromous, living and growing in the sea, but entering fresh waters at spawning time. Such are the five species of salmon of our west coast.

From California to northern Alaska and across to Kamchatka are found five species of true salmon of the genus *Oncorhynchus*, viz.:

1. The Hump-back salmon, *O. gorbuscha*,
2. The Dog salmon, *O. keta*,
3. The Silver salmon, *O. kisutch*,
4. The Blue-back salmon, *O. nerka*, and
5. The Chinook salmon, *O. tshawytscha*.

The most interesting and by far the most important of the five are the Chinook and the Blue-back; and it is to the last of those two species that this paper is devoted.

In Kamchatka and Alaska this species is known as the Red salmon and is commercially worth more than all the other salmon of Alaska combined. It here ranges in weight from five to eight pounds, and in late summer and early fall they enter the rivers and lakes of Alaska in myriads at spawning time. In the Columbia River it is called the Blue-back salmon and, next to the Chinook, is the most valuable fish of that river.

The Blue-backs enter the Columbia along with the Chinooks early in the spring, the height of the run being in the month of June; and the catch in the lower Columbia amounts to several hundred thousand fish annually. Such as escape the labyrinth of nets, traps and wheels which for miles literally fill the lower Columbia, pass on to their spawning grounds. We do not yet know just where all their spawning grounds in the Columbia basin are located, but we do know that there are important ones in the inlets of Wallowa Lake in Oregon, and Payette Lake and the Redfish Lakes in Idaho.

It was not, however, until 1894 that any naturalist visited these lakes at the spawning time and made any study of the spawning habits.

In September of that year we made a brief visit to Alturas and Pettit lakes and Big Payette Lake, where we found this salmon spawning.

Big Payette Lake is situated near the head of Payette River about 120 miles northeast from Weiser, Idaho. Alturas and Pettit lakes are two of a group known as the Redfish Lakes, lying among the eastern spurs of the Sawtooth Mountains, forty-five to seventy-five miles northwest from Ketchum, Idaho, the nearest railroad station. These Redfish lakes are really the headwaters of Salmon River, the principal tributary of the Snake, and their distance by water from the sea is more than a thousand miles.

The investigations of 1894 showed that the vicinity of those lakes afforded excellent facilities for studying the habits of the salmon which spawn there, and it was decided to visit them again in 1895.

It should be here stated that the Blue-back salmon which enter the Columbia River are no longer known by that name when they reach their spawning grounds, but are known as Redfish. When they enter the river from the sea they are a clear, bright blue above and silvery on the sides, but when they reach their spawning grounds they have become more or less red, especially the males, which are often a bright scarlet red on the back and sides, the head being a light olive-green. At these Idaho lakes two forms of the Redfish have long been known to occur, a large form weighing four to eight pounds and corresponding to the regular Blue-backs taken in the mouth of the Columbia; the other is a small form weighing almost invariably a half pound each and not corresponding to any salmon ever taken in the lower Columbia. Structurally it does not appear to differ from the large form in anything except size, and the two forms are regarded as being specifically identical.

But a number of questions concerning this fish were veiled in more or less obscurity, among which may be mentioned the following:

1. Do the Redfish which spawn in the inlets of the Idaho lakes really come up from the sea, and when do they first arrive?

2. During the spawning season the Redfish are observed to have their fins more or less worn or frayed-out and to have sores upon the body. Are these mutilations received on the spawning grounds, or are they injuries incident to the long and perilous journey from the sea?

3. What are the habits of the Redfish during spawning time?

4. What becomes of them after done spawning? Do they return to the sea, to the lakes, or do they all die?

In order to answer as many of these questions as possible, it became at once evident that an extended series of observations at one of the lakes would be necessary. A camp was therefore established at Alturas Lake last summer on July 20, and the observations begun then were carried on continuously until September 24.

Alturas Lake is situated at an altitude of 7,200 feet, between two immense glacial moraines extending downward from the eastern spurs of the Sawtooth Mountains. It is about two miles long, four-fifths of a mile wide, and has a maximum depth of 158 feet. Its inlet is a small mountain stream about eight miles long, and thirty feet wide at the mouth. The outlet of Alturas Lake is somewhat larger, and after flowing through Perkins Lake (a small lake about a half mile below) enters Salmon River Valley. After a course of about five miles to the northeast, Alturas outlet joins Salmon River.

Just above the lake on either side of the inlet tower extremely rugged mountains whose peaks are 9,000 to 11,000 feet above the sea, and the scenery is as wild as any to be found in America.

In order to study the Redfish effectually, we set gill nets in the outlet and in the inlet and examined them from day to day. The nets in the outlet would tell us when the fish arrive from below on their way to the spawning grounds. The nets in the inlet would tell us when the fish run up out of the lake to their spawning beds, and also whether they return to the lake after done spawning.

Without going too much into detail, it will suffice to say that daily observations of the lake, outlet and inlet, were made, and the nets, though not kept continuously set, were so regulated as to assist in solving as many as possible of the problems involved.

Not a single Redfish was ever caught in any of the nets in the outlet. If they come up from the sea, they had reached Alturas Lake before July 20, when our nets were set.

On July 24 four small Redfish were caught on the net in Alturas inlet, and in a day or two they were abundant in this stream. Evidently, therefore, they had entered the lake at some date prior to July 20, and had remained in it until the evening of July 23 when they first entered the inlet.

Beginning with July 23 the fish continued to enter the inlet until early in September. During this time at least 2,000 Redfish, only about a dozen of which were of the large form, entered this small creek. Hundreds of these were examined as they were running up into the inlet from the lake, and not one of them showed any sores, frayed-out fins, or mutilations of any kind. Toward the close of the spawning season there was scarcely a fish whose fins were not more or less worn out (frequently the caudal was entirely gone) and whose back or sides were not sore. And we were able to see how these mutilations were received.

During the spawning period there is a rather definite pairing off of the sexes. The spawning beds are usually in very shallow water on a bottom of fine gravel and sand. While spawning, this gravel and sand is moved about a good deal and made up into so-called nests, both sexes taking part in the work. The gravel is moved about by the fish striking it with the tail, or by pushing against it with the lower fins, or sometimes even with the dorsal fin and the back. The gravel is moved by a rapid, quivering movement of the body as the fish swims over the nest; then she circles around down stream a few feet and approaches the nest to repeat the act again. The male follows closely behind the female, and frequently moves the gravel in the same way.

The fish move about to some extent in the inlet, but there is no evidence that they ever try to return to the lake. Our nets caught a good many from the upper side, but they were nearly all dead or dying fish which had been carried down by the current, and were only slightly gilled or simply lodged against the upper side of the net. We saw no evidence whatever indicating any tendency to return down stream, and it is not easy to believe that any fish, so seriously mutilated as these all are at the end of the spawning season, could survive. On September 5 we counted about 1,000 fish in Alturas inlet; two weeks later all had died but about 150, and a week later practically all had died.

We consider it, therefore, absolutely proved that the Redfish which spawn in the inlets of the Idaho lakes spawn only once and then die, and that the mutilations are received on the spawning beds.