
A REPORT

UPON

SALMON INVESTIGATIONS IN THE HEADWATERS OF THE
COLUMBIA RIVER, IN THE STATE OF IDAHO, IN 1895,

TOGETHER WITH

NOTES UPON THE FISHES OBSERVED IN THAT STATE
IN 1894 AND 1895.

BY

BARTON WARREN EVERMANN, Ph. D.,
Ichthyologist of the United States Fish Commission.



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The investigations concerning the physical and natural-history features of the Columbia River basin begun by the Commission in 1892 were continued in 1895. The work in 1894 and 1895 was directed chiefly to an inquiry into the spawning habits of the redfish (*Oncorhynchus nerka*) and the chinook salmon (*O. tshawytscha*).

The preliminary inquiry made in 1894 by Dr. J. T. Scovell and the writer at Big Payette Lake and in the headwaters of Salmon River, the report upon which has been published,¹ indicated that those two localities afford excellent facilities for the study of those two important species at spawning time. They were therefore selected as the field of operations for 1895, and a party was sent to each.

Mr. Thomas M. Williams, of Stanford University, was sent to Big Payette Lake, where he arrived July 19 and remained until September 25. Prof. Seth E. Meek, of Arkansas State University, and Mr. Norman B. Scofield, of Stanford University, were sent to the headwaters of Salmon River. They arrived at Sawtooth July 17, established camp on Pettit Lake July 22, and were joined August 9 by Dr. Oliver P. Jenkins and the writer. On August 28 the camp was moved to Alturas Lake, and on September 18 it was again moved to Alturas Creek in the valley near Salmon River. Dr. Jenkins remained in the field until August 29 and Professor Meek until September 12. On September 11 Mr. William Barnum, of the Fish Commission, joined the party, and on September 24 the work was brought to a close.

Mr. Williams's field of operations was limited practically to Big Payette Lake and its inlet and outlet, while that of the other party covered much more territory, embracing, as it did, the entire group of Redfish Lakes, except Stanley Lake.

As already stated, the inquiry made in 1894 showed that both the redfish and chinook salmon have important spawning-grounds in each of these regions, and it was to these two species that the present investigations were primarily directed. The opportunity to study the other species of fishes found in those waters was not, however, neglected, and a large amount of information bearing upon their habits and geographic distribution was obtained.

There are, as is well known, two forms of the redfish which breed in the inlets to certain lakes in Idaho. These two forms seem to agree in habits and in all structural characters except size, and apparently constitute a single species. The individuals of

¹A Preliminary Report upon Salmon Investigations in Idaho in 1894, by Barton W. Evermann. <Bull. U. S. Fish Comm. for 1895, 253-284.

one form weigh from $3\frac{1}{2}$ to 6 pounds, while those of the other and more numerous form weigh almost invariably one-half pound each.

The principal problems concerning this fish, the solutions of which were sought in our investigations, may be stated as follows:

1. Do both the large and the small redfish come up from the sea, or are the small ones a landlocked form, inhabiting the lakes except during the spawning season, when they run up into the inlets?
2. If the redfish are anadromous, when do they reach their spawning-grounds?
3. Where and how do the redfish receive the mutilations noticed upon them when spawning?
4. What are their spawning habits, particularly when on the spawning-beds?
5. Do the fish return to the lake or the sea after spawning, or do they all die?
6. Where do the young redfish stay?
7. What is the definite location of the present spawning-beds, and what is their condition?

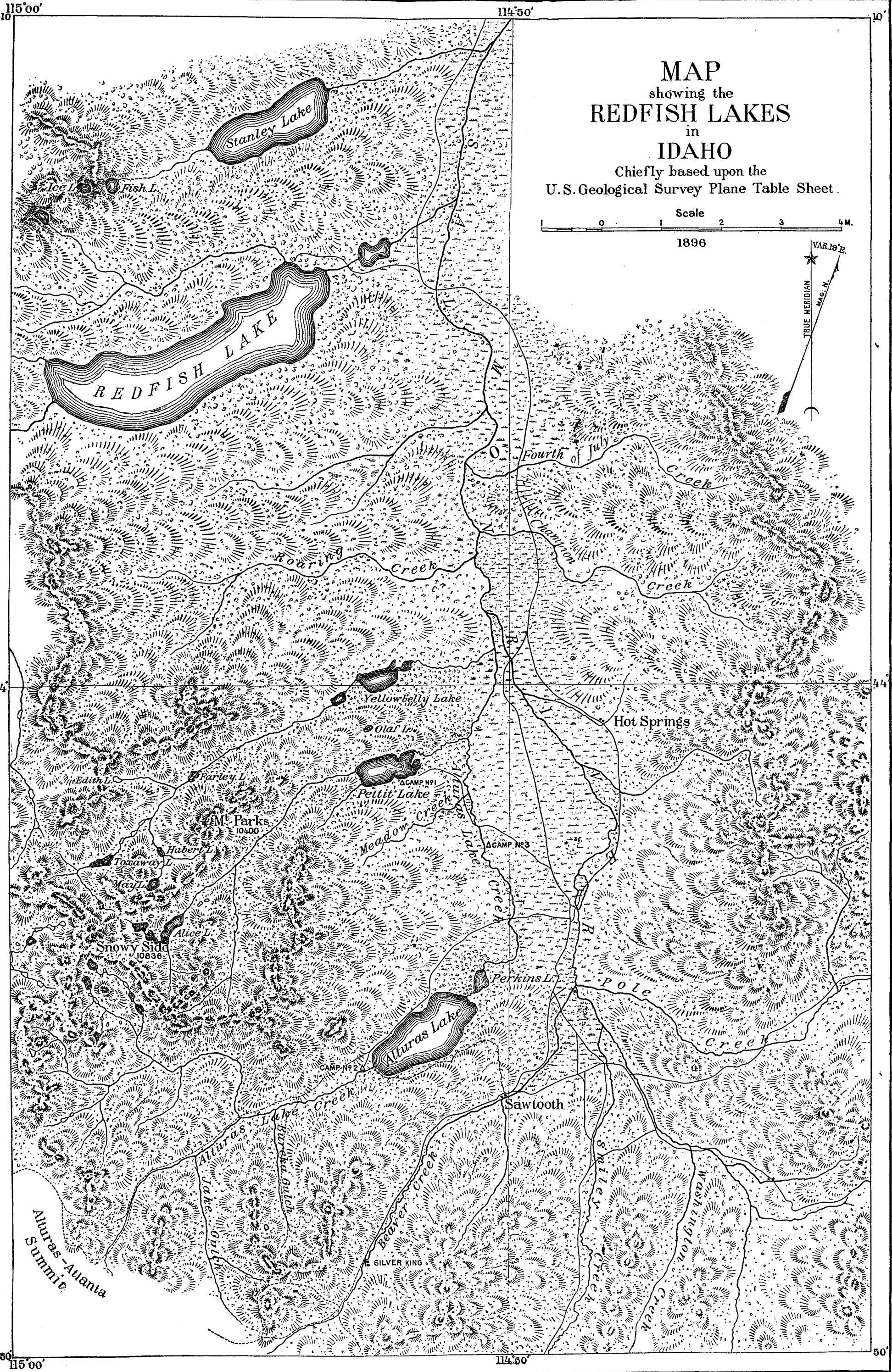
The chinook salmon also have important spawning-grounds in the upper Salmon River basin and in Payette River, and definite information regarding this species was also desired.

1. Where are its spawning-grounds, and what their extent and present condition?
2. When does it reach its spawning-grounds?
3. What is the condition of the fish when they first arrive? Are the mutilations, frayed-out fins, and sores the result of the long journey from the sea, or are they all received while on the spawning-beds?
4. What are the habits of this fish while spawning?
5. What becomes of them after they have finished spawning?
6. How long do the young remain in the vicinity of the spawning-beds?

In order to study these various problems in the most satisfactory manner, a camp was established July 22 on Pettit Lake. This location was thought to be such as would enable the different members of the party to keep a close watch upon the outlet and inlets of Pettit Lake, the outlet and inlet of Alturas Lake, Alturas Creek, and a portion of Salmon River. Gill-nets were set as follows: One of $7\frac{1}{2}$ -inch mesh in Salmon River just above the mouth of Alturas Creek, and one of same kind in Alturas Creek about a mile above its mouth. These were meant for the chinook salmon and the large redfish. A $2\frac{1}{2}$ -inch-mesh net was placed in the outlet and one in the main inlet of Pettit Lake, and one in the outlet and one in the inlet of Alturas Lake. These four were intended for the redfish, particularly the small form. If the salmon and redfish had not yet come, the nets below the lakes would tell us of their arrival. The nets in the inlets would tell us when the redfish began ascending the inlets from the lakes. These various nets would also enable us to determine whether either or both species return downstream after spawning.

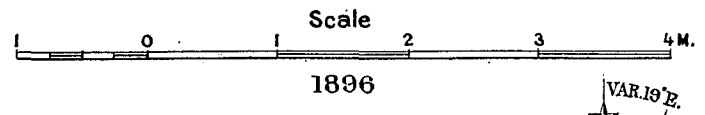
It was soon demonstrated that the nets were too remote from each other to permit daily visits being made to all. In consideration of this fact and the early solution of certain of the problems, the locations of some of the nets were changed. And after the fish had appeared at any particular net, and the time of their arrival was thus determined, that net was lifted for a time, to allow the fish to go on to their spawning-beds. Visits were made to all the nets at least as often as every other day.

On August 28 we moved camp from Pettit Lake to the inlet of Alturas Lake, in order that the redfish in that stream might be watched continuously. Occasional



MAP
 showing the
REDFISH LAKES
 in
IDAHO

Chiefly based upon the
 U.S. Geological Survey Plane Table Sheet.



115°00' 114°50' 10' 44' 50' 50' 115°00' 114°50'

Stanley Lake
 Fish L.
 Redfish Lake
 Fourth of July Creek
 Roaring Creek
 Yellowbelly Lake
 Hot Springs
 Pettit Lake
 M. Parks 10400
 Snowy Side 10836
 Alturas Lake
 Sawtooth
 Pole Creek
 Alturas Summit

visits were still made to Pettit Lake, Alturas Creek, and Salmon River, thus enabling us to keep informed as to the progress of events in those waters.

At Big Payette Lake similar methods were employed by Mr. Williams. Gill nets were set in the outlet and in the inlet, and inspected from time to time as required.

The detailed operations of these various nets will be given in connection with the discussion of each particular species of fish taken in them.

In the present connection, the following brief summary of the more important results of these investigations may be given:

1. The redfish, both large and small, had reached these lakes prior to July 20, when our observations began. While the proof that the large form is anadromous may be regarded as conclusive, the evidence that the small one comes up from the sea is not complete. It seems probable that both are anadromous, but, so far as the Idaho lakes are concerned, the small form has not been proved to be so.

2. If the redfish, large and small, are anadromous they reach the Redfish Lakes, in some years at least, earlier than July 20.

3. The mutilations, sores, fraying out of fins, etc., are not received en route to the spawning-grounds, but are practically all received subsequent to reaching them.

4. The redfish all die soon after spawning.

5. The young redfish remain in the lakes and connecting waters for at least one year from the time when the eggs were spawned.

6. The chinook salmon arrived on or about July 24, and were practically without mutilations or sores.

7. All the chinook salmon which come to these waters die after spawning.

8. The young chinook salmon appear to remain for one year after the eggs are laid, near where they were hatched.

THE REDFISH LAKES.

The group of lakes known collectively as the "Redfish Lakes" is situated in the western part of Blaine and Custer counties, Idaho. They all lie on the west side of the Salmon River Valley at the east base of the Sawtooth Mountains. The center of the group is, approximately, in latitude 44° north and longitude 115° west.

The principal lakes of the group are known as Alturas, Pettit, Yellowbelly, Redfish, and Stanley lakes. Besides these there are two or three smaller ones at the same altitude, while at the heads of their inlets at greater elevations are a great many small lakes. All of these lakes empty their waters into Salmon River and really constitute the headwaters of that stream. Each of the larger lakes lies in a basin scooped out by glacial action. Across the canyon at the lower end of each lake is a broad terminal moraine through which the outlet has cut its way.

The general direction of the longer axis of each of these lakes is northeast and southwest, and on either side are high ridges extending from the Sawtooth Mountains into the edge of the valley. These ridges are the immense lateral moraines of the ancient glaciers which formed the canyons in the mouths of which the lakes now lie. The larger, higher morainic ridges have a granite axis or core, but the smaller ones are apparently composed entirely of morainic material. In most cases the ridge on the right shore of the lake is lower than the one on the opposite side.

In the main canyon and the branches which open into it flow the inlet streams and their many smaller tributaries. These streams have their sources in the fields

of snow which lie on the more protected slopes among the high and rugged peaks of the Sawtooth range. The elevation of Salmon River Valley in its upper portion is 7,000 to 7,300 feet, while that of the larger lakes is about 7,200 feet. The Sawtooth range is a group of remarkably rugged mountains, from whose different slopes the streams flow in all directions. On the north are the creeks which form the middle fork of the Salmon; on the east are the headwaters of the main fork of the Salmon; on the southeast and south are Big Wood River and the streams which go to make the south fork of Boise River; while the west slopes furnish the water supply for the north fork of the Boise and the east fork of the Payette.

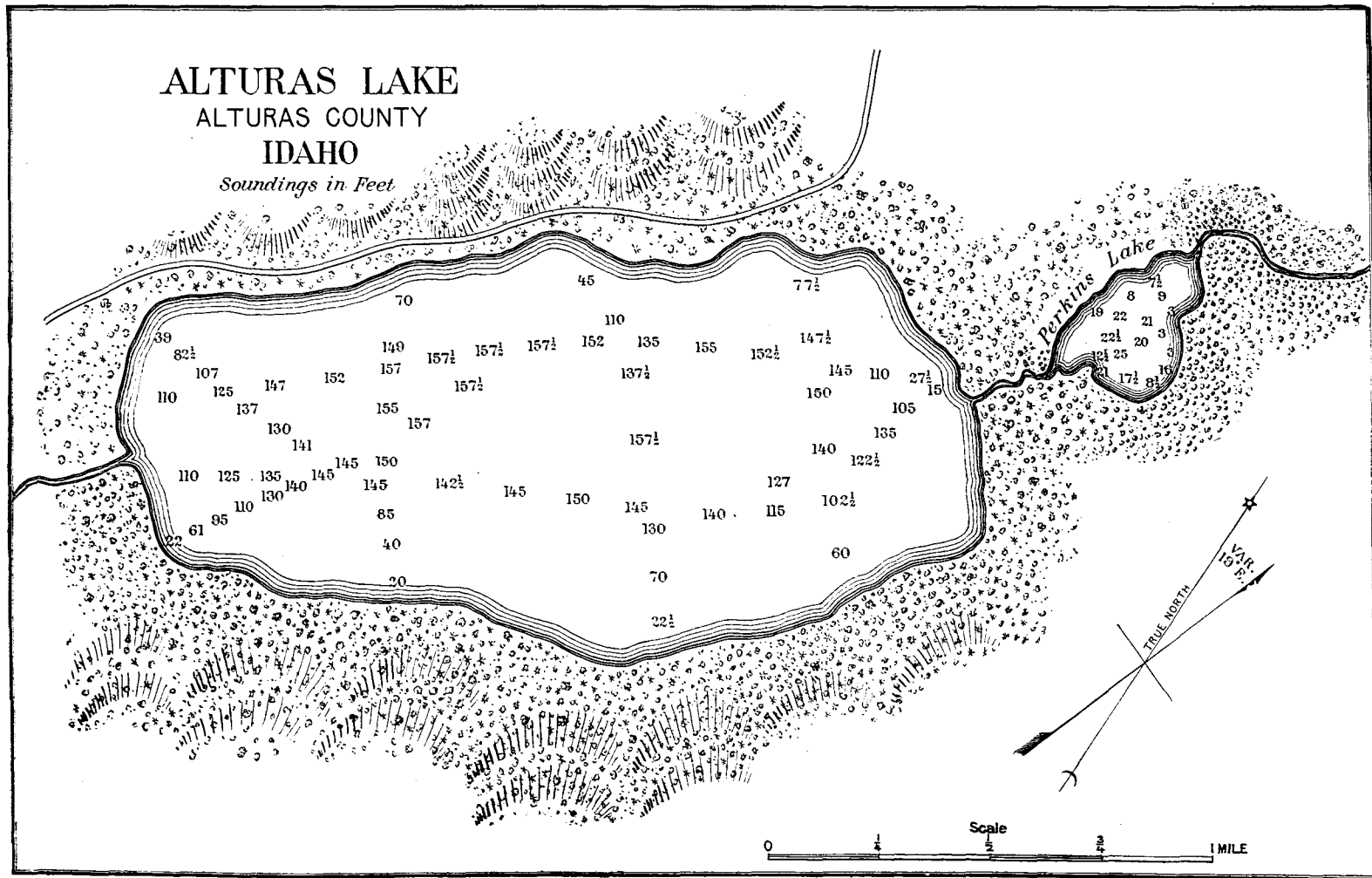
The general direction of this range is north and south. The peaks are extremely precipitous and often consist of a series of sharp needles or spires whose summits are inaccessible. These sharp needles give the range a very jagged outline, as seen from a distance, and suggested the very appropriate name which the range bears. These peaks are, in most cases, 10,000 to 10,800 feet high. The highest one, whose elevation has been determined by Mr. E. T. Perkins, jr., of the United States Geological Survey, is known as Snowside and is 10,836 feet above the sea.

The evidences of glacial action are on every hand and on a grand scale. Wherever the bottom or sides of the old glacier beds are exposed and composed of rock that does not readily disintegrate, the striations and grooves are distinctly retained. These markings are, however, in many places obscured by disintegration or covered up by talus or the enormous amount of material brought down into the canyons by snowslides, which are very frequent in these mountains. There are also numerous mutton-backs or *roches moutonnées* in the upper and middle parts of these canyons. Some of them are very large and, when not covered by débris, show in a remarkable degree the markings characteristic of glacial regions.

The moraines for the most part appear to have been but little disturbed since their first formation, and remain to-day essentially as left by the retreating glaciers. Enough disintegration has occurred, however, to form sufficient soil among the bowlders to give footing to a fairly heavy growth of timber. As a rule, all of the ridges on the west side of Salmon Valley are pretty heavily wooded. The higher mountains and the more rugged peaks are, of course, above timber line, and in some cases the lower ends of the moraines extending into the valley have few or no trees.

These moraines have been so little altered or modified that they still show with great clearness all the intricacy of detail of the moraines of great glaciers. In some positions near the main peaks the lateral moraines are immense naked ridges of clean angular bowlders with no sign of soil or vegetation upon them. They appear as if the ice of the glacier had but recently melted away from them. The larger lateral moraines extend long distances into and down the Salmon River Valley. These ridges are, as a rule, heavily timbered with Murray pine and Douglas fir, with here and there a clump of cottonwoods (*Populus tremuloides*). The forest on these ridges stops as abruptly as do the ridges themselves.

One of the most conspicuous and interesting features of the landscape is seen in these long, densely wooded ridges extending out into the broad, treeless valley of Salmon River. Looking down upon them from any high peak, they appear as long tongues of dark green reaching out into the valley and contrasting strongly with the duller colors of the dry grasses and the sage-brush.



ALTURAS LAKE, IDAHO; ALTITUDE 7,200 FEET.
The inlet to this lake contains important spawning beds of the Redfish or Blueback Salmon (*Oncorhynchus nerka*).

In discussing the fauna and flora of central Idaho, Dr. Merriam gives an excellent account of the forests of this region.¹ He assigns the Sawtooth Mountains and their adjacent and contained valleys to the following life zones:

1. Arctic-Alpine zone, from the upper limit of tree growth or timber line to the tops of the highest peaks. The height of the timber line varies according to slope exposure from 10,000 to 11,000 feet.

2. Subalpine or Timber-line zone, occupying the strip from the upper limit of stunted tree growth down to the upper limit of full-grown, perfect trees. The dwarfed trees growing in this zone are *Abies subalpinus*, *Pinus albicaulis* and *Picea engelmanni*, and the limits of the zone lie approximately between 10,000 and 11,000 feet.

3. Hudsonian or Spruce zone, lying between 9,000 and 10,000 feet. Its characteristic trees are the same as those of the Subalpine zone, but in this they obtain full and perfect size.

4. Canadian or Douglas fir zone, lying between 7,700 and 9,000 feet. The characteristic trees are the Douglas fir (*Pseudotsuga douglasii*) and the Murray pine (*Pinus murrayana*), with a few of *Picea alba* and *Populus tremuloides*.

5. Neutral or Transition zone, occupying the strip between 6,400 and 7,500 feet altitude, and with the sage-brush (*Artemisia tridentata*) as its most characteristic plant.

That portion of southern Idaho having an elevation of less than 6,400 feet and comprising the great Snake River plains, he assigns to his Upper Sonoran zone.

The forests about the Redfish lakes are composed almost entirely of the coniferous species already mentioned. In the immediate vicinity of the lakes is the Murray pine and occasional examples of Douglas fir and white spruce, though these two species are most abundant on the slopes some distance above the lakes. A few small, white-bark pines were seen near Alturas and Pettit lakes, but this species reaches its maximum size and abundance in the Hudsonian or upper timber zone, as stated by Dr. Merriam.

This region has never been mapped, even with approximate correctness. The United States Geological Survey is now engaged in making a topographical survey of this portion of Idaho. Through the kindness of Mr. Henry Gannett, chief topographer of the Survey, and Mr. E. T. Perkins, jr., topographer in charge of the Idaho field work, the Commission has been permitted to use the plane-table sheet of the Sawtooth region, and the accompanying map is based upon the Survey's work. That portion of the map north of Yellowbelly Lake is approximately correct only as to general features, as that region has not yet been examined by the Survey. Our own observations did not extend north of Yellowbelly Lake except in Salmon River Valley and in the immediate vicinity of Redfish Lake.

The following pages give detailed descriptions of the different lakes which we examined.

ALTURAS LAKE.

This lake, which is sometimes called Sawtooth Lake, is situated about a mile² northwest from the village of Sawtooth, from which it is separated by a densely wooded morainic ridge which rises some 600 feet above the lake. The greatest width of the lake is about four-fifths of a mile, and its greatest length about 2 miles. The general direction of its longer diameter is nearly northeast and southwest. The shore line is quite regular, there being no considerable bays or coves. Throughout the upper 1½ miles of the lake the opposite shores are approximately parallel and, as already stated, about four-fifths of a mile apart.

¹North American Fauna, No. 5. The elevations given by Dr. Merriam, referred to here, are all somewhat too great.

²The distance by trail over the ridge is about 3 miles.

Of course there are numerous little irregularities in the shore line, but they are scarcely noticeable to the observer standing at either end of the lake or looking down upon it from the mountain ridge to the northwest.

The setting of Alturas Lake is extremely beautiful. On the right side is a heavily wooded ridge rising gently from the water's edge to a height of 400 to 600 feet. In some places the shore is comparatively level for some rods back from the lake; in two or three places there are small, level meadows, and a fairly good trail extends the entire length of the lake on the left side. The immediate shore is, throughout most of its extent on the right side, covered with a heavy growth of bushes, chiefly alder, but with a good many willows and a few cottonwoods.

The trees nearest the water are nearly all Murray pine, but there are a few Douglas fir (*Pseudotsuga douglasii*) and spruce (*Picea engelmanni*), and an occasional small piñon (*Pinus albicaulis*). There are also a few small, stunted junipers. In the more level, moist places, firs and spruce are abundant, often growing to a height of 100 feet or more and a diameter of 2 or 3 feet, but the usual size is much smaller.

On the more sandy, drier portions of the shore and on the sides and top of the ridge the Murray pine is the principal tree. It is usually a tall, slender tree, less than a foot in diameter, exceedingly straight, and 25 to 100 feet high. In the moist places on the hillside, where the ground is springy or where a small stream comes down, there are often considerable clumps of cottonwoods or quaking asps. Beneath the trees are grasses and numerous species of flowering plants and shrubs. On the drier, more open places the scraggy, aromatic sage (*Artemisia tridentata*) and the rich, pleasing blue of the lupine (*Lupinus argenteus*) are seen in abundance; where it is more moist and somewhat shaded the rank and gorgeous *Epilobium* is the most conspicuous plant in early autumn, while in the yet more shaded and damper tangle are found the dark-blue aconite (*Aconitum columbianum*) and brilliant patches of the beautiful shooting star (*Dodecatheon jefreyi*), whose delicate flowers wither and die early in July or August. And among the grasses in the level, marshy meadow places the large, deep-blue gentian (*Gentiana affinis*), with its short stem, can be seen in profusion and perfection long after the frosts and the first snows have come.

Among the shrubs the service-berry (*Amelanchier alnifolia*), the small, red whortleberry (*Vaccinium myrtilloides microphyllum*), and the curious *Lonicera involucrata* were the most interesting. The first of these is rarest of all and, though growing to a height of 6 to 10 feet, its fruit rarely ripens in this locality, the summers being too short. The most abundant is the little whortleberry, with its pale-red berries, which ripen in early August and upon which the fool-hens, robins, and bear delight to feed.

On the northwest side of the lake is a rugged, granite mountain ridge, rising 1,000 to 1,500 feet above the lake. This originally formed the left shore of the large glacier which, coming down from the Atlanta summit, plowed out this valley and formed Alturas Lake. This mountain is rocky and precipitous, and has but little timber upon the side toward the lake. Immense snowslides have from time to time come down the side of this mountain, carrying everything before them into the lake. Down several rocky gulches flow small but turbulent streams during times of rain or melting snows. But once the rains have ceased or the snows have melted, all but two or three of these streams dry up entirely. There are two or three which are fed partly by springs, and they continue to flow throughout the dry summer. Along this side of the lake there is but little timber, except near the lower end, where there is a broad,

level tract, densely covered with a growth of small Murray pines, through which a forest fire has recently raged, killing nearly every tree.

A fairly good wagon road extends from Salmon Valley up this side of the lake to the inlet. The outlet of the lake is through a heavily wooded valley, where the Murray pine is the prevailing tree.

At the upper end of Alturas Lake is the narrow valley of the inlet which will be described more fully later on.

Depth.—A great many soundings were made in this lake, the majority of which are indicated on the accompanying map. Six principal lines were run across the lake and soundings taken at every 100 strokes with the oars, that is, about every 400 feet. As may be seen from the map, the lake is most shallow and grows deep most gradually on the right side. The left side becomes deep very close to shore. At the upper and lower ends, also, the depth increases quite rapidly. The greatest depth found was 157½ feet, which was near the middle of the left side of the lake. There seems to be here a basin of considerable extent, ranging in depth from 150 to 157½ feet.

The left bank is rocky and in places precipitous; the lower end and the right side are covered with coarse gravel, while at the upper end the bottom is of fine sand as far out as bottom can be seen.

The water of the lake is very pure and clear, and, when the surface is not disturbed, one can see bottom at a depth of 40 feet and can detect the presence of small fishes at a depth of 30 feet or more.

Temperature.—The water of this lake is very cold and does not differ appreciably from that of Pettit Lake. Our camp was not at any time so situated as to make it practicable for us to take temperature observations on Alturas Lake at regular intervals. The surface temperature at 9.30 a. m., August 10, was 61°, and at 4 p. m. was 63°. It did not vary greatly from these figures during the last half of July and up to the 22d of August. At that date it began to grow gradually colder and was down to about 59° by September 22. The bottom temperature was found to be from 3° to 8° colder than that at the surface, varying with the depth. The lowest temperature was found to be 54°, at a depth of 157 feet.

