D. A. MacLulich

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AT SYRACUSE UNIVERSITY

FRANKLIN MOON, *Dean*

Roosevelt Wild Life Bulletin

VOLUME 5 NUMBER 2

OF THE

Roosevelt Wild Life Forest Experiment Station

THE FISHES OF THE CRANBERRY LAKE REGION

THE STORY OF KING'S POND

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D. A. MacLulich

THE FISHES OF THE CRANBERRY LAKE REGION

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PART I. AN INVESTIGATION OF THE BROOK TROUT SITUATION IN CRANBERRY LAKE, NEW YORK, AND ITS TRIBUTARY STREAMS.

INTRODUCTION

Cranberry Lake and its tributary waters have long been famous for the trout fishing they afforded. The lake itself is said always to have been noted for the large size attained by the indigenous trout (*Salvelinus fontinalis*), and the tributary streams and outlying ponds for the abundance of this species.

In late years deterioration of the fishing became so marked that many persons interested in the region recognized the necessity of taking steps to improve conditions by some means in addition to that of planting young fish.

The prevailing sentiment appears to be that the most important measure to that end would be the closing permanently all of the streams flowing into the lake, excepting only the main inlet, the Oswegatchie River. It seems, however, that the brooks had previously been closed for a number of years, but the desired improvement of conditions had not resulted, as is indicated by the following letter, dated September 20, 1915, which was written by Judge Vann to Secretary Houghton of the New York State Conservation Commission:

"I regret that circumstances prevented me from attending the meeting called by you at Wanakena to consider the petition of various persons interested in Cranberry Lake asking for further and additional protection for brook trout in the waters of that lake and its tributaries.

"I have fished in the waters of Cranberry Lake nearly every year for almost forty years and have had an opportunity to observe the

changes that have taken place with reference to brook trout. When I first went there the fishing was almost virgin and about the same as it is now in the unfrequented parts of Canada. But few people visited the lake, and while some of them caught enormous quantities of brook trout, smoked and salted them and took them out for sale, still the means of access were so poor that no perceptible diminution in the catches of trout could be perceived for nearly ten years. By that time the roads and means of access had become better, a hotel had sprung up accommodating thirty or forty persons, and people came in with tents, so that sometimes there would be as many as thirty people or more fishing at one time, that is, at the spring holes in the lake, up the inlet and below the dam. There was no stream fishing, however, of any amount and night fishing was unheard of. Fifteen or twenty years ago people began to fish the streams because the catches at the spring holes had become much reduced. This led after a time to regulation by the town board which prohibited stream fishing for a series of years and that regulation was continued, the last five years having expired on the first of January last. From five to ten years ago night fishing began on a perceptible scale. The large trout during warm weather are in the habit of coming up into the shallow water of the streams and following the channel where the water is cold at the bottom, reach a point where it is only about two feet deep. They take the fly eagerly in the night time and can be captured in large quantities by experienced men. All this kind of fishing is done substantially by the guides, although they are frequently accompanied by sportsmen in whose employ they are. There is no sport in it, for the fisherman cannot see the fish bite, cannot see him play, and he uses tackle that enables him to pull the fish in by main force almost as soon as he is hooked. It results in meat, not fishing. I think the testimony of all who engage in it, guides and all, is that there is no fun in it. The result is a large number of fish are captured each year ranging from one to four pounds simply for the sake of getting the fish, without any sport.

"Stream fishing and night fishing have brought the catches in Cranberry Lake down to a low ebb. The most skillful fishermen report small catches except on special occasions, when circumstances are particularly favorable. In my judgment brook trout in Cranberry Lake will be substantially exterminated in a very short time unless both of these methods of taking fish are prohibited. The streams are the great breeding places of the trout, where they are hatched and grow to a catchable size, and gradually work themselves

down into the lake. They are very easily caught with worm bait in the streams, even by the most unskilled fishermen. Taking them in the streams cuts off the great source of supply and if persisted in must result in substantial extinction.

"There are now twenty fishermen visiting the lake to one twenty years ago, because two railroads make access very easy and a half a dozen hotels or more furnish entertainment to all who come, except those who own cottages, nearly a hundred in all, who of course, entertain themselves. All experienced and thoughtful men who have watched the lake for many years past realize that the great increase in the number of fishermen, the fishing of the tributary streams and the night fishing are rapidly depleting Cranberry Lake of brook trout. I regard further regulations as imperatively necessary. I do not ask it for myself particularly, for I am an old man and cannot fish much longer, but for the coming generation I urge the Conservation Department to furnish further protection of the kind mentioned in the petition. Public sentiment, represented by those who live the year round at Cranberry Lake, by those who have cottages and live there a part of the year, and by the occasional visitors, many in number, is in favor of the proposed extension of protection. I have conversed with many of all classes upon the subject and I have yet to meet a man who was opposed to the proposition, although I have heard of two, neither of any particular influence or standing, who were opposed to one of the measures but not to both. I regard both as important, but the prohibition of fishing in the streams as the most important."

In 1922, Commissioner Alexander Macdonald requested the Roosevelt Wild Life Forest Experiment Station to cooperate with the New York State Conservation Commission in a study of the affluents of Cranberry Lake, with the view of determining the necessity or advisability of closing those streams to fishing.*

In 1923, the latter half of May and the month of June were devoted to as complete a survey as the time would allow of the entire system comprising the Oswegatchie River below the "deadwater", and of all the streams entering the lake, as well as of some of the more remote headwaters.

Later during the first half of November, 1924, and the last half of October, 1925, further studies were made, particular attention

* A preliminary report of this Survey was submitted to Commissioner Macdonald early in the spring of 1924. The following year, in accordance with our recommendations, the tributary streams of Cranberry Lake, except the Oswegatchie River, were closed to fishing.

then being given to the spawning activities of the brook trout of this region.

CRANBERRY LAKE

At the present time Cranberry Lake is a body of water of very irregular outline. This condition resulted from the raising of its level, years ago, by the dam at the outlet. This greatly enlarged its area and overflowed the low land bordering the lower courses of some of the streams flowing into the lake, making bay-like arms which are locally called flows. Each of these flows now takes its name from that of the principal affluent, as for instance, Brandy Brook Flow. Certain places in some of these flows afford the principal summer fishing in the lake.

The lake appears originally to have been a shallow expansion of the Oswegatchie River, which, joined by Dead Creek, flowed in a northeasterly direction to where it formed the expansion, thence northward to what is now Cranberry Lake Station. The distance from Wanakena, at the head of Oswegatchie Flow, to Cranberry Lake Station is about eight and a half miles. The distance from the head of Dead Creek Flow to the station is about the same. From "South Creek Flow" (Six Mile Creek), at the south end of the lake, it is approximately five and three-quarter miles, and from the head of the adjoining Chair Rock Flow it is about six miles to Cranberry Lake Station. Directly east and west from the head of East Inlet Flow the distance across is a little over four miles. Between these two flows is a point of land which is called Indian Mountain Point. From this point to Union Point, almost directly north, the distance is about two and three-fifths miles. This last mentioned distance represents the north to south diameter of the lake. The east and west diameter of the principal expansion of the lake is a little more than four miles.

There are a number of islands, the largest of which is Joe Indian which is close to seven-tenths of a mile long, east and west, and situated near where the Oswegatchie Flow joins the principal expansion. Buck Island, the next in size, is a little over one-half mile north of Indian Mountain Point and about three-fourths of a mile southwest of Joe Indian Island. From the head of Brandy Brook Flow at the mouth of Brandy Brook to the western end of Joe Indian Island the distance is about three and one-fourth miles. But there is another arm of the flow entering from the north, about one mile long, which makes the length of the entire flow somewhat greater than its distance from the mouth of Brandy Brook.

The flows mentioned still contain numerous standing dead trunks of trees, and upturned roots, greatly marring the beauty of the shores (see Fig. 88). In some of the flows there is an abundance of aquatic vegetation and in others scarcely any, except in protected coves.

The lake is rather shallow, the deepest water, according to report, being of limited area and not exceeding 90 feet in depth.

TRIBUTARY STREAMS AND ADJACENT WATERS

The affluent streams of Cranberry Lake vary in size from mere rivulets to creeks or brooks several miles in length, some of which are very tortuous and some have ponds of various sizes at their headwaters. All have been greatly changed from their original condition, principally by lumbering operations. A brief description of each follows:

Oswegatchie River (Inlet). The headwaters of the Oswegatchie lie in Hamilton and Herkimer counties, within which many branches join the main stream before it crosses the boundary line of Herkimer and St. Lawrence counties. High Falls (Figs. 63 and 64) is not much over half a mile in a straight line from the boundary. This water-fall is an impassable obstruction to further upstream movement of trout. Some two miles or more farther upstream is a beaver dam which is said to obstruct movements of trout in both directions. From High Falls down to within two and a half miles of Wanakena the stream flows through bogs and meadows, and is navigable by canoe nearly to the Little Falls (Fig. 67), at the head of the rapids just above Wanakena, some 17 or 18 miles.

Below High Falls are numerous tributary streams of various sizes, in some of which trout are said to abound. The largest is Wolf Pond outlet, the greater part of which lies in a rugged valley in Herkimer County.

Large trout are said to ascend the Oswegatchie to High Falls. Between High Falls and the beaver dam the trout are resident and smaller. Above the beaver dam they are still smaller. At the time of our visit in September, 1922, the river was very low, a condition which enabled us easily to ascertain the general character of the bottom. The water was, however, fairly swift. All along "the rapids" from Wanakena and upstream some distance (Fig. 68) the bed is composed of granitic boulders, mostly of small size, and rocks, but scarcely any gravel or sand, affording therefore no spawning places for any considerable number of trout. Farther upstream the boulders are larger and more numerous, but nowhere were there

any pools sufficiently deep for large trout, except just below Little Falls (Fig. 67). Above Little Falls, at various places along the stream, bed-rock bottom is exposed; thereupon the bottom is composed of smaller rocks of gradually decreasing size, until it consists largely of sand by the time it reaches a slight dip a quarter of a mile or so below the deadwater. Here the water pours over the dip into a large pool. Excepting the two small trout taken near Wanakena, the only trout taken by us in this stream were caught at this point. Several small fish and one about 10 inches long composed the catch.

A trip by canoe was made for about four miles up the deadwater from Inlet House.

The banks of the stream are abrupt but low in most places, with alders growing more or less horizontally in the stream. Some distance upstream, the banks are locally higher, with a few large trees, such as spruce, balsam, and an occasional pine. Some distance back from the immediate banks, in the meadow, are growths of small tamaracks. Aside from alder patches and occasional trees, the banks are overgrown with sedge (cut grass) and blue joint grass in places.

The deadwater averages perhaps 30 feet in width, with some wider and some narrower places (even as narrow as 15 feet).

Quite a number of "deep holes" were observed which were pointed out by Mr. George Sternberg as good fishing places. But there was one place said to be 20 feet deep, from which no fish was ever known to have been taken.

The bottom in the stretch of the deadwater is composed mostly of sand, with areas of floating sedge and a very little pond weed.

There are occasional short rapids along the course of the deadwater and presumably it is in these places that trout spawn, since the shifting sand of the bottom elsewhere would hardly appear favorable.

The "flow" of the Oswegatchie is several miles long and has eliminated any quickwater that may previously have existed as far upstream as Wanakena.

According to an old inhabitant ("Uncle Steve" Ward), at a narrow part of this flow, before the lake was raised, there was a short stretch of quickwater and a pool where trout used to spawn, and a great many large fish were caught there.

Skate Creek. This is a small stream rising a couple of miles or so south of Wanakena and flowing into an old mill pond on the opposite side of the river from this village. For the most part the creek lies in a low, flat, narrow valley and the lower portion runs

through tangles of alders and other bushes. It is nowhere of satisfactory appearance as a trout stream, although it is generously supplied with spring water. Some small trout occurred throughout its length, at least wherever we examined it. On June 4, near its upper end, above the corduroy road which crosses it, somewhat more than a mile from the mill pond, it was found to be merely a sluggish rivulet. Here it flows or lies in a semi-bog, partly dry and partly wet. The stream is so narrow that one may easily step across the widest places. Here the brook actually flows, in some places under old logs and sometimes evidently underground, with here and there reappearance of the water in the form of little pools. In each of several of the pools a little trout was found. Above this boggy tract the old "up-river" road crosses the stream again on a rather steep hillside, where in high water if there ever be any, there must be a considerable waterfall which it seems impossible that trout might be able to surmount. Nevertheless, small trout occur above this falls as well as in the pool at the foot of it.

Some distance downstream is a reservoir formed by a concrete dam across the brook, in which we also observed trout. It is quite evident that fish planted in the lower course of the stream could not pass this dam. Farther down, trout were observed in places which they probably could reach from the mill pond, although the brook is very much obstructed by brush and dead wood.

In the upper waters six trout from 3.5 to 5 inches long were caught, and farther down, in the wider portion of the stream, two others, 5.5 and 6.37 inches, respectively, were taken.