Vegetation in the lake.—In most places this lake is comparatively free from plant life. While there is considerable bottom vegetation in some places it does not anywhere reach the surface, except in a limited area in shallow water at the head of the lake. About the mouth of the inlet, beginning on the sandy bottom in water 4 or 5 feet deep and 10 to 20 feet from shore, and continuing out to a depth of 60 feet or more, is a thick, rank growth of vegetation, the principal species being *Potamogeton perfoliatus lanceolatus*, *Potamogeton zosterifolius*, *Potamogeton amplifolius*, a species of *Myriophyllum*, a *Nitella*, and a *Chara*. This growth seems to extend entirely across the upper end of the lake at varying distances from the shore, but is always confined to the fine sand bottom, and apparently between 4 feet and about 60 feet in depth. More extended observations than we were able to carry on will probably show that other parts of the lake possess similar patches of vegetation, particularly along the right side. These masses of vegetation fill, of course, an important place in the biology of the lake. Harboring, as they do, the great bulk of the food of most of the species of fishes which live in the lake, here will be found minnows, suckers, and young *Salmonida* in greatest abundance. Indeed, nowhere else in the lake did we find fishes of any kind in any considerable numbers.

Crustacea, etc.—A small surface tow-net was used a few times and the lower forms of life found to be abundant. Only two species of mollusks were found, viz, *Limnæa palustris* in the lake among the vegetation and *Planorbis trivolvis* about the lake.

Reptiles and batrachians.—Only one species of snake (*Thamnophis vagrans*) was seen about this lake. Not more than four or five examples were seen. The only batrachians obtained were *Rana pretiosa*, *Bufo halophilus columbiensis*, and *Hyla regilla*. All these were fairly abundant, particularly the frog.

Muskrats were not uncommon and were sometimes caught in our gill-nets, to which they did considerable damage with their sharp teeth.

Bear were not uncommon about the lakes and along the streams. After the salmon began to die the bear frequented the streams to feed upon the dead or dying fish.

The birds that deserve mention are the following: Horned grebe (*Colymbus auritus*), red-breasted merganser or fish-duck (*Merganser serrator*), and mallard (*Anas boschas*), all of which feed more or less upon the fish. The fish-duck was quite common and fed largely upon the dead redfish, which, as a rule, were kept pretty well cleaned up, the fish-ducks being the principal agent in their prompt removal.

Several species of insects found about these lakes deserve mention. First of all is a large, voracious horsefly (*Therioplectes sonomensis*), which is excessively abundant in July and August, when it is very annoying to both man and beast. So troublesome was it in some localities that work had to be abandoned. Later in the season this fly proved very good bait for trout and squawfish.

Among the butterflies noted about the lakes were the following:

Neophasia menapia Feld.	Colias eurythene keewaydin Edw.	Lycæna acmon Dbl. Hew.
Argynnis eurynome Edw.	Thecla fuliginosa Edw.	Pamphila uncas Edw.
Grapta zephyrus Edw.	Thecla titus Fabr.	Chrysophanus sp. ?
Vanessa antiopa L.		

Trout and squawfish were seen feeding upon several of these species, but the one of greatest interest was *Neophasia menapia*. This small white butterfly was common at all times during the latter part of July and August. On August 15 a remarkable flight was noticed at Pettit Lake. While ascending the ridge on the left shore of Pettit Lake great numbers were seen about 10 o'clock in the morning. The wind was then from the north, and the butterflies were being carried along by it down toward the lake and Salmon River Valley. As we ascended the ridge toward the top of Mount Parks the numbers continued to increase until we had reached a height of about 8,500 feet. Above that altitude the numbers were much reduced, but many were seen even upon the summit, 10,400 feet above the sea. The flight was a most interesting one. A stiff breeze was blowing and the thousands of butterflies were being carried along at a rapid rate. When in protected places they traveled more slowly, but rarely did one stop to rest.

On August 20 a similar flight was witnessed by Mr. Williams at Big Payette Lake. The people in that region had never before noticed this species as being particularly abundant, and regarded this flight as something quite unusual.

For several days following the flight at Pettit Lake this butterfly was unusually abundant in the lower canyons and the valley. While flying across the lakes or streams hundreds would each day drop into the water through fatigue or frayed-out wings, when they would be seized by the trout, squawfish, and perhaps by other species. Mr. Williams noticed small fishes feeding upon them at various times,

particularly on August 28. On August 21, I was astonished to see large numbers of squawfish in Redfish Lake feeding upon these butterflies which were dropping into the water. It was in the evening, when the cooling of the air benumbed the butterflies as they were passing over the lake. The squawfish would strike at the butterfly the moment it fell upon the water, and in a manner much resembling that of the trout. A number of stomachs of trout and squawfish which we examined showed that for some days this butterfly constituted an important part of their food supply.

Inlet.—Alturas Lake has but one inlet of any importance. This enters the lake near the middle of the shore at the upper end. It has its rise in the mountains southwest of the lake about 5 miles, in three principal forks, the middle one of which comes down the steep, rugged canyon from the summit over which passes the trail from Sawtooth to Atlanta. These three forks are all small, and fish of any size are not able to ascend far above their union. The upper portion of the canyon through which this creek flows is narrow, rocky in some places, but usually with a good growth of trees and bushes. Near its head the white-barked pine (*Pinus albicaulis*) is the most abundant, while lower down are the Douglas fir (*Pseudotsuga douglasii*), Engelmann's spruce (*Picea engelmanni*), white spruce (*Picea alba*), and Murray pine (*Pinus murrayana*).

Below the union of the three forks the canyon widens out and in the last 2 miles of its course it is perhaps a mile in average width. The Murray pine grows thickly along the stream, but away from it on the left or west side this tree grows in small clumps or groves with level meadows interspersed. At some places along the inlet the ground is marshy, and there is usually a thick undergrowth of willows and other bushes. In its lower portion this creek is a stream of considerable size, averaging about 25 or 30 feet in width and varying greatly in depth.

On September 17 the measurements of the inlet at its mouth were as follows: Width, 40 feet; average depth, 10.4 inches; average current, $1\frac{1}{2}$ feet per second. This would indicate a discharge of about 18,000 gallons per minute. The stream was measured on the same day at our camp, about half a mile above the mouth, and the following results obtained: Width, $14\frac{2}{3}$ feet; average depth, 10 inches; average current, $3\frac{1}{2}$ feet per second, thus indicating a volume of about 21,000 gallons per minute. The lack of agreement between the two results is probably due to an underestimate of the width and depth at the mouth. The left bank at the mouth overhangs considerably, and sufficient allowance was probably not made for the water running under it. During the early part of the summer the volume of water flowing in this creek was considerably greater, perhaps as much as 28,000 gallons, while at the lowest stage of water the volume is probably not greater than 17,000 gallons. At the time of our measurements the flow was somewhat above low stage, on account of recent rains.

The banks of the creek are low and composed of sandy soil, or in some places of sand or gravel. The stream bed is of moderately coarse gravel on the riffles in the upper portion, and smaller gravel in similar places in the lower portions. But through most of its course the bed is of very fine gravel and sand. Occasionally there is some mud bottom, but this is very rare. The bed is remarkably clean and free from débris or filth of any kind.

The depth of the water in most places varies from a few inches to 2 feet or less, though there are numerous "holes" where the depth varies from 2 to 4 or 5 feet. A deep hole rarely extends entirely across the creek, but lies over toward one bank, the

water always becoming gradually shallow toward the other shore. Except after heavy or continued rains the water is extremely clear, and even after rains it is not turbid enough to prevent one seeing to the bottom of the deepest pools. Ordinarily, when the surface is not rippled by the wind, one can very easily see even very small fishes in any part of the stream where they chance to be; so that one may walk the length of the creek and count all the fishes in it over 3 or 4 inches long, and feel pretty confident he has seen all there really are, if he but scrutinize the stream carefully.

Fishes.—One rarely sees a stream with so few fish in it as this. Species and individuals are both few. Besides the redbfish, which come into the creek only at spawning time, the only species of fishes which we saw during a month's observation were the following:

Bull trout (*Salvelinus malma*), not more than a dozen.

Chinook salmon (*Oncorhynchus tshawytscha*), a few young, none over 6 inches long.

Minnow (*Leuciscus balteatus*), a few seen occasionally.

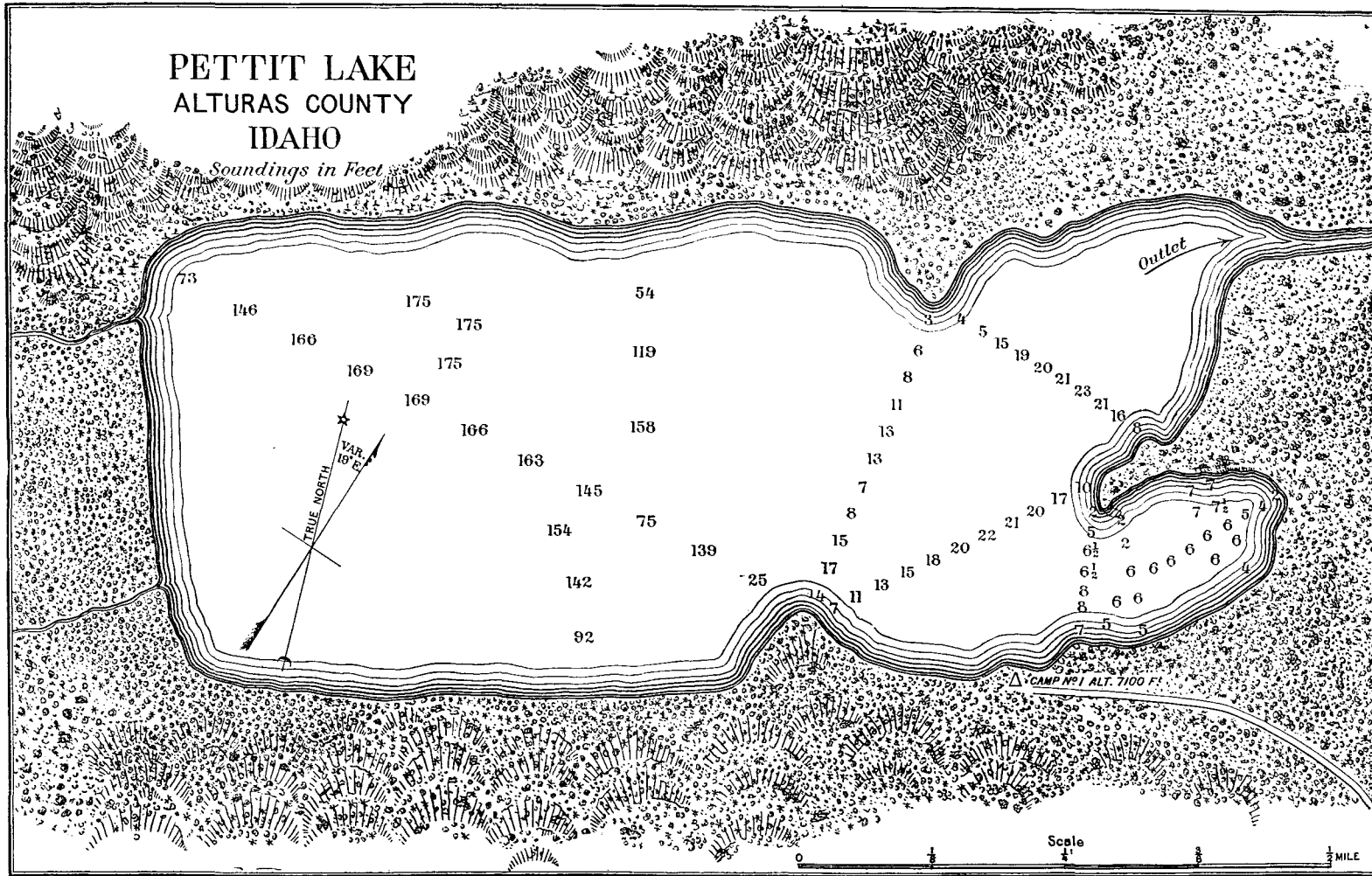
Young whitefish and young suckers probably run up into the inlet, and the blob may also do so now and then, but we never saw these species there.

Cut-throat trout should also be found there, but we are not sure that any were seen. All the small fish which looked like trout proved upon examination to be young chinook salmon.

Temperatures recorded at camp on Alturas Lake Inlet, August 29 to September 18, 1895.

Date.	8 a. m.		12 m.		8 p. m.		Remarks.
	Air.	Water.	Air.	Water.	Air.	Water.	
	Degrees.	Degrees.	Degrees.	Degrees.	Degrees.	Degrees.	
Aug. 29	-----	-----	-----	-----	45	49	
30	47	43	65	49	45	50	Several thunder-showers last night.
31	47	42.5	74	49	48	51	
Sept. 1	38	42.5	70	48	46	49	
2	49	43	52	47	48	48.5	Taken at 9 p. m.; strong wind.
3	47	43.5	52	46	50	47	Light rain in morning; windy all day.
4	47	43	50	46	45	48.5	Taken at 8.45 p. m.
5	37	43	45.5	46	37	47	Rain; snow on mountains.
6	29.5	39.5	-----	-----	33	43	Taken at 9 p. m.; fair.
7	29	38.5	56	44	38	47	Fair.
8	36	39.5	64	46	50	48.5	Rain.
9	41.5	42.5	44.5	44.5	38	43	Snow and rain all day.
10	35.5	40.5	40	42	37	41.5	Taken at 1 p. m.; some snow; rain at night.
11	38	40	47	44	42	43.5	Taken at 1 p. m.; rain all last night and most of to-day.
12	45	42.5	52.5	44.5	66	55	Continuous rain.
13	45	43	46	44	26.5	43	Hard rain all day.
14	31	38.5	44	43.5	32	44	Clear and cold.
15	28	37.5	51	43.5	43	45	Do.
16	35	39	63	46	41	45	Clear and warmer.
17	32	39	58	44.5	45	47	Still clear.
18	39	41	¹ 76	¹ 57	¹ 47	¹ 57	Clear and warmer.
19	¹ 44.5	¹ 50	¹ 46.5	¹ 52	-----	-----	Cold rain all day.

¹ These temperatures were taken at the camp on the outlet of Alturas Lake.



PETTIT LAKE, IDAHO; ALTITUDE 7,300 FEET.

The two small inlets to this lake are visited by the Redfish or Blueback Salmon (*Oncorhynchus nerka*) for spawning purposes.

PERKINS LAKE.

This is a small lake situated about 300 yards below Alturas Lake, the outlet of Alturas Lake flowing through it. The greatest length is about one-fourth of a mile and the greatest width about one-eighth of a mile. The general direction, like that of Alturas and Pettit lakes, is northeast and southwest, or perhaps a little more nearly north and south. The shore line is quite regular. At the head of the lake, near the inlet, is a small peninsula extending into the lake; near the lower part of the east side is a considerable inward curve in the shore line, while the west shore is made up of small curves. The inlet is at the upper left-hand corner and the outlet is on the same side of the lower end.

The shores of this lake are everywhere low, rising only a few feet above the level of the lake's surface and extending back from the lake in all directions without much, if any, increase in elevation. A heavy growth of small Murray pines surrounds the lake; just above the lake is a small meadow, which has evidently been covered with water at one time, and it is even yet somewhat marshy; on the left the narrow strip of pines separates the lake from a large meadow, which extends to the mountain more than a mile to the westward. This meadow supports a good growth of the native grasses, with here and there large patches of gentians and castellejas.

About the upper end of the lake is considerable marshy ground, and the shores are muddy; elsewhere the shores are either of white sand or fine gravel.

Perkins Lake is quite shallow. Six lines of soundings were run, and the depths found are all indicated on the accompanying map. The greatest depth obtained was 25 feet, east of the point projecting into the lake at the upper end. Over the larger part of the lake the depth is pretty uniform, ranging from 19 to 25 feet. At the lower end it is shallow, not anywhere exceeding 9 feet, and usually not over 5 feet. At the upper end the bottom is somewhat muddy, particularly in the large basin toward the right; elsewhere the bottom is of fine gravel or clean white sand.

There is considerable aquatic vegetation, patches of *Myriophyllum*, *Potamogeton*, *Chara*, and perhaps other species, being found in various places. In the shallow water about the head of this lake and in the marshy areas connected with it the young of *Leuciscus balteatus* and *Catostomus machrocheilus* were found during August and September in great abundance, and with them were many young *Ptychocheilus oregonensis*, *Coregonus williamsoni*, and *Salmo mykiss*, these last three species becoming less abundant as the water became warmer. There were also a few *Rhinichthys cataractæ dulcis* and *Agosia umatilla*.

While this lake is small, it is nevertheless an important one in its relation to the fish life of the Upper Salmon River Valley. Its shallowness, extensive mud bottom, warmer water, and considerable vegetation, are apparently conditions favorable to the hatching and growth of the young of the above species, which must form an important part in the food supply of the trout and the young salmon and redfish.

Pettit Lake.—The next important lake of this group is generally known as Pettit Lake,¹ and is situated about 5 or 6 miles north from Alturas Lake. This lake is

¹ The nomenclature of the lakes in this region is still somewhat indefinite. The names given on the General Land Office map (1891) do not conform to local usage in a single case. On that map a good-sized lake is placed at the head of Beaver Creek and called Atlanta Lake. Mr. Perkins and Mr. F. C. Parks inform us that there is no lake there, and that there is no lake in the Sawtooth Mountains bearing that name. Alturas Lake is located, but no name is given it. The next lake of the series is Pettit Lake, the one called Redfish Lake on the map; while the ones called Pettit Lake and Goat Lake on the map are apparently meant for Redfish Lake and Stanley Lake.

smaller than Alturas Lake and is more irregular in outline. The greatest length is about 1.1 miles, while the greatest width is about half a mile. The upper half of the lake has the sides relatively parallel, but the lower half is quite irregular in outline. The outlet is at the lower left-hand corner; on the right of this is a considerable peninsula projecting into the lake. At its outer end it turns toward the right shore and has very much the shape of a fish-hook, inclosing a small shallow bay.

Like Alturas Lake, this lake is also of glacial origin and lies between two immense lateral moraines. The ridge on the right is apparently composed entirely of morainic material. At the upper end of the lake this ridge is 200 or 300 feet above the surface of the water, but it becomes gradually lower as it approaches the Salmon River Valley, until opposite the lower end of the lake it is perhaps not over 50 feet high.

The ridge bounding the lake on the north rises rather abruptly, attains a height of 500 or 600 feet, and probably possesses a granite axis or core. To the left, this ridge is continuous above with Mount Parks, and below, it extends far out into Salmon River Valley. The terminal moraine extending across the canyon at the foot of the lake has a broken, uneven surface, and the outlet through much of its course possesses many rapids. The ridge on the left and the upper end of the one on the right are covered with a heavy growth of conifers, chiefly Murray pine and Douglas fir. The Murray pine grows most abundantly near the lake and on the lower slopes, while the fir is rarely found on the lake shore, it being found chiefly somewhat above the lake. At the head of the lake is a narrow valley or canyon densely wooded throughout. Near the lake it is level and somewhat marshy in places and supports a heavy growth of Murray pine, Douglas fir, and white spruce.

Pettit Lake is quite deep. Lines of soundings were run across it in various directions and the depths found are indicated on the accompanying map. As will be noticed, this lake, like Alturas, has its greatest depth near the upper end and toward the left shore. That part of the lake reaches a maximum depth of 175 feet. The lower third of the lake is comparatively shallow, a greater depth than 23 feet not being found. The narrow bay at the lower end on the right side is still more shallow, $7\frac{1}{2}$ feet being the greatest depth found.

At the head of the lake a fine sand bottom extends out until at least a depth of 40 feet is reached. There are also some areas of white sand bottom along the right side, but most of this portion is covered with small granite rocks. The lower half of the lake, particularly the narrow shallow bay, has a sand bottom except along the immediate shore, where it is usually rocky. The left shore of the lake is usually rocky and the bottom descends very abruptly, a depth of 50 feet or more being reached within a few feet of shore.

There seems to be less vegetation in this than in Alturas Lake. Small patches were observed at various places in relatively shallow water, but we did not determine the character of the bottom in the deeper places, so do not know whether there is any vegetation there. The water is very clear and pure. Where the bottom is of white sand it can be clearly seen at a depth of 40 feet, but in the deep parts of the lake the water appears very dark when viewed from the boat.

Temperature.—The water of this lake is very cold. Surface temperatures were taken at irregular intervals from July 26 to August 12, after which the temperature of the surface near our camp was taken regularly three times daily. The results are set forth in the tabular statements which follow. The bottom temperature in the deeper

parts was found to be from 4° to 10° colder during the day than the surface temperature taken at the same time. The maximum difference was found at noon, July 29, when the surface was 68° and the bottom, at 165 feet, 58°. This is probably as great a difference as existed at any time, even in the warmest weather. The nights were always quite cold enough to reduce the temperature of the surface water to that of the bottom or even below it, and not until some time after sunrise would it again exceed the bottom temperature.

Temperatures taken in Pettit Lake and connecting streams in July and August, 1895.

Date.	South inlet.	North inlet.	Lake.			Outlet.
			Surface.	Bottom.	Air.	
July 26	52°, noon.....	53°, 12.30 p. m.	63°, 1 p. m.....	59°, 1 p. m.....		
29	48½°, 11 a. m....	52°, 11 a. m....	68°, noon.....	58°, at 165 feet, noon		
30	50°, 10 a. m.....	50°, 10 a. m.....	65°, 9.30 a. m....	60°, at 70 feet, 9.30 a. m.		
Aug. 1	51°, noon.....	53°, noon.....	64°, 10 a. m.....			
2	47½°, 9.30 a. m.	50°, 9 a. m.....	63°, 9.15 a. m....			
6	48°, 10.30 a. m.	51°, 10.15 a. m.				
8			61°, 8 a. m.....			
9			63°, 9 a. m.....		36°, 8 a. m.....	
11	46°, 11.45 a. m.	50°, 12.15 p. m.			80°, 5.17 p. m..	
13	49°, 10.45 a. m.	49°, 10.45 a. m.				
14						61°, 9.15 a. m.
17						71°, 3.50 p. m.
22	47°, 9 a. m.....	47°, 9 a. m.....				67°, 2.30 p. m.
23	47°, 10 a. m.....	48°, 10 a. m.....				
25	47°, 8.45 a. m..	47½°, 8.45 a. m.				61°, 6.15 p. m.
26	44°, 10.10 a. m.	48°, 10.30 a. m.	62°, 11.15 a. m.			63½°, 11.30 a. m.
27	45°, 12.30 p. m.	47°, 11.30 a. m.				57°, 10 a. m.

¹ Temperatures recorded in this paper are in Fahrenheit degrees and taken with the Wilder protected thermometer.

Temperatures taken at camp on Pettit Lake, August 12 to 28, 1895.

Date.	8 a. m.		12 m.		8 p. m.		Remarks.
	Air.	Water.	Air.	Water.	Air.	Water.	
	<i>Degrees.</i>	<i>Degrees.</i>	<i>Degrees.</i>	<i>Degrees.</i>	<i>Degrees.</i>	<i>Degrees.</i>	
Aug. 12	50	61	67½	65			Beginning with August 12, the temperature of both air and water was taken at 8 a. m., noon, and 8 p. m. The place selected for taking that of the water was near our camp, which is indicated on the map, and in water 1 to 2 feet deep, the thermometer being allowed to rest upon the bottom. The thermometer for air temperature was kept on the shaded side of a small cabin on the lake shore at our camp.
13	54		72		65	65	
14	46	61	78	66½	67	66	
15	53	61½	74	65½	66	66	
16	48	61	67½	65	59	65	
17	48	61	71	64	63	65½	
18	48	62	72	65	62	65	
19	51	61½	76	66	64	66	
20	50	61	73	65	52	65	
21	51	63	64	63	58	64	
22	48	61	66	64	59	64	
23	48	60	65	64½			
24			67	65	55	63	
25	50	60	67	64	54	64	
26	46	61	62	63	53	61½	
27	44	59	54	61	47	61	
28	42	59					

Pettit Lake does not differ materially from Alturas Lake in the animal and plant life which it supports. So far as we were able to learn, the fishes of the two lakes are identical as to species, *Rhinichthys*, *Cottus*, and *Agosia* being apparently more common in Pettit, while suckers seemed to be more abundant in Alturas Lake.

Inlets.—This lake has two inlets, both of which enter it at the upper end, as shown on the accompanying map. The inlet to the right is much smaller than the other, and is probably not over $1\frac{1}{2}$ or 2 miles long. The other is at least 5 miles in length. The canyon through which these streams flow is extremely rough and rocky, except near the lake, where it is level and somewhat marshy. But beginning a mile or so above the lake there is scarcely any soil in many places, the bedrock coming to the surface in a wonderful series of mutton-backs, many of which are of immense size and show the largest grooves and most interesting striations I have ever seen. There are in places great masses of fallen timber, which have been brought into the canyon by frequent snowslides, while in other places are large quantities of rock fragments, which have been brought down by snowslides or which have fallen from the cliffs above.

The right side of this canyon is for the most part rather steep, but pretty well timbered, while on the left it is bounded by a great granite wall, in some places perpendicular for several hundred feet. There are occasional breaks in this wall, but it is difficult to find any place where one can climb to the top from below. In descending into this canyon from the summit of Mount Parks, we were compelled to go several miles above the lake before finding a place where we could descend this wall. Between the top of the wall and the summit of the mountain is a large area covered with slide-rock, which every year contributes liberally to the *talus* at the foot of the wall. This mountain peak, named Mount Parks, is the culmination of the ridge separating Pettit Lake from Yellowbelly Lake, and is 10,400 feet above sea level. It is an extremely rugged peak extending about 1,000 feet above timber line. In the more protected places on its slopes the snow remains continuously.

At the head of the main inlet to Pettit Lake are two small lakes, the larger known as Alice Lake. Their outlet has numerous falls and cascades. These lakes apparently have no fish in them.

Redfish Lake.—This is the largest of all the so-called redfish lakes, and is situated on the west side of Salmon River Valley, about 15 miles below or north of Pettit Lake. It is about 6 miles long and a mile wide, and, like all the other lakes of this series, its general direction is northeast and southwest. There are no large irregularities in the shore line, but the middle of the lake bows somewhat to the east. The right shore is low in most of its extent, rising gradually into a high morainic ridge, 200 to 400 feet higher than the lake. The left shore is abrupt and rocky throughout most of its length, and ascends rapidly into a high, rugged mountain ridge.

At the head of the lake the shore is also rocky, and ascends into precipitous cliffs, there being no level valley above. There are here two small inlets and one considerably larger. They all have their rise in the snow-fields lying among the extremely rugged mountains which lie beyond the lake. The canyons down which they come are remarkably rough, being filled with *roches moutonnées*, loose boulders, fallen and tangled timber, and other obstructions. The largest of these inlets enters the lake near the left or west side of the upper end, and is about 25 feet wide and 2 feet deep near the mouth. It would be very difficult for fish to ascend this stream more than a few hundred yards, so full is it of fallen timber, rapids, and cascades; indeed, it seems that wholly impassable falls would soon be encountered.

At the lower end of the lake, toward the left shore, another important inlet is received. This stream has its rise in several forks among the high mountains at the head of the lake, and flows down a narrow canyon nearly parallel with and only a short distance from the left shore of the lake. Near its lower end it makes a somewhat abrupt turn to the right and enters the lake only a few rods from the outlet. This creek is the longest of the inlets, and probably carries as much water as all of the others. It has its sources in the permanent snow-fields, among the ragged, beetling crags about the head of this lake, probably the most rugged and inaccessible of all the peaks of the Sawtooth Range.

At or near the heads of these inlets are several small lakes, all very cold, and most of them apparently quite deep. One of the most beautiful and most interesting is at the head of the left branch of the lower inlet. Its altitude is about 9,500 feet, and its area perhaps 10 acres. Its shores on all sides are of bed rock, and very steep. The lake occupies a circular depression in the rock, the origin of which is not easy to explain. At the outlet the water flows over a narrow ledge of rock *in situ*, and at all other places the shores are of rock, in places rising from 10 to 400 feet above the lake. There has been no damming by moraines, and the great depth of the basin and the character of the shores preclude the belief that it is of glacial origin, except upon the supposition that the descent of the glacier was very abrupt and that its force was exerted as a gouging agent, deepening the hole at the foot of the peak without wearing away the rock below.