McCarthy Brook. This little brook is about a mile or so long, flowing northwestward and joining the Oswegatchie Flow a short distance below Wanakena. It is a meandering stream and approaches close to the Wanakena—Dead Creek trail in one place. The upper course of the brook is through bogs, swamps and slash. Below the trail the distance to the flow, following the meandering stream, is much greater than it is in a direct line. At the time of our visit on June 9, the brook was bankfull (Fig. 69) and overflowing in low places, due to recent rains; but it must be a rather small brook in dry periods. Its lower course is through boggy and meadow-like tracts containing, here and there, small fir trees (Fig. 70), etc., on hummocks somewhat back from the immediate banks, until within about 100 yards of the flow. There it has a decided rocky incline where the current is fairly swift; but there was considerable current also

Fig. 65. Top of High Falls. Shows pool and two channels in solid rock. Oct. 16, 1925.

Fig. 66. Looking over High Falls toward the rapids below. Oct. 16, 1925.

Fig. 67. Little Falls of the Oswegatchie about a mile above Wanakena. A smaller channel with slower water is situated behind the rock island shown on the left.

Fig. 68. Section of the rapids in the Oswegatchie River above Wanakena. Brook Trout were taken here during June 1923, but not in September 1922. May 26, 1923.

in the course above this point. A number of fairly deep holes and pools were observed.

Fishing was difficult above the Wanakena—Dead Creek trail, owing to the dense slash, and only two small trout were secured. Below the trail 26 trout averaging 5.43 inches were caught. Only five were 6 inches or more in length. These ranged from 6.29 to 7.12 and averaged 6.7 inches.

Dead Creek. Dead Creek is about a mile and a half long, rising in a bog and flowing northeastward into the head of Dead Creek Flow, where it enters not very far below the trail to Cat Mountain Pond, which crosses it. At its lower end it flows through a comparatively level and rather low tract. For 50 yards or more upstream from the flow the stream is a wide deadwater. Above this it is narrow, with sandy bottom strewn with rocks and cross logs. The banks are bushy. On May 7 the brook was explored for a distance of half a mile or more upstream, or until it became so small as to appear of little importance as trout water. For some of this distance it consisted of a series of little cascades in a decided incline or pitch. At one point there is a large boulder and a cascade, beyond which no other fish than trout were seen (Fig. 71). Suckers, redfins and horned dace were plentiful below. Above this place the brook became rapidly narrower and more sluggish. The bottom is largely sand and there are numerous pools (Fig. 72), each of which contained at least one small trout.

Twenty-one trout varying from 3.75 to 8 inches in total length and averaging 5.6 inches were caught in this creek. Only four measured 6 inches or more. The fish were bright-colored, even some of the smallest resembling adult breeding fish.

Six Mile Creek. Six Mile Creek rises in Bassout Pond, somewhat over four miles in a direct line from the South Flow, but in all probability at least six miles by the brook. A half mile or less below Bassout Pond the stream is joined by the very short and insignificant outlet of Cat Mountain Pond. About a mile and a quarter above South Flow it is joined by the very small outlet of Olmstead Pond on the west, and a little over half a mile above this flow it is joined by the outlet of Cowhorn Pond.

On September 12, 1922, the creek was studied at the pool at the head of "navigation," at Sliding Rock Falls (Fig. 73) and at a point some distance upstream where it is crossed by the trail to Olmstead Pond. The pool mentioned lies below a corduroy bridge at the foot

of a series of cascades and other smaller pools. From this point up to the Sliding Rock Falls pool and to its junction with Cowhorn Pond stream, the creek is fairly wide, with numerous pools which are easily fished. The bottom is largely of sand.

Sliding Rock Falls (Fig. 74) is so named from its rather steep, smooth incline, which bathers utilize as a "shoot" into the pool below. The slope of the slide was measured and found to be 62 feet and 8 inches long to the pool, and its vertical height was estimated to be 18 or 20 feet. At the upper point visited the stream is narrow, with sandy bottom. A short distance above the trail is an old corduroy "elevated road" over the brook bed, once used for hauling logs from the region of the headwaters. The remains of this can be seen in figure 76.

Some trout were caught below the Sliding Rock Falls pool, and a number of highly colored little trout were taken at the uppermost point visited.

On June 2, 1923, the creek was explored from where it leaves Bassout Pond to some distance below its junction with the outlet of Cat Mountain Pond (Fig. 75). There was very little water in the brook and it was therefore narrow and shallow. The old corduroy road, previously mentioned, was noted here all along the course, sometimes at one side and sometimes in the brook.

The brook here has sandy and muddy bottom. Cat Mountain Pond outlet is very small and shallow.

Several small trout were caught in the main creek and one in Cat Mountain Pond outlet. Most of the fish were taken below this outlet, there being scarcely water enough above even for small trout. A beaver dam exists at the foot of each of the ponds (Fig. 89) mentioned, and there are at least two in the course of the stream.

On June 24, 1923, the stream was examined from Sliding Rock Falls up to the point visited on September 12, 1922. As far as this point it flows for the most part rather sluggishly through a low, boggy or more or less meadow-like area, and is bordered by dense alder growths. The bottom is mostly sand, with water plants growing in shallow tracts. The water is clear but of reddish tinge. Some distance above Sliding Rock Falls a low beaver dam had formed a small pond in which small trout appeared to be numerous; one was taken at every cast. In the course of the stream through this flat there were not many pools easy of access. Eleven trout measuring from about 5.23 to 7.08 inches in length were caught.

In the place where we examined the creek on September 12, 1922, several small trout were caught which appeared to be of the same

year classes as those of the date mentioned. These are referred to again later in this report. Above this place there is a fairly steep rocky incline, but the brook is rather small. Above the incline it again flows through a flat country, in the course of which another beaver dam is encountered. The low, flat terrain continues nearly up to the headwaters. An old corduroy logging road extends from Bassout Pond to the Sliding Rock Falls mentioned above. It evidently was once an elevated road over the stream for much of the distance, but now in many places it has collapsed and frequently its old, rotten timbers lie in the brook (see Fig. 76).

Above Sliding Rock Falls the stream can hardly be regarded as an ideal trout brook. It is hard to fish and the fish run small. While chub or horned dace are common throughout the length of the creek, few if any redfins are found above Sliding Rock Falls, although they are very abundant below.

Outlet of Cowhorn Pond. Cowhorn Pond creek or outlet flows from the pond northward for perhaps four miles and then joins Six Mile Creek, with which its course, nowhere more than half a mile distant, up to the junction has been roughly parallel. It receives the waters also from two small ponds on the east: Ash Pond, two and one-half miles above the junction, and Indian Mountain Pond, on the side of Indian Mountain and about half a mile above the junction with Six Mile Creek.

On June 22, we examined the stream for a mile and a quarter or such a matter upstream from its junction with Six Mile Creek. Just above the junction there is a steep, rocky and ledgy incline (Fig. 78), with fairly deep pools, but some of these pools are filled with sand and detritus owing to jams of old logs, brush, etc. This steeper condition extends upstream some distance, but there are stretches which are comparatively level. Farther upstream is a bog where the brook has a sandy bottom and is bordered by a dense growth of alders which overtop and grow horizontally in the brook. Above the bog is a meadow-like tract, wooded for some distance, then succeeded by some small falls and pools, above which the stream is again more or less level and comparatively shallow for a long distance. In this stretch the bottom is sandy, with considerable brush litter in places.

Trout were fairly common upstream as far as the bog. A few were also found above the bog. One fry was seen near the limit of our upstream observations.

Fifteen trout from about 4.37 to nearly 8 inches in length, and averaging nearly 6 inches, were collected. Smaller specimens were frequently seen.

Chair Rock Creek. This creek rises in Darning Needle Pond and flows northward to Cranberry Lake, or into Chair Rock Flow, a distance of two miles or more. About three-fourths of a mile, more or less, below Darning Needle Pond the creek is joined by the outlet stream of Fishpole Pond, lying to the southwest. On September 10, 1922, the creek was examined upstream from the flow for about a quarter of a mile, to a rather high ledge which forms an almost perpendicular waterfall of 8 or 10 feet, but at that time dry and mossgrown. It must be an imposing cascade during highwater. Most of the brook from its mouth to this point is thickly studded with very large boulders and there are also short stretches of smaller rocks. Very few pools were found. Just above its mouth there is a drop in the creek where it flows among big boulders and is crossed by a logging bridge. Above this point a short distance was a dense jam of old logs and débris, through which it would seem that no trout could pass, at least at that stage of water. At another point it was obstructed by freshly cut tree-tops (Figs. 79 and 80). Not very far below the upper falls, previously mentioned, was a rather large and fairly deep pool, perhaps 2 feet deep, under a big boulder. One trout of 8 or 9 inches was caught here, the only one observed in the stream. A smaller trout was taken below the above mentioned logging bridge.

On June 18, 1923, we again explored the stream as far up as Darning Needle Pond.

This pond is shallow, with muddy bottom, so far as could be determined, and there was a growth of aquatic plants, principally the yellow water lily. It is said that sometimes the pond affords good fishing for trout and that specimens up to one-half pound in weight have been taken. At the foot of the pond is a beaver dam, below which is a very shallow pool. Farther down the outlet stream some wide shallow pools occur, containing pondweed (*Potamogeton*). For half a mile or so down from the pond the stream lies in a low, comparatively level tract, but later becomes more rapid with steep inclines. There are at least three fairly high cascades, with good pools below. As previously stated, the stream contains many large boulders, but apparently not much fine gravel or sand. Much old brush and débris as well as freshly cut tops and boughs from recent lumbering operations choke the brook in many places. (Figs. 79 and 80).

There seemed to be some small trout in every pool of any size here, but such pools were few. In the entire distance from Darning Needle Pond to the mouth of the creek, 16 trout, varying from about 4.5 to 7.2 and averaging 5.7 inches, were caught.

There was evidence that lumbermen had recently fished this brook. It is now certainly a poor trout brook.

Sucker Brook. This brook enters Cranberry Lake near Barber Point, on the southeast shore. It is formed by the junction of outlets of Curtis Pond and Dog Pond, about 1½ miles to the eastward.

On September 10, 1922, this brook was explored as far as the head of a flooded swamp, caused by a beaver dam. The water was very low, even in the lower section of the brook. The brook bed was composed of large boulders and small rocks for half a mile or so upstream to a stagnant pool, above which an old log jam and débris obstructed the stream. Above this were three beaver dams. From the lower beaver dam, for at least a mile, the brook flows through a partly flooded swamp. No trout were found.

On June 15, 1923, the brook was explored for a quarter of a mile or more above the beaver flow. It is here a rather pretty brook, with large deep pools and shallow expansions (Fig. 81). There are interrupted patches of overhanging alders. So far as observed the bottom was composed of sand.

Along this section there appeared to be many small trout, and eight, measuring from nearly 5 to about 6.5 inches total length, were caught.

On the following day the examination was continued as far as the junction of Curtis and Dog Pond outlet brooks.

The Curtis Pond outlet brook is steep and rocky, with a bed of fine sand near its mouth. The Dog Pond brook appears to be rocky also, but is smaller and not so steep. At the junction of these two brooks (Fig. 82) is a rather large shallow pool with clean and fine gravel bottom. It appears to afford an excellent spawning place for trout. Below this the brook is comparatively wide and for the most part shallow, with sandy bottom. There are some alder patches along the brook, but it is generally more open than was the section examined the previous day.

A fair number of small trout were present, sometimes several in a pool. A few of a length of about 2 inches were seen, and one about an inch long was caught in a side pool of a small diverted branch of the main stream. Farther down were some deep pools, and in these somewhat larger trout occurred.

In this upper section of the brook 10 trout, from about 4.25 to nearly 7 inches, and averaging 5.5 inches total length, were caught.

Below the beaver flow, in the rocky pools and quick water (Fig. 83), 10 other trout from about 5 to 7.5 and averaging 6.25 inches total length, were caught. It should be noted that no trout were found in this section of the brook in September of last year.

Sucker Brook is easily fished and therefore could easily be depleted.

East Creek. This is a small creek not much over two miles long, flowing west and a little north into East Creek Inlet or Flow.

On September 9, 1922, this creek was explored for a distance of about a mile upstream. It was found to be very shallow, and stagnant in many places. There were some quiet shallow pools with floating sedges, some jams of old boughs, tops and other débris, and some large boulders; but most of the rocks were cobble-stone sizes.

The brook apparently spreads out under the surface turf overlying the boulders and the roots of trees. A large section of the stream—if it can be called a stream—is bordered by a narrow belt of raspberry, blackberry and other bushes or vines. The water is dark wine color, or brownish, like "juniper water".

The brook is so jammed at its mouth with logs, stumps, etc., that it hardly seems possible for trout to ascend it. A few small trout, about 3 to 8 inches total length, were caught. The larger trout were evidently adult males. It is probable that they represented permanent residents.

More extended observations were made on June 14, 1923. We ascended the brook for two miles or more and examined and fished it downstream. Near its head the brook is probably a couple of feet wide and consists of a series of small pools with narrow connecting channels (Fig. 84). The bottom is composed of sand and some silt. The water was reddish, as observed in the fall. Downstream the brook quite rapidly widens out, but for the most part is shallow, although occasionally relatively deep pools occur. Some distance farther down occur three large shallow pond-like expansions or pools. The character of the immediate banks of the stream is variable, more or less open situations alternating with considerable patches of encroaching alders, which make the brook in such places difficult to approach (Fig. 85). Throughout this distance the brook lies in a bog, or bushy, meadow-like level tract with much "slash". The bottom is composed of sand, sometimes fairly clean but often quite silt-covered.