On the right side is a snow-field of considerable size, whose base is laved by the waters of the lake and which reaches up among the inaccessible spires which tower several hundred feet above. This lake is quite deep, as is shown by the dark, blue color of the water, and the descent is very abrupt; nowhere, except at the outlet, is there room for one to walk along the water's edge. The outlet of this lake has numerous falls and cascades, and can not be ascended by fish.

The immediate shores of Redfish Lake and the immense morainic ridges lying on either side of it are covered with a heavy growth of Murray pine and Douglas fir.

Depth.—Redfish Lake is the deepest of this group of lakes which we sounded. We were not able in the time at our command to run systematic lines of soundings across the lake. Several soundings were made in the upper end, and depths ranging from 100 to 296 feet were found. The greatest depth, 296 feet, was obtained near the left shore and not far from the upper end of the lake. The lower portion of the lake is somewhat shallower.

Temperature.—This lake is apparently colder than Alturas or Pettit Lake. On August 21, readings of the surface temperature were taken at various times and at several different places, and 61° was the uniform result obtained. That of the main upper inlet at its mouth was 44°; that of the lower inlet was the same.

The fishes of this lake are, so far as known, the same as those of Alturas and Pettit lakes. The large redfish are known to come to this lake, but none came in 1895, so far as we were able to learn.

The outlet of Redfish Lake is quite a stream, carrying perhaps twice as much water as is discharged by Alturas Lake. It is broad, with a rocky bed, and flows through a relatively level and a narrow valley. A short distance below the lake it flows through a small, unnamed lake, in the same manner as the outlet of Alturas Lake

flows through Perkins Lake. The lower part of Redfish Lake outlet was not examined by us; nor were we able to make any examination of Stanley Lake, the last one of the series of Redfish Lakes.

THE UPPER SALMON RIVER AND ITS TRIBUTARY STREAMS.

In its upper course the Salmon River occupies a broad, treeless valley, whose elevation is from 7,000 to 7,300 feet above sea level. Except along the immediate banks of the river and its tributary streams, and in certain marshy places, the valley is well covered with sage (*Artemisia tridentata*). Along the streams are more or less dense thickets of willows (*Salix rostrata*), and in the marshy areas are grasses, gentians, and a white marsh marigold.

The general direction of the valley from its head to opposite Redfish Lake is nearly due north and south. The river is very tortuous in its course, but below the mouth of Alturas Creek it keeps chiefly to the west side of the valley.

The hills and ridges on the east side of the valley are either wholly without forests or have only isolated clumps of trees here and there, and narrow fringes of trees along the small creeks which come into the valley from that side. On the west there is heavy forest everywhere, even upon the long, narrow morainic ridges which extend out into the valley, forming such a marked and characteristic feature of the landscape.

Above the mouth of Alturas Creek, Salmon River receives several small tributaries, the principal ones being Washington, Smiley, and Beaver creeks from the left, and Pole, Lost, and Warm Spring creeks from the right. Of those from the left, Beaver Creek is the most important. It has its rise on the divide beyond Shaw Mountain, and flows northeast. The town of Sawtooth is situated upon this creek.

All of these creeks are said to be excellent trout streams.

Alturas Creek.—This is the most important stream tributary to the upper Salmon River. It is not only the outlet of Alturas and Perkins lakes, but it receives, also, the outlets of Pettit and Yellowbelly lakes. The general direction of Alturas Creek (or Lake Creek, as it is frequently called) is north, and its length is about 4 or 5 miles. Its average width is 40 to 60 feet, and in August the depth ranges from 1 foot to 4 or 5 feet. In its upper course it is relatively broad and quite uniformly shallow, with a moderately swift current over an even bed of small gravel. Here and there large glacial bowlders are seen in the stream. After passing through Perkins Lake, the stream widens somewhat for a short distance, then becomes narrower and more swift and the banks become less uniform in height; in some places they are 3 or 4 feet high, in others low and marshy. The shores are well timbered with Murray pine throughout the course except in the last $1\frac{1}{2}$ or 2 miles, or along that portion lying within the Salmon River Valley proper. There they are covered with sage on the dry portions and willows and an occasional alder where the ground is marshy. The special importance of this stream lies in the fact that the chinook salmon have spawning-beds in its lower course.

Alturas Creek receives three tributary streams from the west, viz, Meadow, Pettit, and Yellowbelly creeks. The first of these is a very small, cold creek, fed almost entirely by springs, and has its head on the mountain ridge separating Alturas and Pettit lakes.

Pettit Creek, the outlet of Pettit Lake, is about one-third the size of Alturas Creek, and is between 1 and 2 miles long. Immediately below the lake the outlet is broad and bordered by marshy ground, but soon it becomes a narrow stream filled with large rocks and possessing a swift current. At several places are considerable obstructions caused by fallen timber which has collected in the stream and which would seem to interfere with the free movements of fishes.

The outlet of Yellowbelly Lake is a similar but smaller stream, which joins Alturas Creek a short distance below the mouth of Pettit Creek.

The creeks which unite with Salmon River below the mouth of Alturas Creek are Roaring Creek on the west and Champion and Fourth of July creeks on the east. We made no special examination of these creeks. It is said that there are few, if any, fish in Roaring Creek, while the headwaters of the other two are said to furnish excellent trout-fishing. The Salmon River, in this part of its course, is a stream of considerable size, 40 to 100 feet wide, and with a very swift current in most places. There are long reaches where the water, 2 to 3 feet in depth, flows rapidly over a bed of clean, coarse gravel; in other places the width is somewhat greater, the depth a little less, the current correspondingly slower, and the bed of finer gravel and sand. At the foot of each of these shallow reaches is usually a quiet pool from 4 to 10 feet deep, in which the larger cut-throat trout and the bull trout delight to loiter.

BIG PAYETTE LAKE AND VICINITY.

Big Payette Lake is the principal lake of the Payette group, situated at the headwaters of the North Fork of Payette River. Mr. T. M. Williams carried on observations here from July 19 to September 25, 1895. He reports the lake as being quite irregular in shape. The main body is 6 to 6½ miles in length from north to south, and about 2 miles wide. At the north end is a long narrow arm extending to the southeast a distance of at least 5 miles; just below the inlet the main arm is greatly constricted, the width there being only a few rods, several rocky islets being found here. A large number of soundings was taken, and the depth in the lower or main portion was found to vary from 40 to 260 feet, the average depth being perhaps as much as 200 feet. The depths found in the arm vary from 130 to 305 feet, the average being about 200 feet. The maximum depth, 305 feet, was found near where the arm joins the main body, or a little southeast from the inlet.

The temperatures taken at this lake are given in the table on page 169.

Payette River.—This river was examined as far down as Van Wick, 40 miles below the lake. Throughout this distance it runs through a large valley known as Long Valley. The fall is not great, there being but one rapids in this distance. The river bed is composed chiefly of gravel and sand, and affords ideal spawning-grounds for salmon. It is only in the upper 10 miles of the stream, however, that spawning-grounds are known. Along this river are a great many small swamps, caused in most instances by old beaver-dams. The only tributaries of importance to this portion of Payette River are Lake Fork, Gold Fork, and Bowlder Creek, all of which come in from the east side and join the main stream near the same point. Lake Fork joins the river about 20 miles below Big Payette Lake; a short distance below comes in Bowlder Creek, a much smaller stream, and a little farther down is Gold Fork, which is about the size of Lake Fork.

Gold Fork and Boulder Creek are said to have been favorite spawning streams for the chinook salmon years ago, but now both of those streams are pretty well filled up with the washings from the gold mines in the mountains above. But few salmon enter them now, and it is said these spawn rather earlier than do those which spawn in the main river.

Lake Fork has never been noted as a salmon stream. This is probably due partly to the fact that it is a much rougher stream with more rocky bed. The last 20 miles of its course is nearly parallel with that of Payette River.

Little Payette Lake, which is drained by Lake Fork and which is about 20 miles above its mouth, is only a mile from Big Payette Lake, but its altitude is about 100 feet greater. This lake is a small one, its greatest length being not more than three-fourths of a mile. It is comparatively shallow and has a good many water plants growing in and around it. It is bordered by a considerable swamp, which probably indicates that the lake was formerly larger than it now is. A few miles above Little Payette Lake its inlet passes through a very narrow and deep canyon where the current is swift and turbulent, and fish would experience some difficulty in making the ascent. Above this place are several small tributary streams which are said to be well filled with native trout.

Payette River above Big Payette Lake is quite deep for the last 2 miles of its course and the current is slow. Between 3 and 5 miles above the lake is the part of the stream in which are located the spawning-beds of the redfish. The stream here is made up of long reaches with a depth of 1 to 4 feet, a moderately swift current, and a bottom of clean fine gravel and sand, connecting deeper holes where the current is slower and the bottom of sand alone. About 9 or 10 miles above Big Payette Lake is Upper Payette Lake. This is about a mile long, one-fourth of a mile wide, and is said to be quite deep. The redfish are said not to ascend to this lake, but trout are very abundant in it.

In the rugged mountains east of Big Payette Lake are several small lakes, a few of which were visited by Mr. Williams. One of these is known as Loni Lake, situated near the summit of the mountains, and 3,000 or 4,000 feet above and 15 miles east of Big Payette Lake. It is at the head of one of the branches of Boulder Creek, and is triangular in shape, each side measuring about half a mile. The shores are steep and rocky, being composed in many places of boulders. The outlet at this season (September) is underground, passing through the loose boulders. The fall of the outlet is very precipitous for several hundred feet, and fish can not now ascend to the lake, which is fed by springs and the melting snows from the surrounding mountains. The greatest depth found by Mr. Williams in this lake was 60 feet. The surface temperature of the water was 54.5°, September 18, when that of the air was 61°.

Boulder Lake is another small lake found here. It lies a few miles north of Loni Lake, and is about three-fourths of a mile long by one-fourth of a mile wide. It appears quite deep, but no soundings could be taken. It is at the head of Boulder Creek, and is fed by numerous small cold springs. It is held in place by a ledge of hard sandstone extending across its outlet, which has much the appearance of an immense stone dam. If this lake is of glacial origin, as one would suppose, it has been gouged out rather than formed in the ordinary way in which glaciers act. In this respect it resembles the small lake, at the head of Redfish Lake, described on page 165.

The outlet is quite steep for some distance, and fish can not ascend to the lake. The temperature of the lake at the surface was 50° at noon, September 19, when the air was 38°.

The following is a list of temperatures taken from the shore of Big Payette Lake about a mile east of the outlet. The lake at this point is shallow for probably 150 feet out from shore, where the bottom breaks off precipitously. Near the shore there is a scanty growth of various sorts of water vegetation. The water probably varies more in temperature at this point than it does at the surface in the deep portion of the lake.

Temperatures taken at Big Payette Lake in 1895.

Date.	Hour.	Air.	Water.	Date.	Hour.	Air.	Water.
		° F.	° F.			° F.	° F.
July 20	8.30 a. m.	58	63½	Sept. 1	6.30 a. m.	44½	60
20	6 p. m.	64	68	1	2 p. m.	68½	66½
21	8 a. m.	65	65	1	6 p. m.	68½	65
21	6 p. m.	75	70	2	6 a. m.	43	59
22	7.30 a. m.	57	65	2	12 m.	58½	62
22	7.30 p. m.	70	67	2	6 p. m.	57	59½
Aug. 15	do	64	67½	3	6 a. m.	46	57½
16	8 a. m.	55	65	3	7 p. m.	54	59½
16	12 m.	77½	69	4	6 a. m.	46½	58
17	7.30 p. m.	57½	67	4	6.30 p. m.	57	57
18	6.30 a. m.	44½	62	5	7.30 a. m.	42½	56½
18	3 p. m.	80	69	6	7 a. m.	28	54
18	8 p. m.	64	68	6	12 m.	53	63½
19	8 a. m.	65	64½	6	6 p. m.	43	61
19	1 p. m.	79	70	7	7 a. m.	29	54
20	7 a. m.	56	65	7	12 m.	61	61½
20	1 p. m.	75	69	8	8 a. m.	50	56½
20	6.30 p. m.	69½	67	9	7 a. m.	45	55
21	6.30 a. m.	53	64	10	6 p. m.	43	60
21	12 m.	68	66	11	7 a. m.	39½	54½
23	7 a. m.	50½	65	11	12 m.	46½	60
23	1 p. m.	71½	72½	11	6 p. m.	47½	55
25	6 a. m.	57½	63½	12	7 a. m.	55	49
25	1 p. m.	72½	71½	13	6.30 a. m.	47½	60
25	6.30 p. m.	59½	66	13	12 m.	54½	43
26	9 a. m.	57½	62	13	6.30 p. m.	43	55
26	12 m.	68	63½	14	6.30 a. m.	32	53
26	6 p. m.	48	59½	14	6 p. m.	37	57
27	7 a. m.	50	58	15	7 a. m.	32	53
27	12 m.	64½	68½	15	12 m.	58	59
28	6.30 a. m.	57½	60	16	6 a. m.	32	53
28	6.30 p. m.	59	63½	16	3 p. m.	61	54½
29	6 a. m.	41½	58½	23	7 a. m.	40	51

¹ Day and night before cold and windy.

² Rain and wind during night before.

³ Windstorm in afternoon; strong wind from northwest during night; cold northwest wind.

⁴ Thunderstorm in afternoon.

⁵ Cold south wind all day.

⁶ Rain storm during night.

⁷ Cold, clear, and frosty.

⁸ Rain and windstorm from southwest during night.

⁹ Continued rain from September 10 to 14.

¹⁰ Clear and cold.

¹¹ Cold and clear for several days previous.

The following temperatures were taken at irregular hours from various streams and lakes in the vicinity of Big Payette Lake:

T peratures of various streams about Big Payette Lake recorded by Mr. Williams in 1895.

Date	Hour.	Air.	Water.	Place.	
		° F.	° F.		
July 28	7 a. m.	63	67	Payette River, 40 miles below lake, at Van Wick.	
Aug. 16	12 m.	77½	68½	At outlet of lake.	
16	7 p. m.	62½	69½	2 miles below lake.	
17	6 a. m.	34	56½	Do.	
17	12.30 p. m.	75	66½	5 miles below lake.	
17	4 p. m.	75	68	10 miles below lake.	
18	6.30 a. m.	44½	65	At outlet of lake.	
21	7 p. m.	63	65	At inlet of lake.	
22	7.30 a. m.	53	63½	Do.	
22	3 p. m.	68½	66	Do.	
22	6 p. m.	64	65	Do.	
23	7 p. m.	61	66	Do.	
24	6 a. m.	46	63	Do.	
24	.....	.....	48½	Small stream 1½ miles above lake.
24	.....	.....	44½	Small stream 2 miles above lake.
24	10 a. m. ....	.....	54	Redfish spawning-grounds, 3 miles above lake.
24	12 m. ....	.....	61½	River 1 mile above lake.
24	6 p. m.	62½	66½	At inlet of lake.	
28	12 m.	60	62½	7 miles below lake.	
29	11 a. m.	70	43	Small spring, tributary to lake on east side.	
29	12 m.	70	68	Little Payette Lake.	
29	1 p. m. ....	.....	50	Small stream, tributary to Little Payette Lake.
29	.....	.....	48	Small streams near top of mountain, north of the Payette lakes and tributary to those lakes.
30	.....	.....	48	
30	.....	.....	43	
30	.....	.....	52	
30	6 a. m.	46	.....	Lake Fork, 6 miles above Little Lake.
30	2.30 p. m. ....	.....	56½	
30	3 p. m.	53½		East prong of Lake Fork, 7 miles above lake.
30	5 p. m.	60		North prong of Lake Fork, 8 miles above lake.
31	6 a. m.	41	47	Lake Fork, 6 miles above Little Lake.	
31	.....	.....	51	Small streams, tributary to Lake Fork, a few miles above lake.
31	.....	.....	52	
Sept. 3	12 m. ....	.....	51½	Payette River, 4 miles above lake on redfish spawning-grounds.
3	.....do.....	.....	51½	In pool with redfish.
3	2 p. m.	58	58	At inlet of Big Lake.	
3	Between 2 and 4 p. m.	160	43	Small streams, tributaries of Big Payette Lake from west side, beginning at the north.	
3		160	43		
3		160	47		
3		160	43½		
3	.....	.....	48½	In pool with redfish, 4 miles above lake.
3	.....	.....	49	
4	.....	.....	50	In pool with redfish, 4 miles above lake.
16	12 m. ....	.....	55	Payette River, 8 miles below lake.
17	.....do.....	.....	58	Lake Fork, 3 miles below Little Lake.
17	2 p. m. ....	.....	46½	Boulder Creek, 15 miles from junction with Payette River.
18	8 a. m.	38	38	Spring near top of mountain south of Boulder Lake and a tributary of Gold Fork.	

1>About.

DETAILED REPORT UPON THE SALMON AND OTHER FISHES OBSERVED.

In the following pages is given a list of all the fishes observed in those portions of Idaho covered by this report, together with detailed natural-history and technical notes upon each. The notes on the quinnat salmon and redfish are made particularly complete, in the thought that any fact contributing to an understanding of the life-histories of these important food-fishes will prove of interest and value.

1. *Entosphenus tridentatus* (Gairdner). *Three-toothed Lamprey*.

This lamprey was found in abundance August 8, 1893, by Dr. Gilbert at Lower Salmon Falls. More than 40 examples were seen, all of them dead. While at these falls in September and October, 1894, I was told that it is very common there during late summer and early fall. I saw none during my stay, although special search was made October 7 along the foot of Lower Salmon Falls. It was also reported as common at Glenn Ferry and at Weiser. At these places I heard it spoken of as being good sturgeon bait. On September 26, 1894, while examining the inlet of Payette Lake, I found one dead individual about 3 miles above the lake. Among the specimens sent in by Mr. Williams is one of this species obtained August 11 in Payette River a mile below the lake. It was found dead, and measures 2 feet in length. The distance between the dorsal fins is about one-third the length of the first dorsal. The length of the head is contained 11 times in total length.

2. *Acipenser transmontanus* (Gairdner). *Columbia River Sturgeon*.

This immense sturgeon is not uncommon in Snake River as far up as Lower Salmon Falls, and is occasionally taken at Millet Island just below Upper Salmon Falls. At the Lower Falls it is said to have been more common in 1893 than in 1894. Mr. Charles Harvey, who lives near the Lower Falls, says he caught 3, each of about 15 pounds weight, in March, 1894. In September and October several others were taken at the same place, some of them weighing 100 pounds or more each. Mr. Harvey says he has seen them 8 or 9 feet in length, and Mr. Bliss reports one 11 feet 5 inches long. Another weighing 700 pounds is reported to have been caught at these falls. On September 1 Mr. Barnum saw one at these falls which was about 4 feet long.

Mr. Liberty Millet has caught sturgeon at Millet Island, and says that the best fishing begins just after high water and continues until the salmon arrive. They are usually taken on set lines about 300 feet long, having 8 to 10 hooks. The largest sturgeon he ever saw was 11 feet 2 inches long, probably the same one seen by Mr. Bliss. It measured 2 feet across the head. One 35 inches long and weighing 7½ pounds was seined by Mr. Millet, October 5. He has seen them only 1½ feet long. He also says he has caught them when their spawn was ripe and believes they spawn at any time.

Glenn Ferry, on Snake River, is said to be a good place for sturgeon. We saw 2 small ones, one a foot long and the other weighing 4 pounds dressed, when there in September, 1894. One taken a few days earlier weighed 60 pounds, and some weighing 800 to 1,000 pounds, are reported.

Mr. William O'Brien, who has a fishery on Snake River about 4 miles below Weiser, does some sturgeon fishing; says he has caught them weighing 600 to 650 pounds; the largest one he ever saw was 13 feet long; once he caught 2 in his seine, each measuring 11 feet in length; never noticed any with ripe spawn; has seen suckers at least a foot long in their stomachs; has also found salmon heads, viscera, etc., in their stomachs. Lampreys make excellent sturgeon bait. Sturgeon are most plentiful in the spring and when the water is muddy. While we were at Mr. O'Brien's fishery September 22 and 23, 1894, a few small sturgeon were taken in the salmon seine. One example, a male 25 inches long, had 11 minnows in its stomach, all of which appeared to be *Mylocheilus caurinus*. Another male, 31 inches long, had the stomach nearly empty, there being nothing that could be identified.

The smallest examples of this sturgeon that I have seen are 6 and 7 inches long respectively, and were taken by Mr. O'Brien September 28, 1894. The number of plates on each of these and on 2 others from the same place is shown in the following table:

Length of specimen.	Number of dorsal plates.	Number of lateral plates.	Number of ventral plates.
<i>Inches.</i>			
6	10	41 and 41	9 and 9
7	14	40 and 41	10 and 10
25	12	45 and 47	10 and 12
35	13	47 and 50	

The lateral and ventral plates are not particularly strong, but those of the dorsal are very large and strong, the height being one-fourth inch in the highest.

3. *Pantosteus jordani* Evermann. "Black Sucker"; "Blue Sucker."

I saw several examples of this sucker at Glenn Ferry, which were caught in Mr. Henry Olsen's seine September 19, 1894. Others were seen at O'Brien's fishery, below Weiser, but it was not seen at Millet's nor elsewhere on Snake River. This species had previously been taken by us in the Columbia River Basin at the following places: Snake River at Idaho Falls, Ross Fork near Pocatello, Boise River at Caldwell, Payette River at Payette, Umatilla River at Pendleton, Columbia River at Umatilla, and Natchess River near North Yakima.¹ It has also been taken by Dr. Eigenmann² in the Boise River at Caldwell. It was not found by us at the Redfish Lakes, but the collections made by Mr. Williams at Big Payette Lake indicate that it is not an uncommon fish in that region. His collections contain numerous specimens from Payette River 4 miles above Big Payette Lake, and from Big Payette Lake itself.

In the following table are given comparative measurements of 9 of these specimens. Nos. 40 and 41 are from Snake River at Glenn Ferry, the others from Big Payette Lake and vicinity:

No.	Length.	Sex.	Head.	Depth.	Snout.	Eye.	Dorsal.	Anal.	Scales.
40	13	Male.	5	5	2½	6½	11	7	15-91-13
41	12	Male.	5	5	2½	5¾	12	7	16-100-15
197	11¼	.....	5½	5½	2	7	12	7	17-103-15
198	11¾	.....	5½	5½	2	6¾	12	7	16-103-13
199	12¾	.....	5½	5½	2	6	12	7	17-99-15
170	10¾	.....	5	5	2	6	12	7	17-94-15
171	12	.....	5	5½	2	6	12	7	17-107-15
208	6	.....	5	4½	2½	5	12	7	17-101-15

It will be noticed that these specimens are much larger than any of this species heretofore obtained. An examination of over 500 specimens collected in the Upper Missouri Basin in 1891, 1892, and 1893, and in the Columbia Basin in 1893, failed to discover any examples over 10 inches long. The posterior chamber of the air bladder is very long and slender, and renewed examination of that organ in this species and in several species of *Catostomus* confirms the view already stated by me, that the air bladder affords the best differential character upon which to separate *Catostomus* and *Pantosteus*.³ The color of the peritoneum is also a character of value in determining these species; in *P. jordani* it is usually quite black, while in numerous examples of *C. catostomus* examined it is more or less silvery.

4. *Catostomus macrocheilus* Girard. "Columbia River Sucker"; "Yellow Sucker."

Abundant in all suitable places in the Columbia basin below the Auger Falls of Snake River. In 1894 I found it common in Snake River at Upper Salmon Falls, Glenn Ferry, and Weiser, and numerous young were taken in Mann Creek and in the small branch of Little Weiser River at Snow's. Mr. Williams found it in large numbers in Payette Lake and its outlet. In Alturas, Pettit, and Redfish lakes and their connecting streams it is one of the most abundant species. When Dr. Meek and Mr. Scofield began their observations, July 17, the suckers were found in the streams, but as the season advanced and the water became lower and less cold, they ran into the lakes, where they remained. After August 10 few adult individuals were seen anywhere except in the lakes, though the young, one-half to 2 inches long, were abundant in shallow, quiet water along the streams.

The gill net set in Alturas Outlet took a good many suckers at various times between July 20 and September 12. The catch was as follows: July 20th, 4; 22d, 1; 23d, 2; 24th, 3; 25th, 3; September 4th, 7; 6th, 1; 11th, 5.

During August and September suckers could be seen in large numbers at certain places in the lakes, the best place being about the mouth of the inlet. I first noticed them in Redfish Lake, August

¹ Gilbert & Evermann: Report upon Physical and Natural History Investigations in the Columbia River Basin, in Bull. U. S. Fish Comm., xiv, for 1894, 169-207.

²American Naturalist, Feb., 1893, and Bull. U. S. Fish Comm., xiv, for 1894, 107.

³Bull. U. S. Fish Comm., xi, for 1892, 52.

20 to 24. Upon going out in the lake about the mouth of the lower inlet in the evening between 5 and 8 o'clock, large schools of fish were seen swimming about at various depths in water 10 to 30 feet deep. After some little observation they were seen to be suckers and squawfish. Sometimes the two species would be mixed and in the same school, but usually they schooled separately.

The suckers ordinarily kept near the bottom while I observed them at this lake, but the large schools which I afterwards saw in Alturas Lake behaved quite differently. Large schools of fish were seen by Messrs. Meek and Scofield at various times in Pettit Lake, chiefly about the inlet or outlet, which were probably suckers or squawfish. Such schools were noticed August 14 and 19 and at other times. Between 7 and 8 o'clock on the evening of September 1 our most interesting observations on this sucker were made. What appeared to be a large school of fish was seen out in Alturas Lake, off the mouth of the inlet, swimming at or near the surface. Upon taking the boat and going out near them, we saw a large school of fish swimming about at the surface, many of them with their noses out of the water. Occasionally one would jump out of the water, and the entire fish could be seen. When they came within 5 to 15 feet of the boat they would take fright, and, with a quick flirt and splash, the entire school would descend beneath the surface, where they could be seen swimming along at various depths. Soon, however, they would ascend to the surface again and repeat the movements first noticed. The noses of many could be seen sticking above the water, and the disturbed surface resembled the ripple caused by the current of a creek flowing out and meeting the still water of the lakes. The schools were composed of 25 to 150 fish each. The majority appeared to be about a foot in length, though many were evidently much larger. We at first took them to be redfish; and in the glow of the setting sun and evening twilight they certainly appeared as red as any redfish we had ever seen. It was therefore with considerable surprise that we discovered, upon closer observation, that the belly and anal fin of each were white, and that each had a sucker mouth. We tried, without success, to gaff some of them, but afterwards we caught many of them in our seine and proved them to be *Catostomus macrocheilus*. They were observed at other times. At almost any time of day, when the water was smooth, they could be seen at various depths about the mouth of the inlet; but we never saw them swimming at the surface or jumping except in the evening and when the water was not disturbed by the wind.

This habit of swimming at the surface with the nose out of the water as if to get air, and the occasional jumping, has not, so far as I am aware, been hitherto observed or recorded in any species of *Catostomus*. It is not easy to determine what may be the purpose or meaning of this curious habit. It is not probable that it is for the purpose of obtaining air. In a lake of the size and depth of Alturas Lake, whose water is pure and cold and more or less disturbed every day by stiff breezes, there would seem to be no necessity of that kind. And it is even more improbable that they come to the surface for food. We observed them on several different occasions and at different times of the day, but at the surface only in the evening. The peculiar red appearance was most marked late in the evening.