The foregoing conditions persist well downstream to where the brook becomes broken up into separate channels and partly disappears underground; but beyond this it reforms and widens out although it

is more or less obstructed by logs and débris. In this section the bottom is composed of coarse gravel. Not far from the lake there is a sharp incline amongst and over boulders, with eddies and shallow pools and quick water connections. At the mouth is a corduroy bridge, above which is a broad shallow stillwater pool, and below which is the flow with numerous prostrate floating tree trunks, stumps, etc.

Trout, from about 3.33 to 5.66 and averaging 5.25 inches total length, were found throughout. At the lower end were taken a few small trout which were decidedly different in color from those taken farther upstream.

Brandy Brook. Brandy Brook is of considerable size, at least in its lower half, and is several miles in length. A part of its lower course lies in a bog of some extent and in this bog it receives several cold spring-rivulet tributaries.

On September 11, 1922, we examined the stream as far as the bog, or swamp, beyond the old lumber camp. The stream enters the flow by a relatively long open section, which on this date was very low. The bottom is here composed of sand, with soft mud and silt superimposed in many places.

So far as observed the brook is shallow, having very few pools deep enough for trout of large size. Alders overhang and grow horizontally in the stream. Near the lower end in particular a shallow tract was observed to be profusely covered with water milfoil or some similar aquatic plants, and there were extensive patches of floating sedge.

At this time trout 5 to 6 inches long appeared to be fairly numerous in the brook.

On June 13, 1923, the brook was examined for a greater distance upstream, namely, as far as the second lumber camp. There appeared to be about the same height of water as in September of the previous year.

At the lumber camp the brook was found to be broken up in a narrow boggy tract. The bottom was still sandy. All along in this section the brook was choked with slash (Fig. 86), excepting in the alder growths. There are numerous entering spring-fed rivulets of cold water. The coldest found registered 46° F.

Trout were found throughout the length of the brook. Twenty specimens, from 4.29 to 8.20 and averaging 5.78 inches total length, were caught.

Most of the larger trout were taken in the upper part of the lower half of the section of the brook examined (Fig. 87).

Minor Tributary Streams. Besides the foregoing principal tributaries of the lake, a number of rivulets and small brooks were examined, which proved very interesting from the fact that nearly all of them contained trout, however unfavorable some of them appeared to be. Their description follows:

(1) A short rivulet rising in a bog and flowing into Oswegatchie Flow on its northern side, nearly opposite the State Ranger School, was examined June 19, 1923. This rivulet has a fairly clean sandy bottom and small pools under old logs, etc., as usual in such brooks. It courses through a stand of timber which has not been lumbered and therefore is void of slash. Its length is relatively great and it appears to contain small trout throughout. Many fry and some fingerling trout were seen. Seven trout varying from 3.5 to 6 inches were caught.

(2) On the same day we explored a small rivulet entering Dead Creek Flow on the west side, about three-fifths of a mile south from the point at the entrance to Oswegatchie Flow from the lake. This rivulet runs mostly through a boggy tract, and has a sand-and-silt bottom. Trout measuring about 2 inches in length were seen, but were not numerous; no fry were observed. Two trout measuring 3.7 and 4.4 inches, respectively, were taken. The cove into which this rivulet flows is choked with old logs, stumps, upturned roots, etc. (Fig. 88.)

(3) A very small rivulet flowing into "Cucumber Hole" was also examined on this date. It is situated about 1⅕ miles from Dead Creek, on the west side of Dead Creek Flow, but is not shown on the topographic map. It enters the lake over an abrupt drop under a huge boulder, and over a little "slide-rock" into the lake. The brook above these boulders is very narrow and shallow, winding through a dense growth of alders, tamaracks, etc.

Trout were found throughout the part examined. Seven specimens from 4.5 to about 5.6 inches long were caught.

(4) "Rasbeck Hole" is situated diagonally southeast from "Cucumber Hole," on the opposite side of Dead Creek Flow. Into it flows a little rivulet which meanders mostly through a meadow of tussock grass, and is rather open and exposed. It is formed by three little branches. The main brook lies entirely in the meadow. A short distance above the second branch is a drop under an old corduroy bridge, lengthwise of the brook. Beyond this it is level again as far

upstream as one can see from here, in the open bordering meadow. There are scarcely any bushes on the banks of this brook. The bottom is sandy with some silt and detritus. The brook is nowhere over 2 feet wide, except in one broad shallow pool. Trout were found all along the part explored. The lower or first branch is an insignificant rivulet, but it contains some diminutive trout.

The upper or second branch comes down a steep incline amongst rocks and timber. It is a beautiful little brook, containing some small trout.

Along the main stream 13 trout, varying from 2.8 to a little over 5 and averaging 4.3 inches in length, were caught.

(5) A small brook formed by three branches, one from Spectacle Ponds, one from Simmons and one from Toad Pond, flows into a cove known as "Black Duck Hole," on the east side of Dead Creek Flow.

The lower course is through a rather flat tract wooded with "virgin timber." A short distance upstream from the lake there is a sharp incline with large boulders, situated in a "blowdown." Further upstream it is again level, but then occurs another slope. Trout were not numerous, only four being caught, averaging about 5.4 inches.

Another small brook enters the same Black Duck Hole a short distance from the preceding, but lies wholly in a bog or swamp. It is somewhat larger than the first mentioned, but shallow and muddy. Farther upstream it flows through a growth of balsam.

Only one trout, 5.9 inches long, was taken in this stream.

These two rivulets were examined on June 21, 1923.

(6) The Cat Mountain trail from Wanakena crosses a small brook, about a quarter of a mile east of Dead Creek, which flows into Dead Creek Flow. This brook is said never to be lower than when it was examined on June 7, 1923, and the water always cold.

Below the trail the stream flows through a low boggy tract and in some places apparently passes under-ground; near the lake it becomes wider, but still has a sandy bottom and quite an extent of broad deadwater in wet ground.

Above the trail, the brook is small, coming down over quite a steep incline, with here and there pools with sandy bottom.

Four small trout were caught not far from the lake, all about 3 to 4 inches long. One taken at the trail in a rather deep pool was close to 6 inches in length. One fry was seen well downstream.

(7) On June 7, 1923, we examined a rivulet running for some distance through a boggy tract along the Cat Mountain Pond trail.

It is narrow enough to be easily stepped across anywhere. It flows over sandy bottom, with numerous little pools and has a noticeable current.

About 100 yards to the eastward is another rivulet of about the same size as the one just mentioned, and about the same character. It appears to be a branch of the first, but this was not determined. It was colder than any of the others, having a temperature of 49° F.

Small trout were fairly common. Five which were caught varied from 3.25 to 6 inches in length.

(8) A third rivulet examined on June 7 lies a short distance north of Dead Creek (toward Wanakena). It flows into a little north arm of Dead Creek Flow. It courses through a boggy tract and has sandy bottom.

Two small trout were caught here.

(9) Farther north is found a similar rivulet, in a bog which is decidedly shaky. From under the corduroy over the stream two small trout, respectively 4 and 5.5 inches long, were caught. Others were seen.

The bottom was sandy though mostly covered with silt.

(10) A little rivulet entering Chair Rock Creek Flow on the east side, not far from the mouth of Chair Rock Creek, was thoroughly explored on June 20. It enters a relatively long deadwater near the flow. The lower course of the brooklet is in a comparatively level tract and contains small pools with sandy bottom and intervening quickwater rips. Further up there is a steep incline amongst and over boulders, and this is more or less jammed with sticks and débris. Above this the ground is comparatively flat, but with a slight incline giving the stream a little quicker current here than that below.

Trout occurred all along, but only small ones. Fry were seen above the obstructed fall previously mentioned, but they were rather more numerous below the obstruction. Lately fry had been dumped into the deadwater at the mouth of the brook. Five cans (2500 fry) were said to have been planted there.

Nine trout varying from about 3 to 5 inches and averaging about 4 inches long were taken in this brook.

The remaining brooklets are hardly worth considering, judging from our observations. Bear Mountain Brook was a mere rivulet at the time of our visit (June 25), containing very little water and being almost dry in places upstream. It has a sandy bottom which is mostly covered with silt and detritus. It flows into a cove which then contained many aquatic plants.

Fig. 69. McCarthy Brook at Wanakena. The upper section through the bog at high water stage. June 9, 1923.

Fig. 70. McCarthy Brook. Middle section at high water stage. Small Brook Trout were plentiful here. June 9, 1923.

Fig. 71. Pool and Falls on Dead Creek about sixty yards above the trail. Upper limit of all fish except Brook Trout. June 7, 1923.

Fig. 72. Dead Creek. Small pools and falls were common along this stream. June 7, 1923.

Three small trout were seen near the mouth of this brook.

The outlet brook of Hedgehog Pond was explored from the mouth to the pond, and was found absolutely dry throughout, except near the pond.

The long bog brook entering a north arm of Brandy Brook Flow was visited in September, 1922. Near its mouth we secured nothing but small horned pouts.

Ponds. Although the streams immediately tributary to Cranberry Lake were of special concern in our study, some attention was given also to the headwater ponds of a number of the streams.

Observations were made at Clear Pond, the outlet stream of which joins the outlet stream of Big Deer Pond and flows southward into Nick's Pond. Nick's Pond outlet stream forms a tributary of the Oswegatchie above High Falls. Both Clear Pond and Nick's Pond are natural trout waters, but in them the trout never have attained a large size, particularly those of Nick's Pond.

We have a record, furnished by Mr. Richard Jesup, of 44 trout averaging 5 ounces, from Clear Pond; and of 11 trout averaging 9.6 ounces, taken in Nick's Pond, in 1917.

We visited these ponds from May 31 to June 2. In Clear Pond only a 6-inch trout was caught. There seemed to be many little sunfish, horned dace and small horned pouts.

There were four beaver dams not far apart, counting the one at the foot of the pond, which was the largest and which had flooded a considerable area and killed much small spruce, etc. It had raised the pond about 5 feet above the former level and obliterated the only suitable spawning beds for trout in the pond.

The outlet is a small brook which joins the outlet of Big Deer Pond to form a somewhat larger one. It has a clean, sandy bottom for most of its extent. We followed it from Clear to Nick's Ponds and found small trout all along its course.

In Nick's Pond we succeeded in taking a few small trout, the largest of which was about 7.4 inches long. The only other fish observed were horned dace.

The waters of Cowhorn, Bassout and Cat Mountain ponds flow into Cranberry Lake. At its outlet each pond is obstructed by a beaver dam (Figs. 89 and 90). Fairly large trout are said to be taken in Cowhorn Pond. Mr. Jesup's record for the pond in 1916 was 125 fish, the largest of which weighed 1¼ pounds; and in 1917 his record was 138 fish, the largest weighing 1¼ pounds. On May 31, 25 trout were caught by members of our party. They ranged from 8.46 to 10 inches.

Other fish observed were little red-bellied minnows (*Chrosomus erythrogaster*), and amongst these were a few black-nosed dace (*Rhinichthys atronasus*). The trout apparently subsist to a great extent upon these little minnows.

The only Cat Mountain Pond trout seen were six samples caught by an angler whom we met and who kindly permitted us to examine his catch. They ranged from 8 to 10 and averaged approximately 8.5 inches. The larger individuals had been eating red-bellied minnows; the smaller contained Entomostraca.

Mr. Jesup's records for 1916 and 1917, respectively, were as follows: "467 trout, the largest weighing 7 oz.; and 480 trout, the largest weighing 5/8 lb. . . . average very constantly six to a pound."

It is probable that these ponds have no appreciable effect upon Cranberry Lake, so far as the trout are concerned, for we may be quite sure that few if any trout leave the ponds by the way of the outlets. The beaver dams would, in all likelihood, prevent egress even if there were no other restraining factor. Probably when there was access to the ponds from the outlets some of the trout in the outlets would enter them and may have helped to maintain the stock in the ponds. But such a contributory factor is now eliminated.

No trout were caught in Bassout Pond; but Mr. Jesup furnished these records for 1916 and 1917, respectively: "624 trout (best fish 1¼ pounds); 345 trout (best fish ¾ pound)."

The following extract is from an article entitled, "The Speckled Trout of the Adirondacks," by Mr. Ray Bergman, published in the August and September numbers of Forest and Stream magazine for 1925 (Part I of the article occurs on pp. 459–461, 496–498 of the August number, and Part II on pp. 525–527, 571 of the September number). Bergman's observations, as will be noted, were made mostly on streams and ponds about Cranberry Lake, which we also studied and hence these have a special significance in this report:

"In the spring of 1921 I cut a nitche in the tail fins of seven trout at Dog Pond. I was very careful not to mark any that weighed over ¾ of a pound. None of these was caught until the summer of 1924, when my partners, Clyde Post and Fred Geist, each had the good fortune to get one. We kept one of them to check up on the size and he weighed exactly 2 pounds 12 ounces. This is a mighty interesting experiment to make if care is taken while doing it. The trout must be put in a wet bag to be weighed and should only be handled with wet rubber gloves. It doesn't take very much to injure the protective covering of slime with which the trout is covered. When this slime is rubbed off it results in fungus attacking the unprotected spot and

the disease often spreads to other fish in the same waters. One can not exercise too much care when returning trout to the water.

"In marking trout one should only take fish of the same size, otherwise it would not be a good check-up. If they are marked in successive years the markings should be different each time and an accurate record taken of such markings. If done in a careful way this is an eye opener as to the growth of fish in different waters.

"In the same year that I marked the 'Dog' trout I also nicked some of the Cat Mountain Pond fish. In this pond I had never caught a trout over 12 inches long and very few of these. Picking out a half dozen of well conditioned fish of seven inches long I carefully marked their dorsal fin with a little nick.