Schools of fish seen by Dr. Meek in Pettit Lake, and at first thought by him to be redfish, he is now sure were suckers. I am convinced that the large schools which Mr. Comstock saw in Redfish Lake and thought to be redfish were really suckers; and it is quite likely that the "acres of redfish" which various persons have reported to have seen in these lakes were not redfish at all, but only suckers.

A great many suckers were caught at different times, either with the seine in the lake about the mouth of Alturas Inlet or in Alturas Outlet in the gill net. Comparative measurements of 57 of these are given in the accompanying table. Nos. 1 to 40, inclusive, were taken in the seine (39 of them at one haul) in Alturas Lake at the inlet, September 10. The smallest weighed three-fourths of a pound, the largest $1\frac{1}{2}$ pounds, and the total weight of the 40 fish was 44 pounds. Nos. 41 to 45, 248, and 249 were taken in the Alturas Outlet gill net September 4. They weighed two-fifths, two-fifths, one-fourth, one-fourth, one-fourth, one-fourth, and one-fourth pound, respectively. No. 42a is from Snake River at Glenn Ferry; Nos. 168, 169, and 172 from Payette Inlet; the others from Alturas Lake or its outlet.

In many specimens examined, the lower lip is incised nearly to the base, there being usually only one or two rows of papillae, or sometimes none, across the base. The lobes are moderately long and rounded. The anal fin is high and pointed, its height being contained $1\frac{1}{2}$ to $1\frac{1}{4}$ in the head. In life these fishes were usually quite dark on back and sides down to axis of body, where the color changes abruptly to white, the contrast being very noticeable, even in the water. The anal fin is plain white. A large, broad tapeworm was frequently found in the abdominal cavity of these suckers.

Table of comparative measurements of 57 examples of *Catostomus macrocheilus* from Idaho.

No.	Length.	Sex.	Head.	Depth.	Snout.	Eye.	Dorsal.	Anal.	Scales.
1	15½	Female ...	4¼	4¾	2 ¹ / ₁₀	6 ⁵ / ₈	13	7	13-72-11
2	16	Female ...	4	4¾	2 ¹ / ₁₀	6	13	7	13-66-10
3	14	Male.....	4¾	4 ³ / ₈	2 ¹ / ₁₀	5¾	13	7	13-67-11
4	15	Male.....	4¾	4¾	2 ¹ / ₁₀	5¾	14	7	13-74-11
5	16½	Female ...	4 ¹ / ₂	4 ³ / ₈	2	6 ¹ / ₂	14	7	14-67-11
6	14	Male.....	4 ¹ / ₂	4 ¹ / ₂	2 ¹ / ₈	5 ¹ / ₂	13	7	14-77-11
7	14	Female ...	4¾	4 ⁵ / ₈	2 ¹ / ₈	5 ³ / ₈	13	7	13-67-11
8	13½	Male.....	4¾	4½	2 ¹ / ₈	5½	12	7	14-69-11
9	13	Female ...	4 ¹ / ₂	4 ³ / ₈	2 ¹ / ₁₀	6	13	7	14-70-11
10	15¼	Male.....	4¾	4¾	2 ¹ / ₁₀	6	15	7	14-74-11
11	15½	Male.....	4	4 ³ / ₈	2	5 ³ / ₈	13	7	14-70-11
12	16	Female ...	4¾	4¾	2 ¹ / ₁₀	5¾	14	7	13-72-11
13	14	Male.....	4¾	4¾	2 ¹ / ₁₀	6	12	7	13-69-11
14	15	Female ...	4¾	5	2 ¹ / ₈	5 ³ / ₈	13	7	14-69-10
15	16½	Female ...	4¾	4 ³ / ₈	2	6 ¹ / ₈	14	7	13-68-11
16	14	Male.....	4¾	4¾	2 ¹ / ₈	5½	13	7	13-71-10
17	16	Female ...	4	4 ¹ / ₂	2 ¹ / ₁₀	5½	14	7	14-72-11
18	15	Male.....	4 ³ / ₈	4 ¹ / ₂	2	6	13	7	14-68-10
19	15	Female ...	4	4 ¹ / ₂	2	5¾	13	7	14-72-11
20	16	Female ...	4	4½	2	6 ¹ / ₂	14	7	14-74-11
21	13½	Male.....	4¾	4¾	2 ¹ / ₈	6 ¹ / ₂	13	7	13-69-10
22	15¼	Male.....	4¾	5	2	5½	14	6	13-73-10
23	15	Female ...	4	5¼	2	6¼	14	7	13-72-10
24	15	Male.....	4 ¹ / ₂	4 ³ / ₈	2 ¹ / ₈	5½	14	7	14-71-11
25	15	Male.....	4 ¹ / ₂	4 ³ / ₈	2 ¹ / ₁₀	5½	13	7	14-73-11
26	15	Male.....	4 ¹ / ₂	4¾	2 ¹ / ₁₀	5 ³ / ₈	14	7	13-68-10
27	13½	Male.....	4¾	4 ³ / ₈	2 ¹ / ₁₀	5¾	13	7	14-75-12
28	15	Female ...	4 ¹ / ₂	4 ³ / ₈	2 ¹ / ₈	5½	13	7	14-72-11
29	13½	Female ...	4	4 ³ / ₈	2 ¹ / ₁₀	5½	14	7	13-69-10
30	15	Male.....	4 ¹ / ₂	4 ³ / ₈	2 ¹ / ₁₀	5¾	13	7	14-70-11
31	15½	Female ...	4	5	2 ¹ / ₁₀	6	13	7	14-76-10
32	14½	Male.....	4¾	5	2 ¹ / ₈	5½	12	7	13-71-10
33	14½	Male.....	4 ¹ / ₂	4¾	2 ¹ / ₈	5½	13 or 14	7	13-72-11
34	15	.....	4 ³ / ₈	4¾	2 ¹ / ₁₀	5½	13	7	14-71-11
35	14½	.....	4	5	2 ¹ / ₁₀	5 ³ / ₈	13	7	14-74-11
36	14	.....	4 ¹ / ₂	4 ¹ / ₂	2 ¹ / ₁₀	5½	13	7	14-71-11
37	15½	.....	4 ¹ / ₂	4 ¹ / ₂	2 ¹ / ₈	6	12	7	14-68-10
38	16½	.....	4 ¹ / ₂	4 ¹ / ₂	2	6	13	7	14-74-11
39	13½	.....	4 ¹ / ₂	4 ³ / ₈	2 ¹ / ₁₀	5½	13	7	14-73-11
40	13½	.....	4¾	5 ¹ / ₈	2 ¹ / ₁₀	5½	14	7	14-71-12
41	12¼	Female ...	4¾	4¾	.....	5	13	7	13-68-10
42	12¼	Female ...	4¾	4 ³ / ₈	.....	5 ¹ / ₂	13	7	12-72-10
43	12	Female ...	4¾	4½	.....	5 ¹ / ₂	13	7	12-72-10
44	12	Female ...	4 ³ / ₈	4 ³ / ₈	.....	5¼	13	7	13-68-10
45	12	Female ...	4 ³ / ₈	4¾	.....	5¼	13	7	12-71-10
248	11½	Female ...	4 ¹ / ₂	4 ³ / ₈	2 ³ / ₈	5 ³ / ₈	13	7	13-69-10
240	11½	Male.....	4 ³ / ₈	4½	2¼	5 ³ / ₈	14	7	12-70-11
42a	13¾	.....	4 ¹ / ₂	5	2 ¹ / ₁₀	6¼	15	7	14-72-13
94	11¼	.....	4	4 ³ / ₈	2 ¹ / ₈	6	14	7	13-69-11
104	10½	.....	4	4½	2 ³ / ₈	5¼	13	7	11-68-10
105	11½	.....	4 ¹ / ₂	5	2¼	6	13	7	12-65-12
109	10	.....	4½	5	2 ³ / ₈	5 ³ / ₈	14	7	11-65-9
110	10½	.....	4¾	4¾	2¼	5 ¹ / ₂	12	7	12-72-11
138	5¾	.....	4	4	2¼	5¼	14	7	12-67-10
168	10¾	.....	4¾	4¾	2 ¹ / ₈	5 ³ / ₈	13	7	13-75-11
169	12	.....	4¾	4¾	2 ¹ / ₈	5¾	13	7	12-75-11
172	12¼	.....	4¾	5	2¼	6	13	7	13-72-11

[Introduced species] *Cyprinus carpio* Linnaeus. *Carp*.

This introduced species has become well established in the lower Snake River. Several were seen at O'Brien's fishery and it was reported at Lower Salmon Falls.

5. *Acrocheilus alutaceus* Agassiz & Pickering. *Chisel-mouth; Square-mouth; Hard-mouth*.

This species was seen by us only at O'Brien's fishery below Weiser. In 1893 it was obtained in Snake River at Payette and in Boise River at Caldwell.

6. *Mylocheilus caurinus* Richardson. *Columbia Chub*.

In Snake River this minnow is one of the most abundant fishes, and is known locally by the misleading names "fresh-water herring" and "whitefish." At Upper Salmon Falls they were even called "trout." The name "whitefish" for this minnow is rather more than local in its application, as it is in use not only on Snake River but at Flathead Lake and perhaps elsewhere. At O'Brien's and Millet's this fish was very abundant, and after the salmon fishing had begun schools of 30 to 50 or more could be seen at any time. They are particularly attracted by the offal thrown into the river when the salmon are cleaned. It takes the hook very readily and possesses considerable game qualities. The best bait seems to be salmon spawn, but they will bite at almost anything—a piece of liver, heart, or a fish's eye. By throwing a few salmon eggs into the water, good-sized schools could be called up at any time. Numerous specimens were obtained at O'Brien's and Millet's, but it was not seen elsewhere except at Glenn Ferry. It does not seem to ascend the tributary streams as far as the Payette and Redfish lakes.

This fish seldom attains a length of more than a foot, and is, like most members of its family, a bony species; nevertheless it possesses some importance as a food-fish. At the hotel in Demersville, above Flathead Lake, Montana, I saw it served as "whitefish," and at certain places on Snake River it is caught and peddled over the country as "trout" or "fresh-water herring." These fish-peddlers, of course, handle salmon primarily, but other and smaller fish are thrown in when they chance to get them.

7. *Ptychocheilus oregonensis* Richardson. *Squawfish; Sacramento Pike; "Yellowbelly"; "Chub"; "Big-mouth"; "Box-head."*

This species, one of the largest of the family, is a common fish throughout the Snake River basin as far up as Shoshone Falls, above which it is not known to occur. I found it common at Millet's, Glenn Ferry, and O'Brien's, but less so than *Mylocheilus caurinus*; several large examples were seen at Lower Salmon Falls. It seems to be abundant at Big Payette Lake, while in the Redfish Lakes it is very abundant. In July it was common in the streams, but later it was rarely seen except in the lakes. It was frequently taken on the gill net set in Alturas Outlet, even in September, but the fish thus taken were probably passing from one lake to the other.

At almost any time large schools could be seen swimming slowly about the mouths of the inlets. Usually they could be seen at depths of 5 to 40 feet, but frequently in the evening they were seen swimming near the surface and feeding upon butterflies and other insects falling upon the water. Their manner of taking these insects was very much like that of the trout; indeed, so close is the resemblance that we at first supposed them to be trout. Frequently they would jump entirely out of the water, so eager were they to secure a falling insect. This was particularly observed at Redfish Lake August 20 to 23, in the evening between 6 and 8 o'clock.

Upon going out in the boat to the place where they seemed abundant, I discovered that they would rise to the fly quite freely. By using the Royal Coachman and fishing as if for trout I caught in a few minutes six good-sized "Yellowbellies." They would rise to the fly promptly, strike quickly, and fight vigorously for a few moments, after which they allowed themselves to be pulled in without much struggle. They would usually not rise to the fly except in the evening, but with a hook baited with salmon spawn they could be caught at any time.

This species is found in all the Redfish lakes, and is so abundant in one of them as to have suggested the name by which the lake is locally known, Yellowbelly Lake. In these lakes it reaches a weight of about 4 pounds, though the usual weight there is about a pound. It spawns in May. In the winter it is sought for as an article of food and is said to afford considerable sport. Dried salmon spawn is used for bait, and the fishing is done through the ice of the lakes. Pettit and Yellowbelly lakes are regarded as the best lakes for this kind of fishing.

This fish is rather bony, of course, but its considerable size reduces this objection to a minimum. When taken from these cold lakes the flesh is firm and sweet, and the "yellowbelly" must be taken into account when the game and food fishes of Idaho are under consideration.

In the following table are given comparative measurements of several examples of this species, all from Idaho:

Comparative measurements of specimens of Ptychocheilus oregonensis from Idaho.

Nos.	Head.	Depth.	Eye.	Snout.	Dorsal.	Anal.	Scales.	Length.
								<i>Inches.</i>
107	3½	4½	6	3½	9	8	16-77-9	12½
108	3½	4½	6½	3½	9	8	16-73-9	14½
100	3½	4½	6½	3	9	8	16-75-9	12½
152	4	5	6	3¼	9	8	16-73-9	9½
148	4	5½	6	3¼	9	8	16-78-9	9½
150	3¾	4½	7	3	9	8	16-76-9	13½
149	3¾	4½	7	3	9	8	17-75-9	12¾
151	3½	4½	6¾	3	9	8	16-74-9	13
167	3¾	4½	6	3	9	8	16-72-8	11½
166	4	4½	6½	3	9	8	15-74-9	11¾
165	4	5	6	3	9	8	16-70-8	13¾
164	4	5	6¼	3	9	8	15-72-8	11½
163	4	5½	6	3	9	8	15-75-8	10½
93	4	4¾	6¾	3	9	8	16-75-9	13
92	3¾	4½	7	3	9	8	15-75-9	12
101	3¾	5½	6¼	3	9	8	16-78-8	13½
102	3¾	5½	6	3	9	8	16-78-8	11½
201	4	5	5	3½	9	8	15-76-9	7½
204	3½	5¼	4¾	3¼	9	8	15-74-8	7
205	4	4¾	5	3½	9	8	14-70-8	6¾
207	4	5	5	3¼	9	8	15-78-8	6¼
202	4	4¾	5	3½	9	8	16-71-9	8
206	3¾	4½	4½	3½	9	8	16-69-9	5¾
203	3¾	4½	4¾	3½	9	8	15-72-8	7
.....	3¾	5½	4	3½	9	8	16-75-8	.....
.....	3½	4½	4	3½	9	8	15-73-8	.....
.....	3¾	5	3¾	3½	9	8	15-69-8	.....
.....	3¾	4½	4	3½	9	8	15-70-8	.....
.....	3¾	5	4¾	3½	9	8	16-69-8	.....
.....	3¾	5	4	3½	9	8	15-73-8	.....
.....	3½	4¾	4	3¾	9	8	15-75-8	.....
.....	3¾	5	4½	3½	9	8	15-73-8	.....
.....	3½	5	4	3¾	9	8	15-70-8	.....
.....	3½	5½	4½	3	9	8	15-72-8	.....
.....	3½	5½	4	3½	9	8	15-71-8	.....
.....	3½	5	4	3¾	9	8	15-69-8	.....
.....	3½	5	4	3½	9	8	15-72-8	.....
.....	3½	4¾	4¾	3	9	8	15-70-8	.....
.....	3½	5	4	3½	9	8	15-69-8	.....
.....	3½	4¾	4½	3	9	8	15-71-8	.....
.....	3¾	5	4	3½	9	8	15-74-8	.....
.....	3½	4¾	4	3½	9	8	15-72-8	.....
.....	3½	5	6½	3	9	8	16-80-9	14½
.....	3½	4½	6½	3	9	8	17-75-9	13½
.....	3¾	5½	6½	3	9	8	16-73-9	13½
.....	3½	5½	6½	3	9	8	15-76-10	14

Teeth, usually 2, 4-5, 2, strong and well hooked, but without grinding surface.

8. *Leuciscus balteatus* (Richardson). *Shiner*.

This is one of the most abundant minnows on the west coast from Oregon to British Columbia; in the Columbia basin it is common everywhere except in Snake River above Shoshone Falls, where it is represented by the closely related species, *Leuciscus hydrophlox*. In the Snake River basin below Shoshone Falls it has been obtained at about every place where we have made collections. At the Redfish lakes it is very abundant, and is known as "shiner." At Pettit Lake a large school could be called up at any time by throwing bread crumbs, oatmeal, or the like into the lake at our camp; while in the shallow water at the head of Pettit Outlet the young were excessively abundant. Among the vegetation off the mouth of Alturas Inlet this species was found in great numbers. On September 9, at a single haul of the seine in 20 to 40 feet depth, about a half bushel of this species was taken. Many of them were the largest and finest individuals we have seen.

This fish was found in the stomachs of bull trout, cut-throat trout, and squawfish, and doubtless forms an important part of the food supply of those species.

Our collections contain large series of this species, chiefly from Alturas and Pettit lakes.

At one time Dr. Eigenmann thought that a certain definite relation existed between the number of anal rays in this species and the altitude of the place from which the particular specimens were obtained; or, as stated by him, "the number of [anal] rays in the species considered [*Leuciscus balteatus*] decreases with the altitude." In the light of fuller data Dr. Eigenmann now agrees with us that this generalization is not borne out by the facts.

As bearing upon this question and as showing the variations in this character among individuals from the same locality, the following table will be instructive. In the first column are given the localities from which specimens were examined, in the second the altitude of each, in the third the total number examined from each locality, and in the following columns the number of examples having the number of anal and dorsal rays indicated by the figures at the head of each column.

Locality.	Altitude.	Total number of specimens examined.	Anal fin rays.										Dorsal fin rays.								
			11	12	13	14	15	16	17	18	19	20	21	22	Average.	8	9	10	11	Average.	
	<i>Feet.</i>																				
Pettit Lake....	7,300	480	1	20	104	190	110	45	10	.....	.....	.....	.....	14.17	0	153	268	10	.....	9.66
Alturas Lake..	7,200	939	2	65	348	367	142	11	4	.....	.....	.....	.....	13.67	1	214	83	4	.....	9.29
Payette Lake..	4,500	2	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	12	.....	2	.....	.....	.....	9
Indian Valley..	3,000	21	5	5	5	3	1	1	.....	1	.....	.....	.....	12.90	1	14	6	.....	.....	9.23
Mann Creek ...	2,800	6	.....	4	1	1	.....	.....	.....	.....	.....	.....	.....	12.50	.....	2	4	.....	.....	9.66
Upper Salmon Falls	2,500	1	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	15	.....	.....	1	.....	.....	10
Snake River at Weiser	2,100	3	.....	.....	.....	.....	.....	1	.....	1	.....	.....	.....	18.66	.....	1	2	.....	.....	9.66

9. *Rhinichthys cataractæ dulcis* (Girard). *Western Dace*.

The western dace seems to be a rather common species throughout the Snake River basin, both above and below Shoshone Falls. The species, as now understood, is one of very wide distribution, its habitat including not only the headwaters of the Missouri, Platte, Arkansas, and Rio Grande, and the entire Columbia basin, but the headwaters of the Colorado of the West and streams tributary to Great Salt Lake. Specimens were obtained by us at Upper Salmon Falls in 1894, and in Alturas Lake, Alturas Outlet, Meadow Creek, Warm Springs Creek, and Pettit Outlet. We did not see it at Redfish Lake nor is it among the collections from Payette Lake, though it doubtless occurs in those places.

10. *Agosia nubila* (Girard).

Found by us only in Mann Creek near Weiser and in the Little Weiser River at Indian Valley in 1894, and by Mr. Williams in Goose Creek at the head of Little Salmon River, near Meadows (1 specimen); apparently not abundant except at Indian Valley.

In their paper upon the fishes collected during the investigations in the Columbia River basin in 1892 and 1893, Gilbert & Evermann called attention to three forms or geographic races of this species centering in western Washington, about Umatilla, and about Spokane, respectively. The western Washington specimens represent typical *nubila*, with dark coloration and large scales; the Umatilla group is characterized by its paler coloration and large scales; while the Spokane group may be known by the smaller scales, the frequent absence of the barbel, and the different coloration. The

specimens of the present collection agree most nearly with the Spokane group, as may be seen from the following table. The barbel is, however, oftener present in these Idaho specimens.

The following table gives comparative measurements of 19 specimens from the three localities:

Localities.	Head.	Depth.	Snout.	Eye.	Barbel.	Dorsal.	Position of dorsal fin.	Anal.	Scales.
Indian Valley	4	4½	3	5	Absent ...	8	To front of nostril....	7	69
	4	4	3	5	Present...	8	To nostril.....	7	71
	4½	4¾	3	4¾	Absent ...	9	To back of orbit.....	7	65
	4½	4¾	3	4¾	Present...	8	To middle of eye.....	7	59
	4½	4¾	3	4½	do	8	To front of pupil	7	66
	4½	4¾	3	4½	do	8	To nostril.....	7	65
	4	4¾	3	4½	Present ½	8	To eye.....	7	65
	4½	4½	3½	4	Present...	9	do	7	60
	4½	4¾	3	4½	do	9	To middle of pupil....	7	71
	4	4¾	3	4½	do	8	To pupil.....	7	64
	4½	5	3½	4	do	8	To nostril.....	7	65
	4½	5	3	3½	do	8	To front of eye.....	7	65
	4	5	3	4	do	8	To nostril.....	7	62
	4½	4½	3	4	do	8	To front of nostril....	7	61
	4	5	3	4½	do	8	To nostril.....	7	61
	4	5	3	4	do	8	To pupil.....	7	68
Mann Creek	4½	4½	3	4	do	8	do	7	61
	4	5	3	3¾	do	8	do	7	63
Goose Creek, Meadows, Idaho.	3½	4¾	3	4	Absent ...	8	To front of eye.....	7	65

11. *Agosia umatilla* Gilbert & Evermann.

The only species of *Agosia* found at the Redfish lakes agrees well with the type and description of *A. umatilla*. Our collection contains 28 specimens from Pettit Lake Outlet and 19 from Alturas Lake, all collected in July and August. It does not appear to be at all common and is not among the collections made at the Payette lakes.

12. *Agosia falcata* Eigenmann.

The collection made in Snake River near Weiser, Idaho, September 22, 1894, contains 66 examples of this species. It is now known from the following localities: Boise River at Caldwell, Idaho (type locality); Payette and Snake rivers at Payette; Mill Creek near Walla Walla, and Columbia River at Umatilla and Pasco.

13. *Coregonus williamsoni* Girard. *Rocky Mountain Whitefish*; "*Mountain Herring*."

This whitefish seems to be a common species in all suitable waters in Idaho. It was found by us in Snake River at Upper and Lower Salmon Falls, Glenn Ferry, and Weiser; Little Weiser River at Indian Valley; Big Payette Lake and Payette River; Redfish, Pettit, and Alturas lakes; Alturas and Pettit lake outlets, and Salmon River. The following information was given by different persons with whom we talked concerning this fish:

Charles Harvey, Lower Salmon Falls: "Common at this place; attains a weight of three-fourths of a pound, though half a pound is the usual weight; it is a very fat fish, and readily takes a hook baited with a grasshopper or grub; it probably spawns late in September."

John W. Smith, Council Valley: "There are millions of mountain herring in Payette Lake; they spawn in October, going far up the inlet above where the redfish spawn. A few years ago we caught 2,200 at one haul of a 75 or 80 foot seine. These fish weigh about half a pound undressed, or one-third of a pound dressed."

F. C. Parks, Sawtooth: "The mountain herring are common in the Redfish lakes and connecting streams. They usually weigh about one-fourth of a pound, though I have caught them in Salmon River weighing 2 pounds. They take the hook readily in the spring and early summer."

Thomas McCall, Lardo: "The whitefish are very abundant in Big Payette Lake. Their spawning time is in October, when they run up the inlet in astonishing numbers. In October of the present year (1895) they were more abundant than usual. Ten wagonloads were caught with seines and pitchforks, and as many more might have been taken without causing any appreciable decrease. They began spawning about the middle of October and the run lasted about two weeks, when the fish returned to the lake. They would average about three-quarters of a pound undressed. Many of those caught we found ready sale for in Warren and Boise at 10 to 15 cents a pound."

Mr. McCall's statement regarding this large run is rather astonishing, but seems perfectly trustworthy and is corroborated by Mr. C. R. White, postmaster at Meadows. Mr. White says:

"The run of whitefish was very remarkable last fall at Fisher Creek, above the Big Lake. Such a sight was never seen before. People went there, caught them, and loaded their wagons in a few hours' time. The people threw them out onto the bank with shovels, they were so thick, and their numbers did not seem to be decreased. The fish were very fat and plump and almost fried themselves. I am not prepared to say but that a similar run occurs every year, but it has not been noticed so much before this year. The mail carrier was building a cabin near where the fish came to spawn, and the men working upon the cabin were the first to notice the great numbers of fish."

Timothy Cooper, Stanley Basin: "Whitefish come up Stanley Lake Inlet by the thousands about October 15, and are seen for about a month, during which time they are spawning. People catch them by the hundred in dip nets."

H. H. Marshall, Stanley Basin: "The whitefish are very abundant in Stanley Lake and run up the inlet in November to spawn."

At the time of our arrival at Sawtooth, in July, whitefish were not uncommon in Salmon River and Alturas Creek, and were occasionally taken in the gill net in Alturas Outlet. At that time they took the hook freely, and several very fine catches were made by Mr. Scofield, Mr. Parks, and others. Those taken on the hook weighed about a pound each, though one was estimated at 4 pounds. The average length was about a foot. The young, still showing the parr marks, were common everywhere in shallow, quiet water, but after July the adults appeared to have gone into the deeper water of the lakes. While seining at the upper end of Alturas Lake September 9 and 10, in 20 to 60 feet of water, large numbers of whitefish were obtained. They averaged about 7 inches in length, were very fat, and when fried were most delicious, far surpassing the trout in sweetness and delicacy of flavor.

In the following table are given comparative measurements of a number of specimens of this species, all from Alturas Lake except the last two:

No.	Head.	Depth.	Eye.	Snout.	Dorsal.	Anal.	Scales.	Gillrakers.	
								Right.	Left.
95	5	4	5	3½	10	10	10-85-8	14+8	13+8
96	5	4½	4½	3½	12	10	10-78-8	12+7	11+6
97	5½	4½	4½	3½	12	10	10-86-8	15+10	13+8
98	5	4½	4½	3½	12	11	10-89-8	13+8	12+8
103	4¾	5	4½	4	11	10	10-85-8	12+6	11+8
127	4¾	5½	4	4	12	11	10-90-8	13+9	13+9
128	4¾	5½	4	4	12	11	10-86-8	10+8	15+9
129	5	5	4	3½	12	11	10-78-8	14+10	13+9
130	4½	5	3½	3½	12	11	10-78-8	13+8	12+8
131	4½	5½	4	3¾	13	12	10-84-8	10+8	11+8
132	4½	4½	3½	4	12	11	10-87-8	12+8	11+8
133	4¾	5	4	4	11	10	10-92-8	12+9	15+7
134	4½	4½	4	4	12	12	10-85-8	14+8	15+10
135	4¾	5½	4	3½	11	10	10-82-8	14+9	14+8
136	4¾	5	4½	4	12	10	10-82-8	15+9	15+8
137	4¾	5	3½	3½	11	10	9-82-8	13+7	13+7
153	5	4½	4	4	12	11	10-80-8	11+8	12+8
154	5	4¾	4	4	11	11	10-79-8	12+7	14+8
155	5	4½	4½	4½	12	11	10-88-8	13+8	12+8
156	5½	4¾	4	3¾	13	11	10-83-8	12+0	12+10
157	4¾	4½	4½	3¾	12	12	10-81-8	12+9	12+9
158	5½	4¾	4½	4	12	11	9-84-7	12+8	12+7
159	5	4¾	4½	4	12	11	9-89-8	14+8	15+9
160	5	4½	4¾	3¾	10	9	9-83-8	12+9	14+8
161	5	4¾	5	3½	13	12	9-81-7	13+8	14+8
162	5	5	4¾	3¾	12	11	9-85-7	14+9	13+8
182	4¾	4¾	4¾	4½	11	11	9-84-7	14+7	13+6
183	5	4½	4¾	4	12	11	9-85-7	12+7	14+7
184	5	4½	4	3½	12	11	9-82-8	12+8	12+8
(1)	4¾	5	3½	4	12	11	9-80-8	12+7	13+7
(1)	4½	4½	3½	4½	12	11	9-82-7	13+8	12+7

¹ These two specimens obtained at Upper Salmon Falls October 2, 1894.