"Three years later I caught one of them and it was only nine inches long, and weighed only six ounces. I firmly believe that there isn't a trout in Cat Mountain Pond that weighs a pound. Why these conditions exist I cannot imagine, as the food supply is excellent, equally as good if not better than Dog Pond. As near as I can judge, the number of trout in each pond is nearly equal and the ponds are about the same size in surface area. 'Dog' however, has at least twice the volume in cubic feet of water. Then, too, 'Cat' Trout are pretty near, if not all, hatchery trout, or decendants of hatchery trout.

"Two other ponds in the near vicinity of 'Cat' show, upon investigation, interesting facts. Bassout Pond, which is almost an exact replica of 'Cat', has fish that average about three to the pound, with an occasional pound fish. This is better than the 'Cat Mountain' average, which is five to the pound. Cow Horn Pond nets trout anywhere from ¼ of a pound to five pounds. The average would probably go about one pound. However, the 'Horn' is a different type than the other two, both in water and the bottom. After an exhaustive study of the food conditions in each of these three ponds, I could not find that they differed much in this respect. All of them have been heavily stocked with hatchery trout and all apparently had trout in before stocking. There is a doubt, however, about 'Cat' and 'Bassout' ever having any trout in before stocking. If this could be true, then it seems to explain somewhat the differences in the size of the fish."

Hedgehog (Clear Pond on the U. S. Geological Survey topographic map) and Glasby ponds were also visited. The steep, absolutely dry bed of the outlet of Hedgehog Pond was followed to the pond. The pond is said not to have been a natural trout water, but it has been stocked, and trout of a large size have been caught there. As usual in such instances where suitable spawning beds are lacking, as they

appear to be in this pond, the fish taken are or were only grown up individuals of the original fish planted.

Glasby Pond is another instance of the same kind, its outlet being very abrupt. It was once stocked with brown trout, which are said to have attained a large size, but these finally disappeared. No fish of any kind are known to occur there now.

In 1917, Mr. Jesup's record lists two brown trout which weighed respectively 3 lbs. 14 oz. and 4 lbs. 4 oz.

RESULTS OF THE SPECIAL INVESTIGATIONS REGARDING BROOK TROUT (*SALVELINUS FONTINALIS*)

This beautiful char is commonly called "brook trout," or just "trout," and seldom bears any other name, although it is sometimes referred to as "square-tail." In the West, where it has been introduced, it is designated as "eastern brook trout."

The natural geographical distribution of the brook trout is from Southern Labrador, Newfoundland, New Brunswick and Nova Scotia westward in the northern United States through New England and New York, and occurring locally in New Jersey, Pennsylvania, and other states bordering the Great Lakes, to Northern Minnesota. In Canada it was probably naturally limited to the waters of the St. Lawrence and Great Lakes System. It is or was found in the mountain streams as far south as Georgia and Alabama.

It was once common throughout the Adirondacks but now is practically restricted to a few localities in the region.

In the Cranberry Lake section it occurs in nearly all suitable streams and ponds, large or small, but doubt has been expressed concerning its natural occurrence in Cat Mountain and Bassout ponds, owing to the supposedly insurmountable Sliding Rock Falls in the outlet stream of these ponds (Six Mile Creek). Yet it would seem as easy for trout as it would for other fishes which occur in those waters, to gain access to them. However, no fish naturally occurred in Glasby Pond, and there may be other such ponds.

The brook trout varies greatly in size attained, according to the conditions under which it lives. The largest individual of authentic record is one of about 14½ pounds taken in the Nipigon River of Ontario a number of years ago. A few of 12 pounds, and more of lesser weight, but which still are to be considered large trout, have been recorded from Rangeley Lakes and elsewhere, in Maine (See Kendall, '18).

The trout subsists upon almost any available animal food but principally upon worms, Crustacea, insects, and other fishes. It has been known to eat its own kind as well as the eggs deposited by individuals of its own species.

The trout of the small streams must necessarily subsist largely upon insects, although those of lakes and ponds feed more or less on small fishes. Trout caught in Cowhorn and Cat Mountain ponds were found to have been feeding upon small minnows (*Chrosomus erythrogaster*). But some trout from Cat Mountain Pond contained a considerable amount of Entomostraca, that is, minute crustaceans such as afford the principal food of young trout in many places.

The insects eaten may be both the aquatic stages of certain species such as mayflies, caddisflies, etc., or the adults of various insects which fall upon or hover over the water.

Trout spawn in the fall. Those permanently resident in streams spawn on gravelly bottom where there is some current. While occasionally trout spawn in the lakes, their beds are then usually found where there is moving water. When, as occasionally happens, they spawn along shore in shallow, still water, it is doubtful if the eggs develop successfully. When possible, trout usually ascend inlets or go down into outlet streams.

A conspicuous example of stream ascent is that of trout running up the Oswegatchie River. The spring run is not followed immediately by spawning, but the fish are supposed to remain in the stream until fall, when they breed.

The Associated Trout of the Region. It appears that the brook trout was the only salmonid indigenous to the Cranberry Lake region; but as previously mentioned, other species have been introduced, namely, lake trout, brown trout and rainbow trout.

No lake trout are known to be present in the region now. The lake is doubtless too shallow and too warm for them.

A few small rainbows have been reported from the region. Brown trout are reported to be fairly common. It is our opinion that the introduction of these three species was a mistake. The brown trout is the only one which has as yet become common enough to afford any fishing. No one of them is in any way superior to the brook trout, except possibly in size attained.

Brown Trout (*Salmo fario*). The brown trout is of European origin. The first of the species to be introduced into this country were brought from Germany by von Baehr.

This trout occurs in lakes, ponds, rivers and brooks, and varies in size attained according to the nature of its habitat. It is the Bach Forelle (brook trout) in Germany, the bern trout in Scotland, and also bears various other local names.

The brown trout sometimes attains a large size. In this country trout of 20 pounds or more have been reported. In order to grow to a large size it must have an abundance of suitable food, and, since it subsists upon essentially the same sort of food as does our native trout, one of the chief objections to it in our trout waters is that it becomes a formidable competitor for the food supply.

The brown trout is a game fish of some quality and the angler requires knowledge of its habits and peculiarities in order to catch it, or rather to induce it to take the lure. It is much harder to catch than is our own brook trout.

Rainbow Trout (*Salmo shasta*). The so-called rainbow trout was first introduced into Eastern waters from California. The first lot brought to the State of New York were not rainbow trout, but California mountain trout, and were not therefore the above named species, but *Salmo irideus*. The name rainbow is a translation of *irideus* and was later bestowed upon the McCloud River trout which was extensively propagated and distributed by the United States Fish Commission. Jordan described the McCloud trout as new to science, giving it the name *Salmo gairdneri shasta*, from a mountain of the region, Mt. Shasta. The McCloud is a tributary of the Pitt River which flows into the Sacramento.