14. *Oncorhynchus tshawytscha* (Walbaum). Chinook Salmon; Quinnet Salmon; "Dog Salmon" of Idaho.

That part¹ of the report upon the work done in Idaho in 1894 which pertained to the salmon, redfish, and salmon trout has already been published, with a large amount of information concerning these three species, gained by interviews and through our own observations. In the present connection the details of the observations made in 1895 are given.

The following extracts from our field notes will most clearly show the condition of the upper portion of Salmon River from time to time as regards the salmon:

July 10: Mr. Timothy Cooper, who lives in Stanley Basin, 5 miles from Stanley Lake, 8 miles from Redfish Lake, or about 35 miles from Sawtooth, saw 2 salmon in Cape Horn Creek. This creek is about 15 miles northwest from Mr. Cooper's and is tributary to the Middle Fork of Salmon River. These fish were in excellent condition and were probably about the first to arrive.

July 27: Mr. Cooper noticed about 100 in the same stream, 10 of which he shot or speared. These 10 averaged about 20 pounds each and were in excellent condition, being scarcely ripe. A good many were taken by other persons.

July 24: Mr. Parks saw 4 salmon in Salmon River below mouth of Alturas Creek. These were the first seen this far up the river and were probably the first to arrive. They appeared to be in excellent condition.

July 31: Dr. Meek saw 2 salmon in Salmon River about 6 miles below mouth of Alturas Creek. No sores could be seen.

August 1: Two were seen in same place where those were seen on July 31, probably the same fish.

August 5: Dr. Meek saw 3 in Salmon River about 2 miles below mouth of Alturas Creek. No sores or mutilations could be seen.

August 6: Mr. Cooper saw 10 salmon in same stream, but did not note their condition.

August 9: One large fish seen in Salmon River 1 mile below mouth of Alturas Creek. No mutilations were noticed. Mr. A. G. Fletcher, of Camas Prairie, saw 2 salmon in Salmon River above mouth of Smiley Creek. One was dead, it having probably been shot by someone; the other was caught. It was a ripe female about 3 feet long, weighed 14 pounds, and was in good condition.

August 11: The first examples caught in our gill nets were taken to-day from the lower net in Alturas Creek. These were 2 specimens, a male and a female, 40 and 31 inches, respectively, in total length, and weighing 18 and 9½ pounds each. They were in perfect condition and were scarcely ripe.

August 13: Six salmon seen in Salmon River between mouth of Alturas and Champion creeks. Four were going up stream, each by itself, while the other 2 were spawning on the upper end of a rifle. No mutilations seen.

August 16: One male salmon was shot by Dr. Meek in Alturas Creek above the nets. It was 37½ inches long and weighed 20 pounds. It was ripe, but showed no mutilations. Two others were seen in Alturas Creek and 1 in Salmon River.

August 17: One male salmon, 31 inches long and weighing 9 pounds, taken in gill net in Alturas Creek. This fish was nearly ripe, but showed no mutilations. The stream was examined for a considerable distance, but no other salmon were seen.

August 20: One ripe male salmon weighing 25 pounds was caught in gill net in Alturas Creek; no sores or mutilations of any kind. Two others were shot in Salmon River, about a mile below mouth of Alturas Creek; they were both ripe males, weighed 22 and 26 pounds, respectively, and were in prime condition. One spent female was found dead in Alturas Creek below the net; it weighed 15 pounds, and had the caudal fin and caudal peduncle considerably mutilated. At least 10 others were seen between the net in Alturas Creek and the mouth. They were ordinarily seen alone, only 3 being seen together. When frightened, all swam downstream into deep pools.

About 2 miles of the river below the mouth of Alturas Creek were examined, and 15 salmon were found. Mr. Comstock examined a portion of the river still lower down, and saw 19 or 20 salmon, 5 of which he shot. A few of these fish showed some mutilations, but most of them appeared to be in excellent condition. Nearly all appeared to be going up stream.

August 22: One spent female was found on bank below Alturas Creek net. It was 25 inches long, and was not at all mutilated. Two others were seen in deep water a short distance below the nets in Alturas Creek. They appeared to be without mutilations, but could not be examined closely, as they hid under an overhanging bank when disturbed.

August 24: One spent female was found in Alturas Creek below the nets. It weighed 16 pounds, and the caudal and dorsal fins were badly frayed out. On this date I traveled up the river from Redfish Lake and inspected it at several places. In about 2 miles in the course of the river next above the ford, near Redfish Lake, 39 salmon were counted. They were usually in twos and threes, in shallow water, where the gravel was finest, and were evidently spawning. Some distance farther up at least a dozen were seen on one rifle, and in the next mile or two at least 75 more were seen. All appeared to be spawning, and many were in water so shallow that their dorsal fins stuck out.

The dorsal, caudal, and anal fins, in a great many cases, were more or less sore or frayed out, and in several instances the nose was sore and there was a large sore on the back at the front of the dorsal fin. In some cases this sore or abraded area was covered with a growth of fungus, presumably *Saprolegnia*.

¹A preliminary report upon Salmon Investigations in Idaho in 1894, by Barton W. Evermann, in Bull. U. S. Fish Commission for 1895 (1896), pp. 253-284.

The salmon now seemed to have reached their maximum number. A rough estimate, based upon the numbers seen in the portions of the stream examined, gave 20 salmon to the mile, or 400 salmon for Salmon River above Redfish Lake. This is an underestimate, for doubtless a good many escaped observation by being concealed under overhanging banks. Taking the entire spawning season, it is probable that not more than 1,000 salmon came to this portion of Salmon River in 1895. This makes a liberal allowance for salmon killed for food or other reasons by people visiting this valley.

The large number of salmon seen on this date was designated as the "second run" by a miner from Stanley Basin. He also stated that about August 14 he caught 16 fine salmon about Cape Horn.

August 26: Alturas Creek below the nets contained 9 salmon to-day. All were either spawning or were spent. Six of the 9 were covered with sores, and had the fins badly worn.

August 27: One dead salmon in Alturas Creek just below mouth of Yellowbelly Creek; length, 37 inches; weight, 16 pounds; caudal, anal, and dorsal fins all frayed out. There were also sores upon the body at base of ventrals, on caudal peduncle, on sides, and in front of the dorsal fin. Another dead fish, a partly spent male, 31 inches long and weighing $7\frac{1}{2}$ pounds, was found a little lower down. It had been shot by someone, and showed but little mutilation. Two live salmon were seen at Stenton's ranch. They were on a rifle and spawning. The dorsal fin of each was badly worn. Still another was seen at the mouth of Alturas Creek. Its dorsal fin also was somewhat worn.

Below the mouth of Alturas Creek another dead spent female was seen. It was 41 inches long and weighed 23 pounds. All its fins were badly frayed, and the body was covered with numerous sores. Another, still further down, a dead, spent female, 31 inches long and weighing 8 pounds; dorsal and anal fins somewhat worn. Still another near by, a dead female, apparently spent, with fins badly worn.

Near the mouth of Champion Creek 5 salmon were seen spawning on a rifle. All were more or less sore. Just below this rifle a dead fish was found. It was $41\frac{1}{2}$ inches long, weighed 19 pounds, and was much worn on the fins. Another was seen at mouth of Roaring Creek, and one was speared at mouth of Champion Creek, which weighed 24 pounds and was $43\frac{1}{2}$ inches long. It was a partly spent male with fins badly frayed.

September 4: Alturas Creek and Salmon River were examined for some distance and no live salmon were seen.

September 18 to 20: Alturas Creek and Salmon River were examined on each of these three days, but no live salmon could be found. The spawning season seems to be over and all the salmon have died.

From the foregoing it appears (1) that the salmon did not reach the upper Salmon Valley until about July 24; (2) that the maximum number was attained about August 24; (3) that few if any mutilations were seen before August 20; (4) that the spawning season was entirely over and the fish all dead or gone early in September.

As regards the time of arrival at the headwaters of Salmon River, the evidence for 1894 and for 1895 agree almost exactly, and the last half of July may safely be taken as the usual time for their arrival. Farther down the river they arrive, of course, correspondingly earlier, at least as early as July 10 at Cape Horn.

The height of the spawning season appears not to be reached until about a month after the first arrivals, and after the maximum is once reached the spawning continues for only a few days, apparently for not more than two weeks.

The worn and mutilated condition of the fish toward the close of the season, and the numerous dead fish seen, indicate with almost absolute certainty that the salmon which come to these waters never return to the sea, but all die. While not actually proved, all the facts indicate that this is true, and I have no doubt that such is the case.

And now as to the mutilations: The observations of this single season furnish abundant evidence to prove absolutely that the fraying out of fins, abrasions, sores, etc., are not injuries received while on their way up from the sea, but are practically wholly the result of contact with the gravel of their spawning-beds, plus some injuries inflicted upon each other on the spawning-grounds. During the early part of the season all the fish were perfect and entirely free from mutilations, while toward the end nearly every fish was more or less injured. The injuries are undoubtedly received on the spawning-grounds and in the ways described in detail under the redfish on page 191.

So far as we were able to learn from our observations and from interviews, the chinook salmon rarely ascends Salmon River more than a mile or two above the mouth of Alturas Creek. More fish go up Alturas Creek than up Salmon River above the union of those two streams. At present they do not appear to run up Alturas Creek more than 1 or $1\frac{1}{2}$ miles above its mouth, and, with one exception, all persons who gave information concerning the salmon in former years agreed that it never ran up Alturas Creek any farther than it does at present. The one exception is Mr. R. E. Carroll, a prospector who has been more or less familiar with this region for 25 years. He first visited Alturas Lake in August, 1867, at which time he says salmon were excessively abundant in Alturas Lake, and were spawning all around the lake. Did not see any in the inlet, but saw some below the lake. Was at

the lake again in 1872 and 1876. There were salmon in the lake at each of those visits, but they were not nearly so numerous. Admitting that Mr. Carroll was not mistaken, it is quite certain that the chinook salmon does not now enter any of these lakes.

In the last mile of Alturas Creek, and in Salmon River from a mile above its union with Alturas Creek down to the outlet of Redfish Lake, the salmon has spawning-beds in all suitable places. The most suitable bottom is that composed of fine gravel with a liberal matrix of coarse sand. On these beds the water will vary in depth from a few inches to 2 feet, and the current will usually be moderately swift. In deeper water the current is not strong enough and the bottom is too sandy; where the current is strongest the proportion of large gravel is too great.

It has often been said that salmon are always headed upstream when seen, and that they are never seen to go downstream. This is not altogether true. It is probably true that while en route to the spawning-beds the salmon rarely, if ever, turn and swim downstream even for a short distance, but when on their spawning-grounds, though always headed upstream when comparatively quiet, one may frequently see them swimming downstream when chasing each other, either in playful or fighting mood. And when disturbed by anyone on the bank they will very often turn tail and swim downstream until a deep hole is reached.

No salmon were seen or heard of at Big Payette Lake by Mr. Williams until August 1. On that date Mr. E. D. York reported seeing 4 salmon in a deep pool in Payette River about 3 miles below the lake. On August 2 and 3 Mr. Williams examined the river for some distance below the lake, but saw no salmon. On August 4 a large seine was used in the river about 5 miles below the lake, and salmon were found in considerable numbers. Several hauls were made, resulting in a catch of 25 salmon, 11 males and 14 females, the lengths and weights of which are given in the accompanying table. All of these fish were in perfect condition, none of them showing mutilations or sores of any kind. Nearly all seemed to be almost ripe with spawn. The stomachs of all were examined, but no food was found in them. On August 7 six more salmon were taken, and on August 11 six others were caught. All of these were in perfect condition.

The seine was used again August 16, when 9 were taken, and again the next day, when 42 more were gotten; 35 of these were taken at one haul. This was about 5 miles below the lake. The river was seined at various places on down for about 5 miles farther, but salmon were scarce in the lower part, which seems to be about the lower limit of their spawning-grounds. In a deep pool about 8 miles below the lake a large number of salmon were seen. All of those caught were in excellent condition. They had not begun spawning.

On August 23 the river was examined again; many salmon were seen, but none had yet begun to spawn. On August 28 salmon were seen in considerable numbers and some were probably spawning. During the two weeks following August 28 the spawning season seemed to be at its height. On September 14 some spent fish were examined, and many were seen more or less covered with sores and with fins considerably worn.

Lengths and weights of chinook salmon taken in Payette River near Big Payette Lake in August, 1895, and examined by Mr. Williams.

Date.	Sex.	Length in inches.	Weight in pounds.	Date.	Sex.	Length in inches.	Weight in pounds.
Aug. 4	Female ...	27	7.5	Aug. 4	Female ...	29	9
4	Female ...	29	9.5	4	Female ...	29	10
4	Female ...	27	8	4	Female ...	29.5	9
4	Female ...	33.5	13	4	Male.....	30	12
4	Female ...	36.5	19	4	Male.....	30	10
4	Female ...	32	12.5	4	Male.....	27	7.5
4	Female ...	30	10.25	4	Male.....	30.5	10
4	Female ...	30	10.25	4	Male.....	30	9.5
4	Female ...	28	8	4	Male.....	28.5	9.5
4	Female ...	33.5	13.5	4	Male.....	30.5	9.5
4	Female ...	32	11	4	Male.....	30	9.5

Lengths and weights of chinook salmon taken in Payette River near Big Payette Lake in August, 1895, and examined by Mr. Williams—Continued.

Date.	Sex.	Length in inches.	Weight in pounds.	Date.	Sex.	Length in inches.	Weight in pounds.
Aug. 4	Male.....	30	9	Aug. 17	Female ...	34	12
4	Male.....	32	19	17	Female ...	32	11.5
4	Male.....	29.5	9	17	Female ...	28	8
7	Male.....	26	6.5	17	Female ...	28	8
7	Male.....	27	7	17	Female ...	29.5	9
7	Male.....	26	6	17	Female ...	30	11
7	Male.....	33.5	13	17	Female ...	30	10
7	Male.....	18.5	2.5	17	Female ...	29	9
7	Female ...	30.5	10	17	Female ...	29	8.5
11	Male.....	30	8	17	Female ...	29.5	9
11	Male.....	26.5	7	17	Female ...	29.5	9
11	Male.....	32	10	17	Female ...	30	9.5
11	Male.....	18	2	17	Female ...	31	10
11	Female ...	28	8.5	17	Female ...	29.5	10
11	Female ...	27	8	17	Female ...	27.5	7
11	Female ...	36	10	17	Female ...	30	9.5
16	Male.....	26	6	17	Female ...	29	9.5
16	Male.....	29	8	17	Male.....	29	9
16	Male.....	27	6.5	17	Male.....	30	9
16	Male.....	28.5	8	17	Male.....	37	17
16	Male.....	28	8	17	Male.....	28	7
16	Female ...	31	11	17	Male.....	29.5	8
16	Female ...	31.5	11	17	Male.....	27	6.5
16	Female ...	31	11	17	Male.....	28.5	8.5
16	Female ...	30	9	17	Male.....	31.5	10.5
17	Female ...	31	11	17	Male.....	29	8.5
17	Female ...	28	7.5	17	Male.....	32	11
17	Female ...	29	9.5	17	Male.....	27	7.5
17	Female ...	36	18.5	17	Male.....	30	10
17	Female ...	29	10	17	Male.....	30.5	10
17	Female ...	28	8	17	Male.....	28.5	8.5

The total number of salmon examined by Mr. Williams, as per above table, is 84, of which 39 were males and 45 were females. The average length of the males was 29½ inches, the average weight 8¾ pounds; of the females the average length was 30½ inches and the average weight 10¾ pounds. The average for the 84 was: Length, 32½ inches; weight, 9¾ pounds.

During the fishing season of 1894 (September to November), at Upper Salmon Falls, Mr. Millet weighed and measured a total of 863 chinook salmon. Of these, 701 were males and 162 females. The minimum, maximum, and average lengths and weights are shown in the following table:

Sex.	Number of fish examined.	Length in inches.			Weight in pounds.		
		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
Male	701	15	46	30	2	39	13 ⁷ / ₁₀
Female.....	162	20	40	33 ⁶ / ₁₀	7	28	14½

The average length of all, both males and females, is 30.3 inches, and the average weight about 14 pounds.

Young salmon.—Young salmon were found in abundance in many places. At the head of Alturas Lake July 20, August 9, and September 9 and 10 numerous specimens were collected. They appeared to be most numerous at this place August 9. In the small creek at White's Warm Springs 5 small specimens were collected July 23. In Meadow Creek, on July 30, numerous specimens were obtained. In Alturas Inlet, about half a mile above the lake, Dr. Meek caught a 3½-inch chinook salmon on a hook, using a redfish egg for bait.

The table on pages 185 and 186 shows the total lengths and comparative measurements of a number of these specimens. The following table gives the number of specimens now in the collections and the minimum, maximum, and average lengths of those collected on each of the various dates:

Date.	Locality.	Number of specimens.	Minimum length.	Maximum length.	Average length.
			Inches.	Inches.	Inches.
July 20	Alturas Lake	5	2½	3	2½
23	Warm Springs Creek	5	1½	2½	2¼
30	Meadow Creek	83	1½	3½	2½
Aug. 9	Alturas Lake Outlet	50	1½	3½	2½
Sept. 7	Alturas Inlet	1	3½	3½	3½
9	Alturas Lake	5	3½	3½	3½
10	..... do	2	3½	3½	3½

An inspection of this table will give some idea of the rate of growth. The few specimens collected July 20 were probably selected because of their large size, and are likely larger than the average at that date. While the table is scarcely available for showing the rate of increase from date to date, it clearly shows a general increase. There is close agreement in size among those taken on any one date, and it is quite certain that all these young salmon were hatched from eggs laid during the spawning season of 1894. The maximum and minimum sizes are so close to the averages as to establish this fact beyond doubt. It is further certain that the fish which hatched from the eggs spawned in 1893 were not to be found in these waters in July, August, and September, 1895.

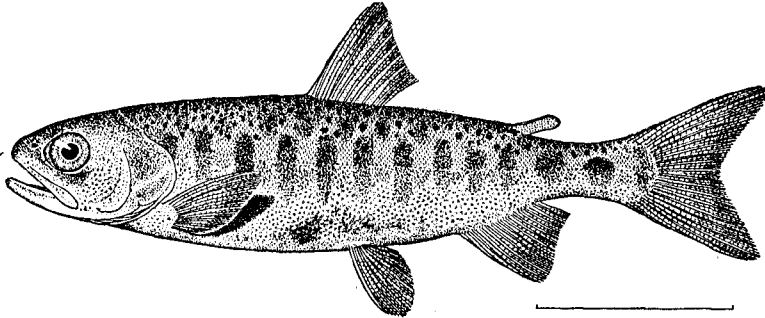
We are not yet able to say just when the young salmon leave the waters where they were hatched and begin their journey to the sea, but it undoubtedly occurs some time between September of the first and July of the second year following that in which they were spawned; thus, a young salmon which was spawned in Alturas Creek in August, 1894, would leave that locality at some time between September, 1895, and July, 1896. The probabilities are that eggs deposited in these waters in August hatch early in the spring of the following year and the young go down the river during the high water of the next spring. But this remains to be proved.

Wanderings of the young salmon.—As already stated, the only spawning-beds of the salmon in the Sawtooth region are in Salmon River itself and in the lowermost mile of Alturas Creek. By reference to the table of localities from which young salmon were collected, it will be seen that they had scattered greatly from where they were hatched. They were found in Warm Spring Creek 3 or 4 miles from the nearest spawning-beds, and the head of Alturas Lake where they were common is at least 5 miles above where they could have been spawned, and one was caught and others seen in the inlet some distance above the lake. From these facts it would appear that after hatching, the young salmon spread into all the suitable waters in the vicinity, entering the shallow waters of the sloughs, smaller creeks, and little ponds along the streams (where the minute forms of animal and plant life suitable for food are abundant), apparently more prone to run up stream than down, and thus reach the lakes above and even their inlets, where they find an ample food supply among the heavy growth of aquatic vegetation at various places in the lakes.

Young salmon taking the hook.—At various times in September young salmonids were seen in the last mile of Alturas Inlet, which were probably all of this species. They were apparently 2 to 4 inches long and were noticed only in the quiet parts of the stream, where they kept very still, swimming about very little, after the manner of *Lepomis*. When tempted with the artificial fly or baited hook they would rise to it, but usually very slowly, and after inspecting it closely, would seize it and start downward. They were not at all voracious, but would generally rise to the hook in a very deliberate way. We at first regarded them as small trout, but on September 7, when Dr. Meek caught a 3½-inch specimen, examination showed it to be a young chinook salmon, and I am inclined to think all the small fish in Alturas Inlet which we thought to be trout were really salmon. The fact that no large trout were seen in the inlet is additional evidence that these were salmon.

While these young salmon would rise to the fly, they would rarely take it in their mouths. After slowly and carefully inspecting it they would usually slowly sink to deeper water. If the hook were baited they would often attempt to take it, but our smallest hooks were too large for such small fish, and we succeeded in landing only one.

The color of these young salmon may be thus described: Side with about 10 rather distinct bluish vertical bars, each about two-thirds diameter of eye, extending across the lateral line, the upper end of each broken up into spots, the lower ending more definitely about midway between lateral line and median ventral line; back and upper part of sides covered irregularly with small dark spots; belly and lower part of sides silvery, but thickly covered with fine dark punctulations, these also covering all other parts of the body; lower jaw pale, with many fine dark specks, rest of head appearing bluish-black from the very numerous fine specks.



Young Chinook Salmon (*Oncorhynchus tshawytscha*), drawn from an example 4 inches long caught in Alturas Lake, Idaho, September 9, 1895.

Eighty-three specimens, averaging about 2 inches in length, give the following average comparative measurements: Head $3\frac{1}{2}$ to $3\frac{3}{8}$; depth 4 to $4\frac{1}{2}$; eye $2\frac{1}{2}$ to 3; snout 4.

Young chinook salmon of this size so closely resemble young cut-throat trout that they can not be distinguished without close observation. The difference in the size of the anal fin (14 to 17 rays in the salmon, and only 10 to 12 in the trout) is the best differential character, but the following characters are also of value: In the salmon the first anal rays are produced, thus making the fin decidedly falcate, the maxillary is longer and more slender, the snout a little more pointed, the mouth less oblique, and the color not quite so dark as in the trout.

From young redfish of the same size the chinooks may be distinguished by the deeper body, darker coloration, falcate anal fin, and the much shorter and less numerous gillrakers.

Lengths and comparative measurements of specimens of young chinook salmon.

Locality and date.	Length.	Head.	Depth.	Snout.	Eye.	Locality and date.	Length.	Head.	Depth.	Snout.	Eye.
Alturas Lake, July 20.....	$2\frac{3}{8}$	4	$4\frac{1}{2}$	4	3	Meadow Creek, July 30.....	$2\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{2}$	4+	$2\frac{3}{8}$
	$2\frac{7}{8}$	$2\frac{3}{8}$	$3\frac{3}{8}$	4	3		$2\frac{3}{8}$	$3\frac{3}{8}$	4	4	3
	$2\frac{3}{8}$	4	$4\frac{1}{2}$	4	3		$2\frac{3}{8}$	$3\frac{1}{2}$	4	4	3
	$2\frac{3}{8}$	$3\frac{3}{8}$	$4\frac{1}{2}$	4	3		$2\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{2}$	4	3
	$2\frac{3}{8}$	$3\frac{3}{8}$	$4\frac{1}{2}$	4	3		$2\frac{1}{2}$	$3\frac{1}{2}$	4	4	$3\frac{1}{2}$
Meadow Creek, July 30.....	$1\frac{7}{8}$	$3\frac{1}{2}$	$4\frac{1}{2}$	4+	3	$2\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{2}$	4	3	
	$2\frac{1}{8}$	4	$4\frac{1}{2}$	4	3+	2	$3\frac{1}{2}$	$4\frac{1}{2}$	4	3	
	$1\frac{7}{8}$	$3\frac{1}{2}$	$4\frac{1}{2}$	4	3+	2	$3\frac{3}{8}$	$4\frac{1}{2}$	4	3	
	$1\frac{1}{2}$	$3\frac{3}{8}$	$4\frac{1}{2}$	4	$2\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{2}$	4	3	
	$2\frac{1}{8}$	$3\frac{3}{8}$	4	4	3	$2\frac{1}{2}$	$3\frac{3}{8}$	$4\frac{1}{2}$	4	$2\frac{1}{2}$	
	$2\frac{7}{8}$	$3\frac{3}{8}$	4	4	$3\frac{1}{2}$	2	$3\frac{1}{2}$	4	4+	3	
	$2\frac{3}{8}$	$3\frac{3}{8}$	$3\frac{3}{8}$	4	$3\frac{1}{2}$	2	$3\frac{3}{8}$	$4\frac{1}{2}$	4+	$2\frac{1}{2}$	
	2	$3\frac{1}{2}$	4	4	3	$2\frac{1}{2}$	$3\frac{3}{8}$	$4\frac{1}{2}$	$4\frac{1}{2}$	$2\frac{3}{8}$	
	$2\frac{1}{2}$	$3\frac{3}{8}$	$4\frac{1}{2}$	4	3	2	$3\frac{1}{2}$	4	5	$2\frac{1}{2}$	
	$2\frac{3}{8}$	$3\frac{3}{8}$	$4\frac{1}{2}$	4	3	$2\frac{3}{8}$	$3\frac{1}{2}$	4+	4	3	
	$2\frac{3}{8}$	$3\frac{3}{8}$	4	4	3	$2\frac{3}{8}$	$3\frac{3}{8}$	$4\frac{1}{2}$	4	3	
	$2\frac{1}{2}$	$3\frac{3}{8}$	$4\frac{1}{2}$	4	3	$1\frac{7}{8}$	$3\frac{1}{2}$	4	4	$2\frac{3}{8}$	

Lengths and comparative measurements of specimens of young chinook salmon—Continued.

Locality and date.	Length.	Head.	Depth.	Snout.	Eye.	Locality and date.	Length.	Head.	Depth.	Snout.	Eye.
Meadow Creek, July 30.....	3 $\frac{5}{8}$	3 $\frac{3}{4}$	4	4	3 $\frac{1}{2}$	Alturas Outlet, August 9.....	2 $\frac{3}{4}$	.....	.....	.....	.....
	3 $\frac{1}{2}$	3 $\frac{3}{4}$	4 $\frac{1}{2}$	4	3 $\frac{1}{2}$		3	.....	.....	.....	.....
	1 $\frac{7}{8}$	3 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$		2 $\frac{1}{2}$	.....	.....	.....	.....
	2 $\frac{1}{4}$	3 $\frac{1}{2}$	4	4	3 $\frac{1}{2}$		2 $\frac{1}{4}$	.....	.....	.....	.....
	2 $\frac{5}{8}$	3 $\frac{3}{4}$	4	4 $\frac{1}{2}$	3		2 $\frac{7}{8}$	.....	.....	.....	.....
	2 $\frac{1}{2}$	3 $\frac{3}{4}$	4 $\frac{1}{4}$	4	3 $\frac{1}{2}$		2 $\frac{1}{2}$	.....	.....	.....	.....
	1 $\frac{3}{4}$	3 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	2 $\frac{3}{4}$		2 $\frac{1}{8}$	.....	.....	.....	.....
	2 $\frac{5}{8}$	3 $\frac{3}{4}$	4+	4	3 $\frac{1}{2}$		2 $\frac{1}{2}$	.....	.....	.....	.....
	1 $\frac{7}{8}$	3 $\frac{3}{4}$	4+	4	3 $\frac{1}{2}$		2 $\frac{1}{4}$	.....	.....	.....	.....
	2 $\frac{1}{2}$	3 $\frac{1}{2}$	4	4	3		2 $\frac{1}{8}$	.....	.....	.....	.....
	2 $\frac{1}{2}$	3 $\frac{1}{2}$	4 $\frac{1}{4}$	4 $\frac{1}{2}$	3		2 $\frac{7}{8}$	.....	.....	.....	.....
	2	3 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3		2 $\frac{1}{2}$	.....	.....	.....	.....
	2	3 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3		2 $\frac{1}{4}$	.....	.....	.....	.....
	2 $\frac{1}{4}$	3 $\frac{1}{2}$	4 $\frac{1}{4}$	4	3 $\frac{1}{2}$		2 $\frac{1}{2}$	.....	.....	.....	.....
	2 $\frac{1}{4}$	.....	.....	.....	.....		2 $\frac{1}{4}$	.....	.....	.....	.....
	2 $\frac{1}{4}$	.....	.....	.....	.....		2 $\frac{7}{8}$	.....	.....	.....	.....
	2	.....	.....	.....	.....		2 $\frac{5}{8}$	.....	.....	.....	.....
	1 $\frac{7}{8}$	.....	.....	.....	.....		2 $\frac{3}{8}$	.....	.....	.....	.....
	2 $\frac{1}{4}$	.....	.....	.....	.....		2 $\frac{3}{8}$	.....	.....	.....	.....
	2 $\frac{1}{8}$	.....	.....	.....	.....		2 $\frac{1}{2}$	.....	.....	.....	.....
	2 $\frac{5}{8}$	.....	.....	.....	.....		2 $\frac{3}{8}$	.....	.....	.....	.....
	2 $\frac{1}{4}$	.....	.....	.....	.....		2 $\frac{1}{2}$	.....	.....	.....	.....
	2 $\frac{1}{2}$	.....	.....	.....	.....		2	.....	.....	.....	.....
	2 $\frac{1}{2}$	.....	.....	.....	.....		2 $\frac{1}{4}$	.....	.....	.....	.....
	2 $\frac{7}{10}$	.....	.....	.....	.....		1 $\frac{7}{8}$	.....	.....	.....	.....
	1 $\frac{3}{4}$	.....	.....	.....	.....		1 $\frac{3}{4}$	.....	.....	.....	.....
	2 $\frac{1}{2}$	.....	.....	.....	.....		2	.....	.....	.....	.....
	1 $\frac{7}{8}$	.....	.....	.....	.....		3 $\frac{3}{8}$	.....	.....	.....	.....
	1 $\frac{3}{4}$	.....	.....	.....	.....		2 $\frac{3}{4}$	.....	.....	.....	.....
	2 $\frac{3}{10}$	.....	.....	.....	.....		2 $\frac{3}{4}$	.....	.....	.....	.....
	2	.....	.....	.....	.....		2 $\frac{5}{8}$	.....	.....	.....	.....
	1 $\frac{1}{2}$	.....	.....	.....	.....		2 $\frac{7}{8}$	.....	.....	.....	.....
	1 $\frac{7}{8}$	.....	.....	.....	.....		2 $\frac{1}{2}$	.....	.....	.....	.....
	1 $\frac{7}{8}$	.....	.....	.....	.....		3	.....	.....	.....	.....
	2	.....	.....	.....	.....		3	.....	.....	.....	.....
	1 $\frac{3}{8}$	.....	.....	.....	.....		2 $\frac{3}{8}$	.....	.....	.....	.....
	2	.....	.....	.....	.....		2 $\frac{1}{2}$	.....	.....	.....	.....
	2	.....	.....	.....	.....		2 $\frac{5}{8}$	.....	.....	.....	.....
	3	.....	.....	.....	.....		2 $\frac{3}{8}$	.....	.....	.....	.....
	2	.....	.....	.....	.....		2 $\frac{5}{8}$	.....	.....	.....	.....
	3	.....	.....	.....	.....		2 $\frac{1}{2}$	.....	.....	.....	.....
	2 $\frac{7}{10}$	.....	.....	.....	.....		2 $\frac{1}{2}$	.....	.....	.....	.....
	1 $\frac{7}{8}$	.....	.....	.....	.....		2 $\frac{1}{4}$	.....	.....	.....	.....
	2 $\frac{3}{8}$	.....	.....	.....	.....		2 $\frac{1}{4}$	.....	.....	.....	.....
	2 $\frac{1}{4}$	.....	.....	.....	.....		2 $\frac{1}{4}$	.....	.....	.....	.....
	1 $\frac{7}{8}$	.....	.....	.....	.....		2 $\frac{1}{2}$	.....	.....	.....	.....
	2	.....	.....	.....	.....		1 $\frac{7}{8}$	.....	.....	.....	.....
	2 $\frac{1}{8}$	.....	.....	.....	.....	Alturas Inlet, September 7..	3 $\frac{1}{2}$	4	4	4 $\frac{1}{2}$	3
	2 $\frac{1}{2}$	.....	.....	.....	.....	Alturas Lake, September 9..	3 $\frac{3}{8}$	4	4 $\frac{1}{4}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$
	2 $\frac{1}{4}$	.....	.....	.....	.....		3 $\frac{3}{4}$	4	4 $\frac{1}{8}$	5	3 $\frac{3}{8}$
	2 $\frac{5}{8}$	.....	.....	.....	.....		3 $\frac{1}{2}$	4	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$
	2	.....	.....	.....	.....		3 $\frac{3}{8}$	4+	4 $\frac{1}{2}$	4+	3 $\frac{1}{2}$
	1 $\frac{3}{4}$	.....	.....	.....	.....		3 $\frac{3}{4}$	4	4	4+	3 $\frac{1}{2}$
	1 $\frac{7}{8}$	.....	.....	.....	.....		.....	.....	.....	.....	.....

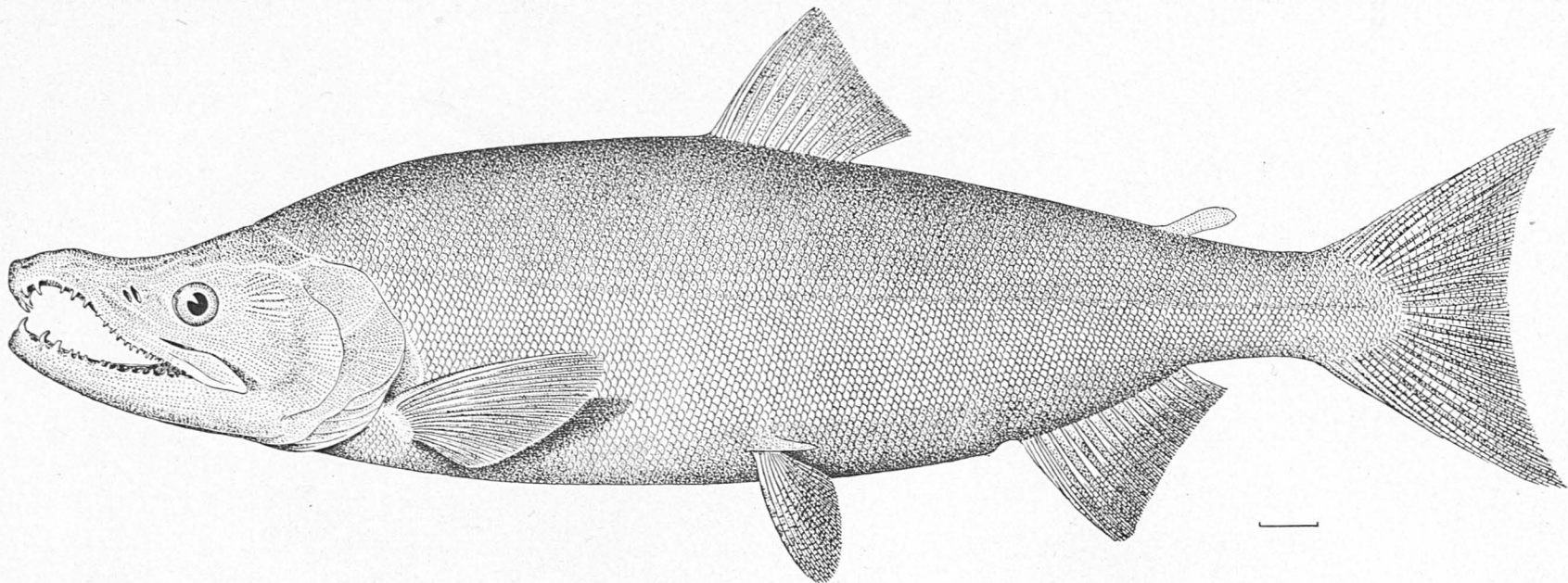
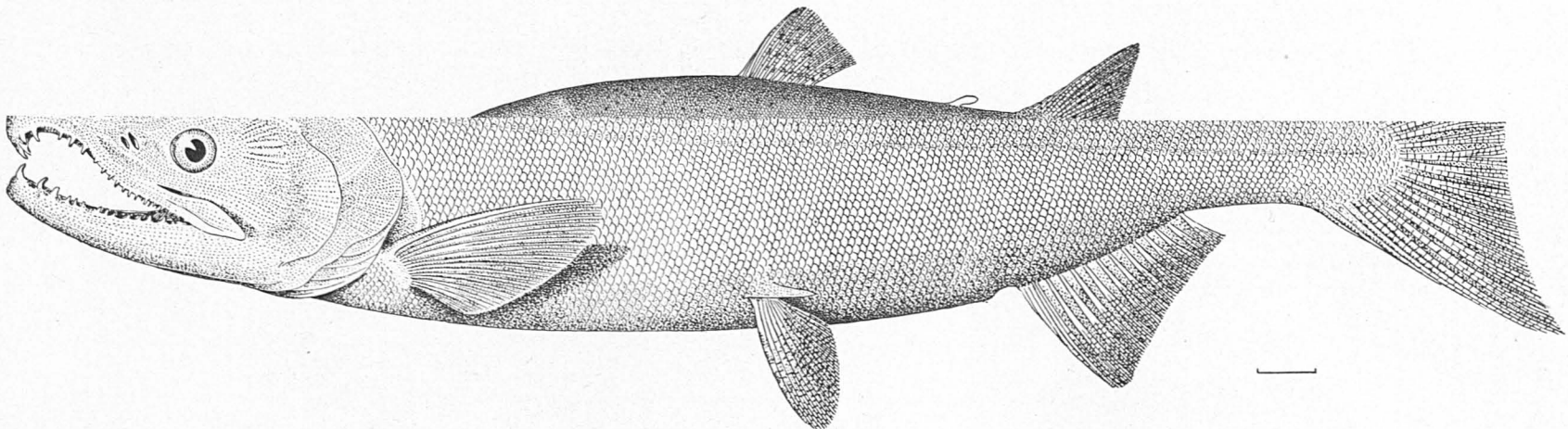


Fig. 1. BREEDING MALE REDFISH (*Oncorhynchus nerka*). Length 24 inches. Alturas Creek, Idaho, September 5, 1895.



15. *Oncorhynchus nerka* (Walbaum). Redfish; Blueback Salmon; Fraser River Salmon; Saw-Qui Salmon; Saukeye Salmon; Krasnaya Ryba; Walla.¹

The information obtained concerning the redfish during my visit to Idaho in 1894 has been published in the report already referred to. The observations made in 1895 were much more extended and are here given with considerable detail:

July 20: Nets were set in both the outlet and inlet of Alturas Lake.

July 25: Four small redfish were found on net in Alturas Inlet. All were caught going upstream; 3 were males and 1 was a female; all were unripe and in perfect condition. This net had been examined July 22, 23, and 24, and no fish either found on it or seen in the creek or lake; these 4 fish therefore seem to be the first arrivals in the inlet. The fact that none had been taken by the net in Alturas Outlet indicates pretty conclusively that the redfish had reached Alturas Lake earlier than July 20.

July 28: As the Alturas Inlet net was being surreptitiously relieved of its catch by persons not interested in the study of the migration of fishes, and as the fact of their arrival had already been determined, the inlet net was taken up and not put in again until August 2.

August 2: An inspection of Alturas Inlet on this date showed that the redfish had entered it in large numbers. At two hauls with a 30-foot seine 56 fish were caught from one hole 4½ feet deep. Of these, 18 were females and 38 males, and all were of the small form. A few of these were ripe, but the majority were firm. All were in excellent condition, none showing any mutilations. At this time they were in bunches in the deeper pools, very few being seen upon the riffles.

August 3: The net to-day contained 2 ripe males and 2 ripe females going upstream, and 4 nearly ripe males apparently going down. Eight others, 3 males and 5 females, were caught about 2 miles up the creek. One male and 1 female were partly spent, the female having only about half a dozen eggs left. Later in the day 15 males and 5 females were taken from the same hole from which the 56 were taken on the 2d. Some of these were ripe, but none were spent and none showed any mutilations.

August 4: Two ripe males and 4 scarcely ripe females in net, 2 of the females apparently going downstream. All in perfect condition.

August 6: Two males and 3 females in net, all going upstream; none ripe and no sores.

August 6 and 7: Ralph Calderwood, of Pioneerville, Idaho, caught 130 redfish in Alturas Inlet near the forks. Of these, about 33 were females; a few had spawned, a few others were about ready to spawn, but the majority were not yet ripe. There were no blemishes or sores on any of them. They were estimated by Mr. Calderwood to weigh half a pound or less each. He thinks he saw about 1,000 redfish in the inlet, all being of the small form.

August 8: A. L. Davis, of Bellevue, Idaho, caught 3 small redfish in the inlet.

August 9: Mr. Davis caught 9 redfish about a quarter of a mile above mouth of inlet. Most of them were males, none ripe. Saw perhaps 50 others. A party of campers from Bellevue caught 49 redfish in Alturas Inlet, only 3 being females. Few, if any, were ripe and none showed any sores.

August 10: The gill net in Alturas Inlet to-day caught 3 redfish, all ripe males and in perfect condition. Two were of the small form (12½ inches long or one-half pound each), the other, a large one, 25½ inches long and weighing 6 pounds (or 5½ pounds dressed). On same day we speared 3 males and 1 female in a pool about three-fourths of a mile above mouth. All were ripe and without mutilations. The Bellevue party caught with spears, jigs, or gaff hooks, 84 redfish, 59 males and 25 females. Of the 84, only 3 had the fins noticeably frayed, one had the caudal badly frayed, and the other 2 were less worn. Perhaps others may have had some slight mutilations, but a somewhat close inspection failed to disclose any. Very few of this lot were ripe, and none spent. All were taken in deep holes 1 to 1½ miles above the lake. Many others were seen. An examination of the last mile of the inlet to-day showed about 175 redfish, all small and all lying in the deeper holes. The net in Alturas Inlet was taken up to-day and kept out until August 30.

August 14: One large redfish, 24½ inches long and weighing 5½ pounds, was taken in the net in the south inlet of Pettit Lake. This was a ripe female and contained exactly 910 eggs by actual count. I do not think she had begun spawning. This net was set July 29; it had, therefore, remained in 15 days before catching any fish.

August 22: Another large redfish on same net, a ripe male 26½ inches long and weighing 5½ pounds. No mutilations on either of these.

August 28: The camp was moved from Pettit Lake to Alturas Inlet, and daily observations were continued there for more than three weeks.

August 29: Counted 80 small and 1 large redfish in Alturas Inlet between camp (half a mile above mouth) and a point an eighth of a mile above. They were mostly on fine gravelly riffles or in deep holes next below the riffles, and were evidently spawning. When disturbed they would drop downstream into the holes, but would very soon return to the spawning-beds. Perhaps 1 out of every 8 was more or less sore. The large one was a ripe male in perfect condition. A pair spawning in a pool near our camp was watched for some time. They would come up to the little pool together, the female usually just ahead of the male. After resting quietly a few moments she would turn somewhat on one side, wriggle her body vigorously, and move the gravel about chiefly with the anal fin and the lower caudal lobe, the male being close behind her all the time. Sometimes she would turn so far over as to bring her side and back in contact with the heaped-up gravel and sand. After moving the gravel she would circle around downstream a few feet and return to the bed to repeat the same act, followed

¹This name was heard applied to the small redfish at Alturas Lake.

closely by the male. A bunch of a dozen in a pool just below the camp was watched from day to day and their movements were essentially the same as those just described. At first we thought that only the females pushed the gravel about, but we soon saw that the males quite often did the same.

There is always a pairing off of the sexes, and as there are usually several more males than females on any spawning-bed the supernumerary males are chased about and driven away by the paired ones. They never stay away, however, but promptly return, only to be chased away again. This is kept up all day, and in water usually only a few inches deep, often no deeper than the fish itself. The fins and even parts of the body are in this way, as well as when moving the gravel on the beds, brought in contact with the gravel and sand and become quite as much worn as those of the females.

An examination of about 2 miles of the creek to-day showed that the fish are most abundant in the second mile above the lake. Throughout the lower mile the fish were not only less abundant, but not many of them were spawning; but in the upper portion of the stream they were much more abundant and nearly all spawning at this time. It was also noticed that a much larger proportion of those in the upper portion were mutilated and sore on the back or caudal peduncle.

August 30: The upper portion of the inlet was examined again to-day and the fish were found even more abundant than yesterday. Practically all were upon the riffles and spawning; a few were seen in deep holes, but they all seemed to be fishes that were done spawning, as they showed mutilations quite plainly. Four which I caught with my hands were badly worn. To-day a gill net (which I shall call Net B) was set in the inlet near our camp, half a mile above the lake.

August 31: This morning the net contained 20 small redfish; of these, 10 were going up (7 males and 3 females) and 10 (7 males and 3 females) apparently going down. These were all ripe, or nearly so, and all in excellent condition; no sores on any and the flesh quite firm in nearly all. In the lower portion of the stream to-day the fish are rather more numerous than yesterday; most of them keep quietly in the deeper holes and do not appear to be quite ready to spawn. Net C was set to-day a few feet below Net B, and a third one (D) was placed in the mouth of the inlet only a few feet from the lake. These three nets we hoped would enable us to determine whether the fish are running up or down, or both.

September 1: Net B, 24 males and 6 females, of which 16 males and 2 females were going up, while the 12 remaining appeared to have been going down, but some of them may have turned in the net; of these 30 specimens, 6 were gilled during the afternoon of August 31 before we put in Net C; of the 12 males gilled from below, 10 were almost ripe and 2 were partly spent; of the 12 apparently gilled from above, 2 females were ripe, 1 female not ripe, and 1 female spent; of the 8 males, 3 were ripe, 2 partly spent, and 1 entirely spent; this last was badly mutilated and covered with sores. Net C contained 12 fish, all males, 10 evidently going up and 2 apparently going down; all of those going up were about ripe; none had spawned and none showed any mutilations. Net D at the outlet contained 5 males and 1 female, all going up; the males were all quite solid, but the female was ripe. Only one of the 42 fish taken in the nets to-day was noticeably sore, and one other showed the ventral fins very slightly worn.

September 2: Net B contained 8 fish, viz, 4 ripe males going down, 1 ripe male going up, 1 nearly spent, sore male going up, and 2 solid females going up. Net C contained 6 fish, viz, 3 ripe males and 1 ripe female going up, and 1 ripe male and 1 partly spent, sore male going down. Net D contained 12 fish, 7 males and 5 females, all going up, except 1 ripe male which was apparently going down, but it is likely that it, too, was really caught going up and turned in the net. Four of the males were ripe, while the remaining 8 fish were scarcely or not at all ripe. There were no sores or mutilations of any kind.

September 3: Net B contained 6 fish, 4 of which were going up. Three of these were scarcely ripe males, the other an unripe female. The 2 going down, a male and a female, were both spent fish, both dead and merely lodged against the net. Net C had 9 fish, 8 evidently going up, and 1 turned so as to appear as if going down. Seven of these were ripe males, the other 2 scarcely ripe females. Net D contained 16 fish, all going up. Of these, 5 males and 2 females were solid, and 5 males and 4 females were ripe. These 16 fish were all in perfect condition, as were all those taken in nets B and C, except the 2 spent fish taken in B, which were both considerably mutilated. Net C was to-day taken up and reset in the outlet of Alturas Lake a few rods below the lake.

Mr. Edward G. Burnet and party, of Corral, Idaho, who spent a few days camping at Alturas Lake, caught about 80 redfish, one of them a large female with nearly the whole tail worn off. About a third of the catch were females.

September 4: Net B contained 5 fish, 2 ripe males and 1 nearly dead male going up, and 1 nearly spent female and 1 dead female going down, the dead fish being merely lodged against the net. Net D had 12 fish, 6 males and 6 females, all going up. Only 3 of the males and 1 of the females were ripe. All were in excellent condition and were salted down by Mr. Burnet, to whom we gave them.

September 5: Net B had 17 fish, 9 going up and 8 down. Of those going up, there were 3 ripe males, 1 scarcely ripe male, 1 partly spent and sore male, and 1 dead spent male; those going down were 1 dead spent male, 4 nearly dead males, 1 dead spent female, and 2 spent males. Nearly all of these fish were more or less mutilated and covered with sores. Net D contained 6 fish, 2 nearly ripe males and 3 ripe females going up and 1 nearly dead spent male going down.

September 6: Net D contained 5 fish, 3 solid females and 2 ripe males, all going up and all in good condition. The record of this date for Net B was unfortunately lost.

September 7: Net B had 8 fish, all males; one ripe male going up and 7 spent males going down; 5 of these were dead or nearly so and were simply lodged against the net; all of the 7 were covered with sores and had the fins badly frayed. Net D had 2 nearly dead males lodged against the upper side, both spent and sore, and 1 ripe male gilled from the lower side.

To-day a careful count was made of all the redbfish in Alturas Inlet and the total number found was about 1,000. The lower $1\frac{1}{2}$ miles of the creek had about 300 fish; the next $1\frac{1}{2}$ miles contained about twice as many, while the remaining portion of the stream contained only about 100 fish. Those in the lower portion were mostly in excellent condition; most of them were in the deeper holes and only a few were seen spawning. These are pretty certainly the fish which have last come into the creek. Those in the middle portion of the creek were either out in shallow water spawning or were spent fish which had retired to the pools. Fully one-half, perhaps two-thirds, of the entire number were plainly seen to be mutilated. The fish in the upper part of the stream were nearly all done spawning and many of them were weak and dying and drifting down with the current. Scarcely a fish could be seen here that was free of mutilations and sores.

September 8: Net B had 2 spent males lodged against the upper side; both were covered with mutilations. Net D contained 12 fish, 7 going up and 5 down; of those going up 5 were females and 2 males, all solid; those going down were 2 dead males, 3 nearly dead spent males, and 1 ripe female which had probably turned in the net; the 5 males going down were much mutilated. Later in the day a 28-inch male weighing $6\frac{1}{2}$ pounds was taken in net B; this fish was ripe and in perfect condition, except a slight mutilation on the branchiostegals.

September 9: Net B had 10 fish, 6 going up and 4 down; those going up were 2 ripe females and 4 nearly spent males; those going down were 3 very sore spent males, lodged against the net and 1 almost spent female.

Net D contained 10 fish, 7 going up and 3 down. Those going up were 3 males and 4 females, all ripe and in perfect condition; the 3 going down were 1 dead male and 1 dead female lodged, and 1 nearly dead female, all spent and much worn. Net D was taken up to-day.

September 11: Net B contained 16 fish; 1 ripe male and 1 ripe female going up; 13 males and 1 female, all spent and sore, going down and merely lodged against the net except 2 males which were gilled. These were all very badly worn, some of them having the caudal almost entirely worn away.

September 12: Net B had 13 fish, 12 males and 1 female, all going down; 7 were dead and lodged, and all but 4 of the 13 were badly mutilated. In the evening this net was again examined and 8 fish found, 5 of them gilled from the upper side and 3 merely lodged; 4 were in pretty good condition but spent; all of the other 4 were spent and much worn, 2 being dead and the others nearly so. An inspection of the last 2 miles of the inlet to-day showed a great decrease in the number of redbfish, and that nearly all that are left are more or less covered with sores.

September 13: The creek has risen about 2 feet on account of heavy rains. The nets were not relieved of their catch, but 8 or 10 fish could be seen lodged against Net B.

September 14: Net B had 14 fish lodged against it this morning, 12 males and 2 females; 3 or 4 of the males were well gilled, while all the others were gilled only slightly or not at all; all but 3 were dead and all but 2 or 3 were badly worn. To-day the entire creek was examined again, and the total number of live fish found was about 263, of which 26 were between the lake and our camp, 137 in the next $1\frac{1}{2}$ miles, and about 100 still farther up. The great majority seemed to be males; indeed, of the 137 seen by Mr. Scofield only 18 were believed to be females. Spawning appeared to be practically at an end; nearly all the fish were badly mutilated; nearly all were lying quietly in the deeper, more quiet portions of the stream or were being slowly carried down by the current. A dozen dead ones, all males, were seen, and it is evident that many others were nearly dead. On September 7 the total number seen was about 1,000; there was, therefore, a decrease of nearly 750 fish in a week. A few days more and all will probably have died.

September 15: Net B contained 1 large redbfish and 4 small ones; the large one was a male in fine condition and only partly spent. All the small ones were males, all spent and sore, 1 dead and lodged against the net, the other 3 gilled from above. Net D at the mouth of the inlet was put in again to-day.

September 15: Net B had 3 dead fish lodged against it.

September 16: Net B had 9 fish on upper side, 7 males and 2 females; all were spent and 5 were dead. Net D contained nothing. The entire inlet was inspected again to-day, and only 213 fish found. The lower 2 miles contained 105 fish, and all the rest of the creek 108; 14 dead ones were seen. Of the 108, only 13 appeared to be females. The fish were nearly all badly mutilated. All were apparently done spawning and many were dying.

September 17: Net B had 10 fish lodged and 2 gilled from upper side; 11 were males and 1 a female, all spent, all with numerous sores and mutilations, and 9 dead. Net D had 1 dead spent female gilled from above. All its fins were frayed out. This net has now been in two nights, and not a fish has been caught going up. This morning Mr. Fred Ashley, who was camped near us, saw 2 large male redbfish in Alturas Lake swimming along the west shore. I visited the place in the afternoon, and saw 1 large redbfish. He was swimming along near shore in shallow water. After going up a few rods, he would turn around and swim down the shore about the same distance, only to return up the shore again. This fish was in excellent condition, and is the only redbfish I have ever seen in any of these lakes.

September 18: Net B had 7 fish, 6 males and 1 female, all lodged except 2, which were gilled going down. All were spent and mutilated, and all but 3 males. Net D contained nothing. To-day camp was moved to Alturas Creek opposite Pettit Lake.

September 22: Net B, which had not been visited since 18th instant, contained 17 fish, all lodged or slightly gilled on the upper side. There were 14 males and 3 females, all dead but 1 male and 2 females. All were spent, and all very much mutilated except 1 live male and 1 live female. Net D contained nothing. An inspection of about $1\frac{1}{2}$ miles of the lower part of the creek showed only 5 live fish, but several dead ones were seen. The spawning season is evidently wholly over, and only a very few weak, dying fish are left.

This date, September 22, is that of our last inspection of Alturas Lake and Inlet. Mr. F. C. Parks, however, visited them at various times in October, but saw no redfish.

The foregoing extracts from our field notes have been given in order that the following discussions of the various more important questions in the life-history of the redfish may be more readily intelligible.

1. Do the small redfish come up from the sea?

This question can not, in the light of our present information, be definitely answered one way or the other. They were already in Alturas Lake July 20, when our net was first placed in the outlet, and it is extremely improbable that any entered the lake from below subsequent to that date. Whether they had really come up from the sea and entered the lake prior to July 20 can not be positively asserted. The evidence that they are anadromous rests chiefly upon analogy and their apparent specific identity with the large form. No specimens of the small redfish have ever been obtained or seen by any collector in the Columbia Basin below these lakes; indeed, so far as can be determined by an examination of the literature upon the matter, the small redfish has never been seen by anyone except in certain lakes or their inlets. The list of lakes in which it is known to occur is as follows: Chiloweyuck Lake (north latitude 49°), near Fraser River; Nicola, François, Fraser, and Okanogan lakes, the first three tributary to the Fraser, the last to the Columbia (Dr. Dawson); Alturas and Big Payette lakes in Idaho; Wallowa Lake in Oregon; Lake Washington at Seattle; Stuart and Shushwap lakes in British Columbia. It was seen many years ago at Wallowa Lake by Major Bendire, who has always maintained that it is an anadromous fish. It probably occurs also in Pettit, Redfish, and Stanley lakes, in Idaho, and possibly elsewhere.

It should be borne in mind, however, that very little search has been made for it in the Columbia by ichthyologists and it might well have escaped their observation. That it has never been detected by the fishermen is difficult of explanation, unless it be that the small size, color, and general appearance of the fish caused it to be mistaken for the black-spotted trout; for, like the large form, these small redfish are more or less red only at spawning time. Even during the spawning season many of the females and some of the males are not red at all and might very easily be mistaken for trout by anyone unacquainted with the technical characters separating the species. In fact, several females taken in Alturas Inlet were pronounced to be trout by more than one person to whom they were shown.

While we may be as certain as anyone can be, in the absence of actual proof, that the small redfish is anadromous, the question is still an open one and can be settled only by careful examination of the Columbia and its tributary streams below the lakes during the period when these fish are supposed to be running.

2. Do the large redfish ascend to these lakes from the sea?

This question can be answered positively in the affirmative. The evidence that this form is anadromous may be regarded as amounting to absolute proof.

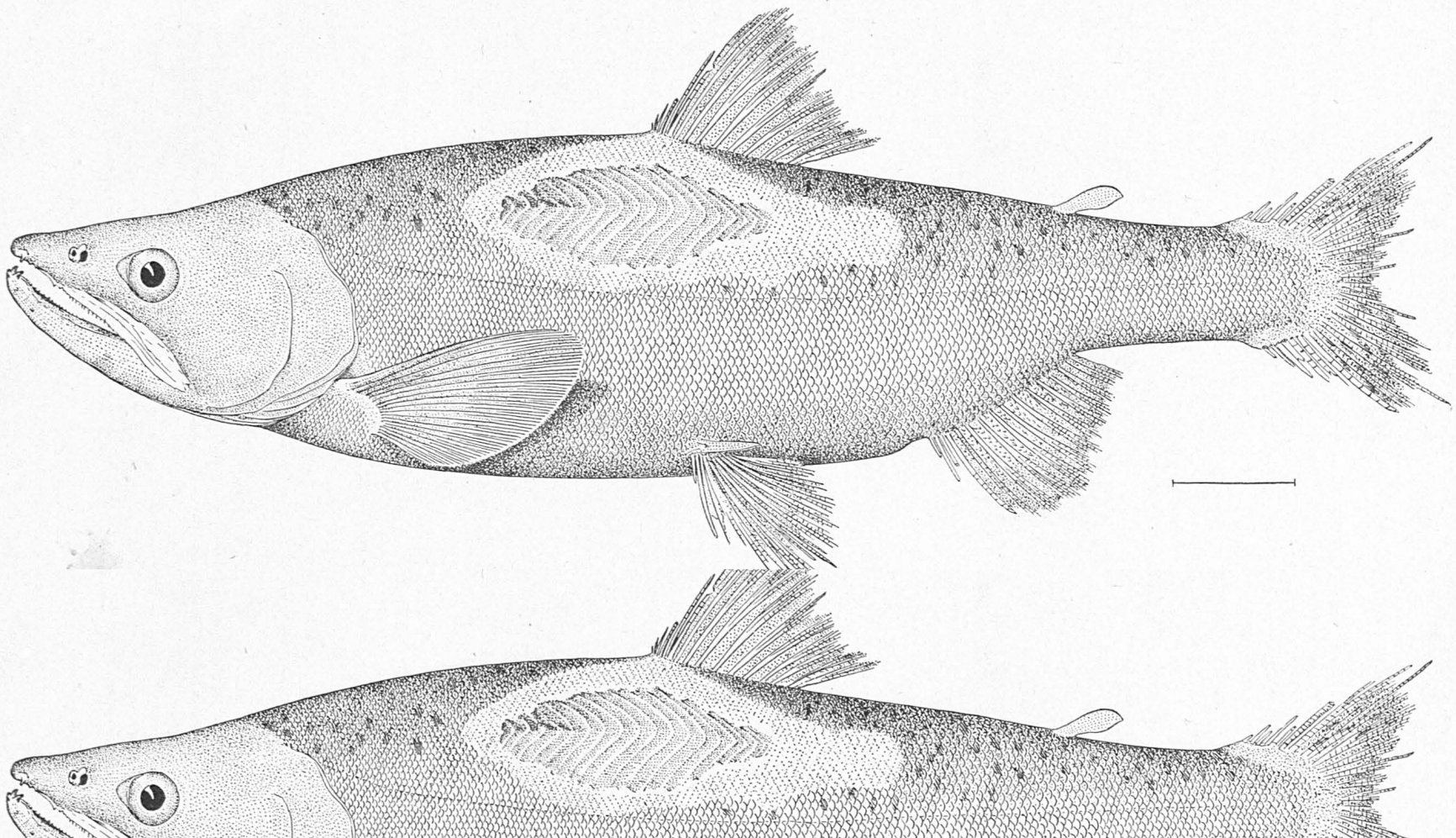
They are caught every year in great numbers in the lower Columbia and rank second in commercial value only to the chinook salmon. But their movements after passing the fishing-grounds of the lower Columbia are not so easily traced. They have been obtained, however, by Major Bendire and also by Dr. Gilbert in the outlet of Wallowa Lake in Oregon. No naturalists have ever reported specimens from any place in Idaho except in the lakes or their inlets.

Mr. F. C. Parks has frequently seen them in Alturas Outlet and in Salmon River, near by, and others have reported seeing them at various places in Salmon River, particularly in the vicinity of Challis. But no large redfish were seen by us below the lakes, the only places where we saw them being in the inlets to Pettit, Alturas, and Big Payette lakes and in Alturas Lake.

3. What is the spawning period of the redfish at the Idaho lakes?

We do not yet know the actual time of arrival at any of these lakes, but more definite data are at hand regarding their time of entering the inlets. As previously stated, the redfish were already in Alturas Lake prior to July 20, began running up the inlet on the night of July 23, and continued to do so until about September 10. The heaviest run was during the time between August 7 and September 1, although a good many came after that date. Ripe fish were found as early as August 2, and ripe, unspent fish were caught as late as September 11. The height of the spawning season, however, extended from August 25 to September 5.

On September 12, 1894, there were 128 redfish in Alturas Inlet and some of them were still spawning. No live fish were seen in Pettit Lake Inlet September 13, 1894, and only 2 redfish were seen there in 1895. Both were the large form, one a ripe female caught August 14, the other August 22.



At Big Payette Lake, September 27, 1894, I saw several small dead redfish and 6 large live ones. They were nearly all spent fish, and the spawning season there was practically over. In 1895 the first redfish at Big Payette Lake were seen by Mr. Williams on September 3. They were in a pool in the inlet about 4 miles above the lake. He saw 3 large ones and 6 small ones. A short distance above another large one was seen. On September 5 this place was again visited by Mr. Williams, and 3 large redfish and 9 small ones were caught. The 3 large ones were all ripe males. Of the small ones no others were seen. On September 15, 3 more large ones were noticed near the same place, one of the 3 being a female. On September 23 the inlet was again visited and 2 large redfish seen. They were covered with sores and appeared very weak.

In a letter received by Mr. Williams from Mr. McCall since leaving the lake, Mr. McCall states that he caught 4 large redfish in the inlet October 8, and that they were still spawning and in good condition. This confirms the belief expressed in the report of my visit to this lake in 1894, viz, that the spawning season here is later than at Alturas Lake.

Prof. O. B. Johnson found the small form spawning in Lake Washington near the last of November, 1888, and on October 8, 1889. Dr. Dawson found them spawning in the first week of September, 1877, in the small streams on the west side of Okanogan Lake, and again in the same streams on September 16 and 17, 1890, particularly in the one known as Bear River. In a letter to Dr. Bean, Dr. Dawson says:

A great number of little salmon-like fish, apparently running up to spawn. It is singular that though they have evidently been long in the stream (from the livid red color of many of them, their frayed fins and tails, with white fungoid growth in places) they have not got farther up the river, which offers no particular impediment to their ascent. They can not all have spawned, as many still hold spawn and milt. Indians say they all die in the stream and do not return to the lake. Many were dead along the shores, and the crows had collected in great numbers in the vicinity. This was within a quarter of a mile or less from the mouth of the river on the lake.—*Forest and Stream*, July 9, 1891.

Dr. Kennerly says that they disappeared suddenly about September 1, at Chiloweyuck Lake. He first saw them in a small stream tributary to this lake, and in vast numbers. On August 17 he and his companions caught 180 with hook and line. About August 10 they appeared at the mouths of all the small streams emptying into the lake in such numbers that they could be caught with the hands.

4. *Where and how are the mutilations received?*

The sores, frayed-out fins, and other mutilations which have been noticed upon the chinook salmon and redfish by everyone who has ever seen these fishes upon their spawning-grounds have been regarded by all as being due chiefly, if not wholly, to the injuries incident to the long journey from the sea. Coming to these Idaho lakes from the sea requires a journey of more than 1,000 miles, and it is, in large part, through swift and turbulent waters and up dangerous rapids, cascades, and waterfalls, against whose ragged and jagged rocky walls and bed the fish would often be thrown by the scething currents. That they could make this long and perilous journey unscathed could scarcely be believed.

In the shorter coastal streams of Oregon, Washington, British Columbia, and northward, the same mutilations have been observed and have usually, without sufficient reason, been attributed to the same cause. Until now it has therefore been generally held that the injuries are received by the fish while en route to the spawning-grounds. Our continuous series of observations at Alturas Lake during the entire period of the breeding season shows, however, that this is not the true explanation. Among the hundreds of redfish which we examined as they came up into Alturas Inlet from the lake, not one possessed any sores or had the fins frayed out in the least; every one was perfect in every way, so far as mutilations were concerned. Not only were all of those caught on the gill nets as they came up from the lake free of sores, but no sores were seen on any of the fish in the creek until some time after the spawning had begun. The first fish were seen July 24, but not until August 10 were any mutilated ones observed, and then only 3 out of 84 examined showed any considerable mutilations.

In marked contrast with this perfect condition of the fish as they arrive upon their spawning-grounds is that observed toward the close of the spawning season, when scarcely a fish can be found whose fins are not badly frayed and upon whose body are not one or more large sores. The nature of these mutilations is well shown in plate 72.

The manner in which the mutilations are really received was readily determined by watching the fish while spawning. The spawning-beds are usually in very shallow water, often only a few inches deep. These beds are of fine granite gravel and sand. There is more or less definite pairing off of the fishes, and each pair usually does all its spawning on a certain area, which may be called the nest. The gravel and sand of this area are moved about and piled up somewhat in heaps or rows as the fish scoop out shallow depressions in the bed; this scooping or moving of the gravel is done as

the fish swims upstream over the bed with a rapid quivering motion of the body; during this act the body is always inclined to one side and the gravel is chiefly pushed in the other direction; after swimming across the nest in this way, the fish circles around downstream and returns to the bed to repeat the same process again and again, and keeps it up for several days. During all this time the male follows closely behind the female, sometimes quivering and plowing through the sand and gravel in the same way and thus receiving mutilations of the same character. Often the back of the fish is turned against the gravel and becomes worn. On each spawning-bed are usually several supernumerary males, and among them and the paired males there is much chasing about and some fighting, which results in still further mutilations. It may therefore be positively stated that the sores and mutilations seen on the redfish at the Idaho spawning-grounds are practically all received after the spawning season begins.

5. *What becomes of the redfish after they have finished spawning?*

Our observations made at Alturas and Payette lakes in 1894 and 1895, and particularly those at Alturas Lake in 1895, which have already been given with considerable detail, leave no doubt as to the answer to this question. The redfish which spawn in the inlets to the Idaho lakes never return to the sea, but all die at the close of the spawning season. The evidence is conclusive. On September 6 there were about 1,000 redfish in Alturas Inlet. By September 14 the number had been reduced to about 263, a net decrease of nearly 750 in one week. Two days later, September 16, only 213 fish were found in the entire stream, and on September 22 there were probably not over 25 fish left. That this decrease was caused by the death of the fish and not by their running downstream into the lake is certain. The gill nets near the mouth of the inlet would have prevented them from returning to the lake had they desired to do so. But the daily inspection of the nets showed that there was little if any tendency on the part of the fish to return to the lake. The fish caught in the nets from above were usually dead or dying fish which were too weak to resist the strength of the current and were consequently carried against the nets. After the spawning season was well advanced, dead fish could be found any day along the stream; and the seriously mutilated condition of practically all the fish near the close of the spawning precludes the probability of their recovery.

6. The question as to the relationship of what I have designated as the large and small forms of the redfish is an interesting one and not easy to settle. The large form has been described as new no fewer than eight times, and the small one twice. The following is a list of the names, in order of date, which have been applied to the two forms:

Large form:

- Salmo nerka* Walbaum, 1792. Kamchatka.
- Salmo lycaodon* Pallas, 1811. Kamchatka.
- Salmo paucidens* Richardson, 1836. Columbia River.
- Salmo tapdisma* Cuvier & Valenciennes, 1848. Kamchatka.
- Salmo arabatsch* Cuvier & Valenciennes, 1848. Kamchatka.
- Salmo melamppterus* Cuvier & Valenciennes, 1848. Kamchatka.
- Salmo cooperi* Suckley, 1861. Okanogan River.
- Salmo richardi* Suckley, 1861. Fraser and Skagit rivers.

Small form:

- Salmo kenneerlyi* Suckley, 1861. Chiloweyuck Lake.
- Salmo warreni* Suckley, 1861. Fraser River.

In 1862 Dr. Gill made the small form the type of a new genus, which he called *Hypsifario*, the "compressed body and projecting snout" being the characters assigned.

Jordan & Gilbert have regarded the small redfish as being specifically identical with the large form. In 1891 Dr. Bean examined a number of specimens of the little redfish which the National Museum had received from Lake Washington, at Seattle, where they were obtained by Prof. O. B. Johnson, of the State University of Washington. An examination of these specimens, together with others from British Columbia, and the notes of Professor Johnson and Dr. Dawson, of Ottawa, convinced Dr. Bean that the little redfish is a landlocked form and should rank as a subspecies, standing as *Oncorhynchus, nerka kenneerlyi*. The differential characters which Dr. Bean regarded as of value were (1) the difference in the number of gillrakers, and (2) the difference in the size of the fins. He thought that the smaller form had only about 30 gillrakers, while the larger had about 40.

An examination of a large series of specimens of each form shows no difference in the gillrakers and none of importance in the fins, as may be seen from the following table. Indeed, except in the matter of size, there seem to be no structural differences of any value whatever. In color the large ones are, at spawning time, usually a brighter and more uniform red, the females being quite as red

as the males. The head in both sexes is pale olive in color. In the small form some individuals, usually males, are quite as red as the large ones, but the small ones are in most cases noticeably darker and less red, the head less olive, and the black spots on the back are more numerous and better defined.

The small form is a much trimmer fish in general appearance—the snout is relatively shorter and the eye larger. At the breeding season the snout in the males of the large form becomes greatly distorted; in the small males the distortion is not so great; in the large females it is rarely noticeable, while no change at all seems to take place in the small females. The constant and uniform difference in size of the two forms is a matter of great interest. The individuals of the small form vary but slightly in length and scarcely at all in weight. The length is about a foot, never varying more than 2 inches either way, and the weight is half a pound, with astonishing constancy. Hundreds of individuals were weighed by us, and, except near the end of the spawning season, the weight was always half a pound each. It made no difference how many fish we weighed in a bunch, the weight in pounds would invariably be half the number of fish weighed. At the beginning of the season, when none had yet spawned, the weight was usually a trifle strong, while at the end it usually fell a trifle short of the half pound, the difference being, of course, the loss due to spawning and worn-off fins.

The individuals of the large form which were examined at the Idaho lakes vary from 22 to 27 inches in total length and from 5 to 6 pounds. Spent fish weigh considerably less. In Alaska and elsewhere individuals of considerably greater weight are frequent. The meaning of this uniform difference in size is a matter not easy to explain, unless it be shown that they are really different species. Until further observations are made, it seems useless to offer any explanation.

Comparative measurements and other data regarding a large number of specimens of the redfish are given in the following table:

LARGE FORM.

Tag No.	Length.	Sex.	Head.	Depth.	Eye.	Anal rays.	Branchiostegals.	Height of dorsal in head.	Condition.
1	21	Male.....	3½	4½	7½	15	13+13 L.	2½	Only a head.
2	.....	Male.....	.....	.....	7½	.....	14+14 L.	.....
3	22	Female ...	4½	5	6½	14	13+14	2	Caudal and ventral badly frayed, spent.
45	20	Female ...	4½	5½	6	14	13+14	1½	
212	23½	Male.....	3½	4½	7½	14	13+13 L.	2½	
213	21	Male.....	3½	4	6½	14	13+13 L.	2½	
214	23	Male.....	3½	4	7	14	15+14 L.	2½	
215	27	.....	4½	5	7	14	13+14 L.	2
216	25	Male.....	3½	4½	7½	14	14+13 L.	2½	

SMALL FORM.

These 14 weighed just 7 pounds.	11¾	Male.....	3½	4½	5	14	13+14 L.	2	Caudal and base of ventral worn, one ventral gone, spent.
	11¾	Male.....	3½	4	5½	14	13+13 L.	2	C., A., D., and V. sore, back sore, spent.
	12¼	Male.....	3½	4½	5½	14	12+13 L.	1¾	Solid, perfect, very little spent.
	11½	Male.....	3½	4	4½	13	14+13 L.	1½	Head bitten, ripe.
	11¼	Male.....	3½	4½	5½	Worn.	13+14 L.	2	C., A., D., and V. all badly frayed, jaws sore, spent, adipose fin gone.
	12	Male.....	4	4½	5	14	13+13 L.	1¾	Solid, no sores; ripe, but not spent.
	12¼	Male.....	3½	4½	5	14	13+14 L.	1¾	Spent, no sores; ripe.
	11½	Male.....	3½	4	5	14	13+14 L.	2	Dorsal frayed, spent.
	11¾	Female ...	4½	4½	5½	13	13+14 L.	1¾	Almost ripe, solid, perfect.
	12¼	Female ...	4½	4½	4½	14	13+14 L.	1¾	Ripe, solid, perfect; very dark.
	11½	Female ...	4½	4	4½	13	13+14 L.	1¾	Scarcely ripe, solid, perfect; very dark.
	11½	Female ...	4½	4½	5	14	13+14 L.	1¾	Nearly ripe, solid, perfect; very dark.
	11¾	Female ...	4½	4½	4½	15	13+12 L.	1¾	Ripe, solid, perfect.
	11½	Female ...	4½	4½	4½	14	13+14 L.	1¾	Scarcely ripe, solid, perfect.

SMALL FORM—Continued.

Tag No.	Length.	Sex.	Head.	Depth.	Eye.	Anal rays.	Branchio- stegals.	Height of dor- sal in head.	Condition.
4	11	Male.....	4	4	5	15	12+13	1 $\frac{1}{2}$	C., A., D., V., P., and snout badly worn.
5	11	Female...	4 $\frac{1}{2}$	4 $\frac{1}{2}$	5	13	13+14	1 $\frac{1}{2}$	C. badly worn.
6	12	Male.....	3 $\frac{2}{3}$	3 $\frac{2}{3}$	5	13	14+14	2	C. and jaws badly worn.
7	11 $\frac{1}{2}$	Male.....	4	3 $\frac{2}{3}$	5	13	13+13 L.	2	C. and jaws slightly worn.
8	10 $\frac{1}{2}$	Female...	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	13	13+13	1 $\frac{1}{2}$	C. badly worn.
9	11 $\frac{1}{2}$	Male.....	3 $\frac{2}{3}$	4	5	14	13+14	1 $\frac{1}{2}$	C., A., D., and V. badly worn.
10	12	Male.....	3 $\frac{2}{3}$	3 $\frac{2}{3}$	5 $\frac{1}{2}$	14	14+14	2	C. slightly worn.
11	11 $\frac{1}{2}$	Female...	3 $\frac{2}{3}$	3 $\frac{2}{3}$	4 $\frac{1}{2}$	14	13+13	1 $\frac{1}{2}$	C. and jaws slightly worn.
12	11 $\frac{1}{2}$	Male.....	3 $\frac{2}{3}$	3 $\frac{1}{2}$	5 $\frac{1}{2}$	14	14+15	2 $\frac{1}{2}$	Perfect.
13	10 $\frac{1}{2}$	Female...	3 $\frac{2}{3}$	3 $\frac{2}{3}$	5	15	14+14	2	C. and V. badly worn.
14	11 $\frac{1}{2}$	Female...	4	4 $\frac{1}{2}$	4 $\frac{1}{2}$	14	14+14	1 $\frac{1}{2}$	C. slightly worn.
15	11	Female...	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	14	14+14	2	Perfect.
16	10 $\frac{1}{2}$	Female (?)	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	14	15+14	1 $\frac{1}{2}$	Do.
17	11 $\frac{1}{2}$	Female...	4	4 $\frac{1}{2}$	4 $\frac{1}{2}$	14	13+14	1 $\frac{1}{2}$	C. badly frayed.
18	11 $\frac{1}{2}$	Male.....	4	4	5	14	12+12	2	C. and D. frayed.
19	12 $\frac{1}{2}$	Female...	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	13	13+14	1 $\frac{1}{2}$	C. badly worn.
20	11 $\frac{1}{2}$	Female...	4	5	5 $\frac{1}{2}$	14	13+13	1 $\frac{1}{2}$	C. gone, A. worn.
21	10 $\frac{1}{2}$	Male.....	3 $\frac{2}{3}$	4	4 $\frac{1}{2}$	14	13+14	2	D. and C. badly frayed.
22	10 $\frac{1}{2}$	Female...	4	4 $\frac{1}{2}$	4 $\frac{1}{2}$	14	14+14	2	C. almost worn off.
48	11	Female...	4	4	4 $\frac{1}{2}$	15	14+13	1 $\frac{1}{2}$	Ripe, perfect.
49	11 $\frac{1}{2}$	Male.....	3 $\frac{2}{3}$	4 $\frac{1}{2}$	5 $\frac{1}{2}$	15	14+13	1 $\frac{1}{2}$	Do.
50	11 $\frac{1}{2}$	Female...	4	4	5	15	13+14 L.	1 $\frac{1}{2}$	Do.
51	12	Male.....	3 $\frac{2}{3}$	3 $\frac{2}{3}$	5 $\frac{1}{2}$	15	14+14 L.	2	Do.
52	11 $\frac{1}{2}$	Male.....	3 $\frac{2}{3}$	4 $\frac{1}{2}$	5 $\frac{1}{2}$	15	13+13 L.	1 $\frac{1}{2}$	C., D., V., worn, spent.
53	12	Male.....	3 $\frac{2}{3}$	4	5 $\frac{1}{2}$	15	13+13 L.	1 $\frac{1}{2}$	Ripe, perfect.
54	11 $\frac{1}{2}$	Male.....	3 $\frac{2}{3}$	4 $\frac{1}{2}$	5 $\frac{1}{2}$	15	13+13 L.	1 $\frac{1}{2}$	C., D., and V. worn, spent.
55	12	Male.....	4	4 $\frac{1}{2}$	5 $\frac{1}{2}$	14	14+14 L.	1 $\frac{1}{2}$	Perfect.
56	11 $\frac{1}{2}$	Male.....	3 $\frac{2}{3}$	3 $\frac{2}{3}$	4 $\frac{1}{2}$	14	14+15 L.	2	C. slightly worn, ripe.
57	11 $\frac{1}{2}$	Male.....	3 $\frac{2}{3}$	3 $\frac{2}{3}$	5	14	14+15 L.	2	Not ripe, perfect.
58	11 $\frac{1}{2}$	Female...	4 $\frac{1}{2}$	4 $\frac{1}{2}$	5	14	13+13	1 $\frac{1}{2}$	Ripe, perfect.
59	11 $\frac{1}{2}$	Male.....	4	4	5 $\frac{1}{2}$	14	13+14	2	Do.
60	11	Female...	4 $\frac{1}{2}$	4 $\frac{1}{2}$	5	14	13+14	1 $\frac{1}{2}$	Do.
61	12	Male.....	3 $\frac{2}{3}$	4	5 $\frac{1}{2}$	14	13+14 L.	1 $\frac{1}{2}$	Ripe, caudal slightly worn
62	11 $\frac{1}{2}$	Female...	4 $\frac{1}{2}$	4 $\frac{1}{2}$	5	14	14+14 L.	2	Ripe, perfect.
63	11 $\frac{1}{2}$	Male.....	4	4 $\frac{1}{2}$	5 $\frac{1}{2}$	14	14+13 L.	1 $\frac{1}{2}$	Do.
64	11 $\frac{1}{2}$	Male.....	4	4	5 $\frac{1}{2}$	15	13+13 L.	1 $\frac{1}{2}$	Do.
65	11 $\frac{1}{2}$	Female...	4 $\frac{2}{3}$	4 $\frac{1}{2}$	5	15	14+15 L.	1 $\frac{1}{2}$	Do.
66	11 $\frac{1}{2}$	Male.....	3 $\frac{2}{3}$	3 $\frac{2}{3}$	6	14	13+13 L.	1 $\frac{1}{2}$	Do.
67	12	Male.....	3 $\frac{2}{3}$	4 $\frac{1}{2}$	5 $\frac{1}{2}$	14	14+15	1 $\frac{1}{2}$	Do.
68	12	Male.....	4	4	5	14	13+13 L.	2	Ripe, perfect, opercular flap gone.
69	11 $\frac{1}{2}$	Male.....	4	4 $\frac{1}{2}$	5 $\frac{1}{2}$	14	13+14 L.	1 $\frac{1}{2}$	Ripe, perfect.
70	12 $\frac{1}{2}$	Female...	4 $\frac{2}{3}$	5	5 $\frac{1}{2}$	14	14+15	1 $\frac{1}{2}$	Do.
71	11 $\frac{1}{2}$	Female...	4 $\frac{1}{2}$	4 $\frac{1}{2}$	5	14	13+14	1 $\frac{1}{2}$	Do.
72	11 $\frac{1}{2}$	Male.....	4	4	5 $\frac{1}{2}$	14	14+13	2	Do.
73	11 $\frac{1}{2}$	Male.....	4	3 $\frac{2}{3}$	6	14	13+14	1 $\frac{1}{2}$	Do.
74	11 $\frac{1}{2}$	Female...	4 $\frac{1}{2}$	4 $\frac{1}{2}$	5	15	14+15	1 $\frac{1}{2}$	Do.
75	11 $\frac{1}{2}$	Male.....	3 $\frac{2}{3}$	3 $\frac{2}{3}$	5 $\frac{1}{2}$	15	13+13 L.	1 $\frac{1}{2}$	C. and D. worn slightly, spent.
76	10 $\frac{1}{2}$	Female...	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	14	13+13	1 $\frac{1}{2}$	C. frayed, ripe.
77	11 $\frac{1}{2}$	Female...	4 $\frac{1}{2}$	4 $\frac{1}{2}$	5	14	13+14	1 $\frac{1}{2}$	Ripe, perfect.
78	11 $\frac{1}{2}$	Female...	4	4 $\frac{1}{2}$	5	14	14+14	1 $\frac{1}{2}$	Do.
79	11 $\frac{1}{2}$	Female...	4	4	5	14	14+15	1 $\frac{1}{2}$	Spent, perfect.
80	11 $\frac{1}{2}$	Male.....	3 $\frac{2}{3}$	3 $\frac{2}{3}$	5 $\frac{1}{2}$	14	14+15 L.	2	C., D., V. frayed; jaws, snout, and back worn bare, spent.

SMALL FORM—Continued.

Tag No.	Length.	Sex.	Head.	Depth.	Eye.	Anal rays.	Branchio- stegals.	Height of dor- sal in head.	Condition.
81	10½	Female ...	4½	4¾	5	14	14+14 L.	1¾	C. and D. frayed, spent.
82	10½	Female ...	4½	5	4¾	15	13+14 L.	2	C. gone; A., D., V., and snout, and P. badly frayed.
83	10½	Female ...	4	5	5	14	13+14 L.	1¾	C. gone; A., D., V., and snout, and P. frayed.
84	10¾	Female ...	4	4	5	14	12+12 L.	1¾	C. slightly worn.
85	11	Female ...	4½	4¾	4¾	15	13+13 L.	1¾	Perfect.
86	12	Male.....	3¾	3¾	5¾	14	13+14 L.	2	Do.
87	11¾	Female ...	4	4¾	4¾	15	15+14 L.	2	Perfect, ripe.
88	11½	Female ...	4	4½	4½	14	14+15 L.	1¾	Do.
89	12	Male.....	4	4½	5	14	13+13 L.	1¾	Do.
90	11½	Male.....	3¾	4	4¾	15	14+14 L.	2	Do.
99	11½	Male.....	4	4	5	14	14+14 L.	2	Perfect, not ripe.
100	12½	Female ...	4½	4¾	5	14	14+15	1¾	Perfect, ripe.
111	11½	Female ...	4	4	5	14	14+14 L.	2	Do.
112	11½	Male.....	3¾	4	6½	14	15+15 L.	2	Perfect, not ripe.
185	11	Male.....	4	4½	4½	15	13+14 L.	2	Perfect; parasites on gills.
186	10¾	Male.....	4	4	4½	14	13+14	1¾	Do.
187	10¾	Male.....	4	3¾	4½	14	12+12	1¾	Do.
188	11½	Male.....	4¾	4¾	4¾	14	12+13 L.	1¾	Perfect, not ripe; parasites on gills.
189	11½	Female ...	4½	4½	4½	14	13+13 L.	1¾	Do.
190	10½	Male.....	4	4½	4½	14	13+14 L.	1¾	Perfect, ripe.
191	10¾	Male.....	4	4	5	14	13+14 L.	1¾	Do.
192	11½	Male.....	4½	4	5	15	12+13 L.	1¾	Perfect, not ripe.
193	11½	Male.....	4	4	5	15	13+13 L.	1¾	Do.
194	11½	Male.....	4	4	5	15	13+13 L.	1¾	Perfect, not ripe; parasites on gills.
220	11¾	Male.....	4	3¾	5	14	14+14	1¾	Perfect, ripe.
221	11½	Male.....	4	4	5	14	12+12	1¾	Do.
222	11¾	Female ...	4¾	4½	4¾	14	13+13	1¾	Do.
223	12	Male.....	3¾	3¾	5¾	14	13+12	1¾	Do.
224	11¾	Male.....	4	4	5	14	13+13	2	Do.
225	11¾	Male.....	3¾	4	5	14	13+13	2	C. and D. slightly worn, ripe.
226	11½	Male.....	3¾	3¾	5	14	12+13	1¾	Perfect, ripe.
227	12	Male.....	4	4	5	14	13+14	1¾	Do.
228	12	Male.....	3¾	4	5	14	13+13	1¾	Do.
229	12	Female ...	4½	4½	4¾	14	13+13	2	Do.
230	11½	Female ...	4½	4½	4¾	15	12+13	1¾	Do.
231	11½	Male.....	3¾	3¾	5	14	13+13	1¾	Do.
232	11¾	Male.....	3¾	3¾	5	14	14+14	2	Do.
233	11½	Female ...	4½	4½	4½	14	13+14	1¾	Do.
234	11½	Male.....	3¾	3¾	5	14	13+14	1¾	Do.
235	12	Male.....	4	4	5	14	12+13	1¾	Do.
236	11¾	Male.....	3¾	3¾	5	14	14+14	2	Do.
237	11½	Male.....	3¾	3¾	5	15	13+13	1¾	Do.
238	12	Male.....	3¾	3¾	5½	14	14+14	2	Perfect.
239	11½	Male.....	3¾	3¾	5½	15	13+14	2	Do.
240	11¾	Female ...	4½	4¾	4¾	14	14+13	1¾	Do.
241	11	Female ...	4½	4½	4¾	14	12+12	1¾	Perfect, ripe.
242	11½	Female ...	4	4	4¾	14	14+13	1¾	Do.
243	11½	Male.....	4	4	4¾	14	13+14	1¾	Do.
244	11	Male.....	4	4	4½	14	13+14	1¾	Do.
245	11½	Male.....	4	4½	5	14	13+13	1¾	Perfect.
246	11½	Female ...	4	4	4¾	14	13+13	1¾	Do.

In the following table are shown the average comparative measurements of the 125 specimens of redfish, the individual measurements of which are given in the two preceding tables.

	Small form, 117 speci- mens (69 males, 48 females.)	Large form, 8 speci- mens (6 males, 2 females).
Length	11.46	22.81
Head	3.991	3.80
Depth	4.13	4.52
Eye	4.97	6.994
Anal rays	14.13	14.12
Branchiostegals:		
Right	13.26	13.44
Left	13.61	13.55
Height of dorsal in head	1.85	2.16

7. *The young redfish.*

Not until this year have the young redfish ever been seen in the Columbia River basin by any naturalist. On July 20 Messrs. Meek and Scofield did some seining in the outlet close to Alturas Lake in shallow water and found young redfish in considerable numbers. The collections made that day contain 124 young redfish, varying in length from 1 $\frac{1}{10}$ to 2 $\frac{3}{8}$ inches and averaging 1 $\frac{1}{8}$ inches.

The total length of each of these 124 is given in the following table. The last seven were taken at the head of the lake, near the inlet.

Table giving lengths, in inches, of 124 young redfish taken at Alturas Lake July 20, 1894.

Length.	Length.	Length.	Length.	Length.	Length.	Length.	Length.	Length.	Length.	Length.	Length.
2 $\frac{3}{8}$	2	2	1 $\frac{7}{8}$	2 $\frac{7}{10}$	1 $\frac{3}{4}$	2 $\frac{7}{10}$	1 $\frac{3}{4}$	2	2	2 $\frac{1}{4}$	2 $\frac{1}{4}$
1 $\frac{1}{2}$	1 $\frac{3}{8}$	2 $\frac{1}{2}$	2	1 $\frac{5}{8}$	1 $\frac{3}{8}$	1 $\frac{1}{2}$	2	1 $\frac{3}{4}$	2 $\frac{1}{2}$	1 $\frac{1}{4}$	2 $\frac{1}{8}$
2 $\frac{1}{8}$	1 $\frac{1}{8}$	2	2 $\frac{3}{8}$	2	1 $\frac{1}{2}$	2 $\frac{1}{4}$	2	1 $\frac{1}{4}$	1 $\frac{7}{8}$	1 $\frac{7}{8}$	1 $\frac{7}{8}$
2	2	2 $\frac{5}{10}$	2	1 $\frac{7}{8}$	1 $\frac{3}{8}$	1 $\frac{3}{4}$	2 $\frac{3}{8}$	2	1 $\frac{7}{8}$	1 $\frac{7}{8}$	1 $\frac{7}{8}$
1 $\frac{7}{10}$	1 $\frac{7}{8}$	2	1 $\frac{3}{4}$	1 $\frac{3}{8}$	1 $\frac{9}{10}$	2 $\frac{3}{8}$	2 $\frac{1}{2}$	2 $\frac{7}{10}$	2 $\frac{1}{2}$	1 $\frac{3}{4}$	1 $\frac{3}{4}$
2 $\frac{7}{10}$	1 $\frac{1}{2}$	2	2 $\frac{1}{2}$	1 $\frac{3}{4}$	1 $\frac{5}{8}$	2 $\frac{1}{2}$	2	2 $\frac{1}{4}$	2	1 $\frac{7}{8}$	1 $\frac{7}{8}$
2 $\frac{1}{4}$	2 $\frac{1}{2}$	2 $\frac{1}{4}$	1 $\frac{1}{2}$	2	1 $\frac{1}{2}$	2 $\frac{3}{8}$	1 $\frac{3}{4}$	2	2	2	2
2 $\frac{3}{8}$	1 $\frac{7}{8}$	2	2 $\frac{7}{10}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	2 $\frac{1}{4}$	2	2	2	1 $\frac{3}{4}$	1 $\frac{3}{4}$
2 $\frac{3}{8}$	2	1 $\frac{7}{8}$	1 $\frac{3}{4}$	1 $\frac{1}{2}$	2	1 $\frac{7}{8}$	2	1 $\frac{3}{4}$	2	1 $\frac{7}{8}$	1 $\frac{7}{8}$
1 $\frac{7}{10}$	2	2 $\frac{1}{4}$	2 $\frac{1}{2}$	1 $\frac{3}{4}$	2 $\frac{1}{2}$	2 $\frac{1}{4}$	2 $\frac{1}{2}$	2	2	1 $\frac{7}{10}$	1 $\frac{7}{10}$
1 $\frac{1}{8}$	2 $\frac{7}{10}$	1 $\frac{3}{4}$	2 $\frac{7}{10}$	1 $\frac{3}{4}$	1 $\frac{1}{2}$	2	1 $\frac{1}{8}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	2 $\frac{1}{2}$

On September 9 we made two hauls with a large seine in Alturas Lake near the inlet. The seine was weighted so that it would sink to the bottom and it was then hauled in water 15 to 60 feet deep, where the bottom was of fine white sand covered in most places with a heavy growth of *Myriophyllum*, *Chara*, etc. Young fish were found to be very abundant among the vegetation, the species taken being, in order of abundance, *Leuciscus balteatus*, *Catostomus macrocheilus*, *Coregonus williamsoni*, *Ptychocheilus oregonensis*, *Oncorhynchus nerka*, *O. tshawytscha*, *Salmo mykiss*, and *Cottus bairdi punctulatus*.

The total number of young redfish taken was 45, the total lengths and comparative measurements of which are given in the appended table. The smallest of these 45 fish measure 2 $\frac{3}{8}$ inches long, the largest 4 $\frac{1}{4}$ inches, and the average was 3 $\frac{5}{8}$ inches.

Total lengths in inches and comparative measurements of 45 young redfish taken in Alturas Lake September 9, 1895.

Length.	Head.	Depth.	Snout.	Eye.	Length.	Head.	Depth.	Snout.	Eye.
2 $\frac{3}{8}$	4 $\frac{1}{8}$	4 $\frac{1}{8}$	4 $\frac{1}{8}$	3 $\frac{3}{8}$	2 $\frac{7}{8}$	4 $\frac{1}{4}$	4 $\frac{1}{2}$	16	3 $\frac{1}{2}$
4	4 $\frac{1}{4}$	4 $\frac{3}{8}$	4 $\frac{3}{8}$	4	3 $\frac{1}{8}$	4 $\frac{1}{2}$	4 $\frac{3}{8}$	4 $\frac{1}{2}$	3 $\frac{3}{8}$
3 $\frac{7}{8}$	4 $\frac{1}{2}$	4 $\frac{3}{8}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$	3 $\frac{1}{4}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	5	3 $\frac{1}{2}$
4 $\frac{3}{8}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{3}{8}$	3 $\frac{1}{2}$	3 $\frac{3}{8}$	4	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{3}{8}$
3	4 $\frac{1}{2}$	4 $\frac{3}{8}$	4 $\frac{1}{2}$	3	3	4 $\frac{1}{2}$	4 $\frac{3}{8}$	5	3+
3 $\frac{3}{8}$	4 $\frac{1}{2}$	4 $\frac{3}{8}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$	3 $\frac{3}{8}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	5	3 $\frac{1}{2}$
3 $\frac{1}{2}$	4 $\frac{3}{8}$	4 $\frac{3}{8}$	4 $\frac{3}{8}$	3 $\frac{1}{2}$	3 $\frac{3}{8}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$
4 $\frac{1}{4}$	4 $\frac{1}{2}$	5 $\frac{1}{8}$	4	3 $\frac{3}{8}$	3 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{3}{8}$
3 $\frac{7}{8}$	4 $\frac{1}{2}$	5 $\frac{1}{8}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$	3 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{3}{8}$
3	4	4 $\frac{1}{2}$	4	3 $\frac{1}{4}$	2 $\frac{3}{8}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3
3 $\frac{1}{4}$	4 $\frac{3}{8}$	5	5	3 $\frac{1}{2}$	3 $\frac{1}{4}$	4	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$
3 $\frac{7}{8}$	4 $\frac{1}{2}$	4 $\frac{3}{8}$	4 $\frac{1}{2}$	3 $\frac{1}{4}$	3 $\frac{3}{8}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$
3 $\frac{1}{2}$	4	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$	3 $\frac{1}{4}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$
3 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$	3 $\frac{3}{8}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4+	3+
3 $\frac{3}{8}$	4 $\frac{1}{2}$	4 $\frac{3}{8}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$	3	4 $\frac{1}{2}$	5	4	3 $\frac{1}{2}$
3	4+	4 $\frac{3}{8}$	5	3	3	4+	4 $\frac{3}{8}$	4	3 $\frac{1}{2}$
3 $\frac{1}{2}$	4 $\frac{1}{4}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$	3	4	5	4 $\frac{1}{2}$	3
3 $\frac{3}{8}$	4	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$	3 $\frac{3}{8}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$
3	4	4 $\frac{3}{8}$	4 $\frac{1}{2}$	3	3	4 $\frac{1}{2}$	5	4 $\frac{1}{2}$	3
3 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$	3 $\frac{1}{4}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$
3 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$	3 $\frac{1}{4}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4	3 $\frac{1}{2}$
3 $\frac{3}{8}$	4 $\frac{1}{2}$	4 $\frac{3}{8}$	4	3 $\frac{1}{4}$	2 $\frac{3}{8}$	4	4 $\frac{3}{8}$	4 $\frac{1}{2}$	3
2 $\frac{7}{8}$	4	5	4 $\frac{1}{2}$	3					

¹ Deformed.

On September 12 the seine was again hauled in the same place and 4 young redfish were caught. They measured 3 $\frac{1}{16}$, 3 $\frac{1}{4}$, 2 $\frac{3}{8}$, and 2 $\frac{1}{8}$ inches, respectively. The difference in size between those taken July 20 and September 9 and 12 is very noticeable, and throws light upon their rate of growth.

These young redfish at first sight might easily be mistaken for young trout or young chinook salmon. They can best be distinguished from young trout by the larger number of anal rays (13 to 16 in the redfish, 9 to 12 in the trout), the more slender body, and the paler coloration. From young chinook salmon they may be known by the more slender body, paler coloration, shape of the anal fin (which is not falcate, as it is in the young chinook salmon), and by the increased number and greater length of the gillrakers (about 37 gillrakers in the redfish and only about 23 in the chinook salmon).

The young redfish 1 $\frac{1}{2}$ inches long has the following coloration: Back pale, with bluish tinge and 25 to 30 rather large bluish-black spots, some of which are oblong and reach to or even cross the lateral line; median dorsal line dark; head dusted with dark points; lower half of side and belly plain silvery white; fins nearly plain yellowish white, unspotted. A specimen 3 inches long, taken September 12, has the same general coloration, but the back is bluer and the spots have become large, oblong, vertical bluish bars, about 12 or 15 in number, 9 or 10 extending across the lateral line; the lower sides and belly yellowish silvery.

8. Periodicity in the run of the blueback salmon.

The statistics of the fisheries of the lower Columbia, as well as other observations, show that the run of this species is large in the even years and small in the odd ones. The origin or meaning of this periodicity has never received an explanation. Indeed, I do not know that the phenomenon has ever received the attention of any naturalist further than merely to note the fact. The fact is one of great interest, changing as it does the character of the fishery every two years, and the search for its explanation opens up a most attractive and promising field for investigation. We know too little about the migrations of this fish, particularly of its movements up and down the coast, to warrant us in holding any decided views as to the origin of this interesting habit, if habit it may be called. An examination of the fisheries in other streams in which this species spawns may throw some light upon

the question. The statistics of the catch of blueback salmon in the Fraser River, as furnished by the Canadian Department of Marine and Fisheries, show a periodicity in the run in that river. Whether there is any connection between the runs in these two rivers, whether a large run in the one is at the expense of that in the other, is improbable, but well worth investigation.

Another explanation suggests itself: It is possible that at some time, years ago, a catastrophe of some kind or other may have occurred in the headwaters of the Columbia which resulted in the destruction of practically all the fish and spawna in the river at that time. Then, upon the supposition that this species reaches maturity in two years (which is wholly improbable), and that it spawns only once (which our observations proved), there would be few if any fish to come to the spawning-grounds the second year after the catastrophe; and this break would be self-perpetuating, and thus would the light run on alternate years be accounted for.

The principal, and I think fatal, weakness in the hypothesis is the supposition that this salmon spawns at 2 years of age. Our observations at Alturas Lake indicate that the young remain near where they were hatched for about one year, and that at 1 year old they are only about 6 inches long. To go down to the sea, grow to a length of 2 feet or more and a weight of 5 to 7 pounds, and then return to the spawning-beds, would at the lowest possible calculation require at least two years more.

Each of these hypotheses appears very improbable and unsatisfactory. The solution must wait for additional knowledge concerning the life-history of the species.

16. *Salmo mykiss* Walbaum. *Columbia River Trout*; *Cut-throat Trout*; *Black-spotted Trout*.

Black-spotted trout are abundant in all suitable waters in Idaho. Our collections of 1894 and 1895 contain numerous specimens, representing the following localities: Snake River at Upper Salmon Falls; Mann Creek 10 miles from Weiser; Little Weiser River at Indian Valley; Payette River and Big Payette Lake; Big Wood River near Galena; Beaver Creek, Alturas Lake, Alturas Creek, Meadow Creek, Warm Springs Creek, and Salmon River near Sawtooth, and Fish Lake near Redfish Lake. A study of these specimens has not led to any satisfactory conclusion as to what varieties, if any, should be admitted.

The specimens from Upper Salmon Falls and Mann Creek have the small scales and the red throat of subspecies *clarkii*, as defined by Jordan & Evermann. The numerous examples from Payette River and Big Payette Lake are less spotted, and have little, if any, red upon the throat. Two specimens caught in Big Payette Lake September 27, 1894, had the following colors: A male, 15 inches long—spots small, half circles, few below middle of side; rosy wash on side and opercles; scarcely any red on throat; belly silvery, back dark-greenish; scales about 145, gillrakers 10+10, branchiostegals 11, anal 12; stomach empty, except three pine seeds. A female, 14½ inches long, had the spots the same as in the male, the sides less rosy, and scarcely any red on throat; scales about 140, gillrakers 7+12, branchiostegals 11, anal 11; stomach filled with small crustaceans.

Two other examples taken in the same lake September 27 possessed essentially the same color markings, as do also the specimens sent in by Mr. Williams. These are certainly the variety *gibbsii*, and are locally known as the silver trout. They are abundant in Big Payette Lake. On the morning of September 27, while sailing from the foot to the head of this lake, trout could be seen jumping in various places; one or more could be seen at any time, while usually 5 to 15 or 20 could be seen jumping out of the water and glittering in the morning sun. They are said to spawn at this lake in June, running up the smaller streams for that purpose.

Trout are very abundant in the upper part of Big Wood River, and the collections contain several specimens from the vicinity of Galena. A fine specimen, a female 14 inches long, taken with the fly by Mr. Barnum in this stream September 24, had the following life colors: Back, dark steel color, thickly covered with small round black spots; middle of side and cheek with a broad wash of rosy red; lower parts silvery; black spots very numerous on back and on dorsal and anal fins, less thick below lateral line; no red on throat. Other examples from the same stream were examined and found to agree with the one just described in the abundance of spots, the rosy sides, and the almost entire absence of red on the throat.

These Wood River trout seem, therefore, closest to variety *gibbsii*.

Young trout were found to be abundant in the Redfish Lakes, while in the streams of the Upper Salmon Valley trout ranging from one-fourth of a pound up to 2 or 3 pounds were very plentiful. Among the streams that afforded particularly good trout fishing were Beaver, Smiley, Pole, and Alturas creeks and Salmon River. During our stay the best fishing was in July, but in the smaller streams

and certain small lakes it continued good throughout the season. Very large catches were made in the small creeks in July, August, and October, but in Alturas Creek and Salmon River July seemed the best time.

Near Redfish Lake is a small lake known as Fish Lake. Its area is perhaps not greater than 25 acres. It is nearly circular in form and is at an elevation of about 9,000 feet. It appears to be quite shallow and is bordered on three sides by marshy or boggy ground. In this little lake trout were exceedingly abundant. On August 22, 100 were caught by Mr. Comstock, of Hailey, and the next day I caught 45 trout from the same lake in less than an hour's time; used Royal Coachman for nearly all, though a few were taken with grasshopper. They bit vigorously and were very gamy.

These trout were remarkably uniform in size, the total length varying only from 8 to 9½ inches, the majority being 9 to 9¼ inches. The weight varied but little from one-fourth of a pound each. In life they presented the following colors: Throat rich rosy red in every case; opercles light rosy; lower part of sides and belly, except median line, rich wine color or dark rosy; middle of side with about 6 to 8 large dark rosy blotches forming an irregular band along the side; whole posterior part of body, dorsal and caudal fins thickly covered with large, more or less stellate, black spots; spots on anterior part of body and on head less numerous. Some examples with a yellowish shade on side; others were very dark, the spots on the posterior half of the body being very close-set.

The trout caught in Salmon River and Alturas Creek agree with those from Fish Lake in the red throat and rosy sides, but are larger, deeper fish, and not so profusely spotted. Those caught in Beaver and Smiley creeks were all small, averaging only 4½ to 5 inches in length. They were usually pretty well spotted, but showed no red on the throat and but little on side. These appear to be mature fish and are said to spawn in July—Mr. Parks thinks between July 15 and August 15, and that they will not bite well after September 1.

In Meadow Creek and the sloughs along Salmon River young trout 1½ to 2¼ inches long were very abundant. In Meadow Creek they were associated with young chinook salmon and young whitefish, but along Salmon River they were about the only fish found. In Alturas Lake a few were found with the young redfish, whitefish, and chinooks, but we are not sure that we ever saw any trout, young or adult, in the inlets to any of these lakes. From young salmon or redfish the young trout may most easily be known by its smaller anal fin, which has only 9 to 12 rays, while in the other species there are 13 to 16.

17. *Salmo gairdneri* Richardson. *Salmon Trout; Steelhead Trout.*

As shown in the former report, the salmon trout is an important fish in Idaho. The investigations of 1895 added nothing to the information obtained in 1894 and given in that report. In order to study the spawning habits of this fish in the headwaters of Salmon River it will be necessary to be on the ground by the last of April and remain until some time in June. It is not improbable that some of the very small trout which we obtained were really the young of this species. I know of no certain way by which to distinguish the young of the steelhead from young *Salmo mykiss*.

18. *Salvelinus malma* (Walbaum). *Bull Trout; Dolly Varden Trout.*

The bull trout was seen by us in Salmon River and Alturas and Pettit lakes, inlets and outlets. It was not seen in Yellowbelly, Redfish, or Big Payette Lake, but it is said to occur in all those waters. Not until these investigations was the Dolly Varden or bull trout known to occur in the Snake River basin, and it is not yet known from any point above the Great Shoshone Falls. In Salmon River and Alturas Creek it seemed to be quite common during July and August, and could be readily taken on the hook with almost any kind of bait. Salmon spawn tied up in pink mosquito bar, grasshoppers, and fish liver were excellent bait. It would sometimes take the fly and always proved a vigorous fighter. In these waters this species attains a weight of 3 or 4 pounds. Its spawning season is in August and September.

This is the only fish, excepting young salmon, which we saw in Alturas Inlet with the spawning redfish. On September 8 a large male bull trout, 22 inches long and weighing 3 pounds, was found in Alturas Inlet near the mouth. This was a spent fish and seemed in good condition except that the upper caudal lobe was gone, apparently bitten off by some animal. The spots on sides were very bright red, and the belly as high up as the pectorals was a beautiful rosy red; the anal, ventrals, and pectorals margined with white, that on the pectoral inclining to yellowish.

19. *Uranidea bendirei* (Bean).

The only place where this species was found was in Goose Creek, near Meadows, Idaho. Goose Creek is a small tributary of Little Salmon River, which flows into Salmon River about 35 miles north of Meadows. The specimens are 6 in number, and were obtained by Mr. Williams July 18. The largest are about 3 inches long. They differ from *C. rhotheus* in having the ventrals 1, 3 (1, 4 in *rhotheus*), in the absence of prickles, as well as in other respects. Our specimens agree well with the type which was obtained by Major (then Captain) Bendire in Rattlesnake Creek, near Camp Harney, Oreg., May 2, 1878. This is the second locality from which this species has been recorded.

20. *Cottus rhotheus* (Rosa Smith).

This species of blob was obtained at the following places: Small creek at Snow's in Indian Valley, September 24, 1894, 4 specimens; Meadow Creek near Sawtooth, July 28 and 30, 23 specimens; Alturas Lake, July 20, 2 specimens; August 9, 2 specimens, and September 10 and 12, 4 specimens; Pettit Lake Outlet, July 22 and August 14, 3 specimens; Payette River near Payette Lake, August 18, 3 specimens; Redfish Lake, August 22, 1 specimen. This seems to be the only blob in the Sawtooth region, and is not very common, the specimens mentioned above, 35 in number, being all we were able to obtain without special effort during the season's work.

They appear to be about equally common in the lakes and the streams. The largest examples obtained are 3 inches in length. As among the other species of this genus, there is much variation in color among these specimens, but the general pattern agrees fairly well with that assigned the original types. The prickles on the anterior part of the body are well developed, and in most cases they extend well onto the caudal peduncle. The dorsal fins are connected in some specimens, while in others they are separate.

This species was obtained by Dr. Eigenmann in 1892 in Snake River at Idaho Falls, and by Gilbert & Evermann in 1893 in Cœur d'Alene Lake near Cœur d'Alene, Idaho, and in Clearwater River near Lewiston, Idaho.

The following table exhibits the variation in fin rays as shown by 28 specimens:

Locality.	Dorsal spines.		Dorsal rays.		Anal rays.				Number of specimens examined.
	VII.	VIII.	16.	17.	11.	12.	13.	14.	
Pettit Lake, outlet	1	2	3	.....	.....	3	.....	.....	3
Meadow Creek, near mouth, Sawtooth, Idaho..	1	9	4	6	.....	5	4	1	10
Alturas Lake, Sawtooth, Idaho	2	6	6	2	2	4	2	.....	8
Indian Valley, Idaho.....	1	3	4	.....	.....	2	2	.....	4
Payette River, Lardo, Idaho	3	.....	2	1	.....	3	.....	.....	3

21. *Cottus leiopomus* Gilbert & Evermann.

This species of blob was described in 1894 (Bull. U. S. Fish Commission for 1894, 203, pl. 20, fig. 2) from 2 specimens obtained by Mr. H. H. Kinsey from Upper Little Wood River near Shoshone. No additional specimens have been collected.

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