Salmo irideus is really a variety of the trout which farther north is called steelhead (*Salmo gairdneri* Richardson). From the fact that Jordan decided that *Salmo iridéus* and *Salmo gairdneri* were synonymous, confusion arose amongst fish culturists, who were led to believe that the McCloud trout and the steelhead were one and the same species. In fact the confusion was augmented by the fact that the name *Salmo irideus* was retained for the McCloud trout by the U. S. Fish Commission even long after Jordan designated it as distinct. The consequence is that when a rainbow trout is reported from our eastern waters, it is not certain which species it may represent.

We have used the name *Salmo shasta* for the Cranberry Lake rainbow trout because it is known that there is or was a pure strain of that species at one of the New York State Hatcheries, and because we have a small specimen of the same species from Quaker Run, Allegany State Park.

From the anglers point of view it probably does not matter which technical name it bears so long as it is satisfactory in a piscatorial way. But it is of importance to the fish culturist to know which species yields the more satisfactory results in the way of stocking, for it is quite clear that one or the other does not prove satisfactory in northern waters. The "rainbow" of Lake Placid, e. g., is a steelhead (*Salmo irideus*). Under favorable conditions both species attain a good size and both are game fish of first quality.

It has been claimed that the rainbow trout is not addicted to fish eating but that it subsists largely upon insects. However, certain fish called "rainbows" have been known to eat quantities of small fish. Perhaps these were steelheads, and perhaps not.

In the McCloud River, the rainbow used to begin spawning in January and continued into April or even until May; and sometimes began as early as December. The steelhead spawns in the spring, beginning early or late according to conditions. Consequently either species is likely to be in poor condition in the spring and early summer, after having spawned. For this reason they appear to be undesirable fish for eastern waters where the fishing season closes at the time these trout are in the best condition. Apparently the "rainbow" of Cranberry Lake is not plentiful enough to give rise to any concern regarding its effect upon the native trout, and it is our advice that no more be planted there.

Mather ('86) says: "It [rainbow trout] was brought from California by both the United States and the New York Fish Commissioners, and introduced by the latter into the Fulton Chain, Woodhall, south branch of Moose River, Bisby and Sylvia Lakes (St. Lawrence Co.), Oswegatchie River, Pleasant, Round, and some other lakes and streams. I have steadily opposed the indiscriminate introduction of this fish into waters which are suited to our own native trout, believing that the latter is the better fish. It has been claimed for the rainbow trout that it grows faster and is gamier than our own. I am not yet prepared to believe that it is gamier, and if it grows quicker it means that it consumes more food, and hence will drive out the native species, as the European sparrow is usurping the place of our native song birds by its voraciousness, fecundity and pugnacity. I am of the opinion that the rainbow trout is a coarser fish than our native trout and not to be compared with it for the table."

Lake Trout (*Cristivomer namaycush*). It is reported that lake trout were introduced into Cranberry Lake years ago and that one

or two had since then been caught or found dead. Apparently the species does not exist there now.

Although the lake trout attains a large size in some waters, it is inferior to the brook trout both as a game fish and in flavor as a food fish.

Cranberry Lake does not appear to afford the necessary conditions for lake trout. It is too shallow and probably too warm. It may lack suitable food. The lake trout spawns in the fall, on shoals, and does not appear to ascend streams for the purpose.

Brook Trout Fishing Conditions. Information received from two guides at Wanakena (L. G. Blandin and Peter Ackey) was to the effect that trout fishing begins soon after the lake is clear of ice, and in the "flows" first.

Usually sometime in May, after a rise of water in the river following a rain, the trout are said to run up the inlet. The run continues until the middle of June, and the fishing is good in the rapids (Blandin). Another run occurs in late September and early October (Ackey). The trout of the spring run remain all summer in the spring holes of the deadwater above the rapids, until the spawning season (Blandin and Ackey). After breeding the large trout of both runs return to the lake (Ackey). The fish spawn in October (Blandin and Ackey). According to both informants the principal fishing is with bait.

Mr. George E. Sternberg, at the Inlet House, stated that the large trout arrive in the deadwater from the lake, from the middle of June to the middle of July, at least the best fishing is found during that period.

At times there is fishing almost anywhere along the stream, but later the trout congregate in spring holes. Both bait and fly fishing are practiced, the large trout taking only large bait or large flies. The largest local trout on record is one of 7 pounds (Blandin, Ackey, Sternberg). Two- or three-pound trout are fairly common, and smaller ones more numerous. Mr. Sternberg cited an instance of a catch of eight trout in one spring hole, which aggregated 16 pounds. Spring holes occur all along the stream as far as High Falls.

Above High Falls the trout run much smaller. Those between the falls and the beaver dam being larger than those above the dam, but all comparatively small.

In 1923, we tried to time our visit to Wanakena so as to be in at the "run of large trout." We arrived there on May 24, but the trout had not put in their appearance. We remained at Wanakena until

June 11, but still no run of large trout occurred. In fact if we accept the statements concerning runs of large trout we shall have to do so with no supporting evidence from our own observations, for the trout did not appear during the season (May and June) or else escaped the notice of persistent anglers. We are not informed that there was any run in 1923. A few large trout were, however, reported to have been caught in the flow. During our observations on the Oswegatchie, small trout were found in fair numbers all along the rapids, but a comparatively small proportion of them would exceed the six inch limit.

On May 25, in a large pool at the head of the rapids, six trout, from 5.33 to 7.5 and averaging 6.7 inches total length, were caught.

May 26, from Wanakena up to Little Falls, several of about the same sizes as those just mentioned were taken. May 28, from Wanakena to a log jam below Little Falls, nine trout varying from 5.7 to 7.6 and averaging 6.6 inches total length, were caught. These trout were found on shallow riffles and in smaller eddies. None were found in deep pools or large eddies.

June 5, from the upper end of the rapids to Little Falls, 20 trout, from 5.5 to 7.25 and averaging about 6 inches, were caught.

June 6, from Little Falls down to the bridge at Wanakena, six trout, from a little over 6.2 to about 8.2 and averaging 7.2 inches, were taken. All of the trout were found in rather quick water in comparatively shallow places.

June 11, four trout were caught along the rapids below Little Falls, from 5.7 to 7.12 and averaging about 6.33 inches; also one of 10.3 inches.

Mr. Richard Jesup supplied the following notes concerning the fishing in 1922, June 1 to August 31: "The Oswegatchie River furnished the best fishing in very many years; our best fish were 3¾ pounds; our total 14, in two days fishing by two rods. This year's very high water apparently brought the trout upstream."

The principal fishing places in the lake during the summer are said to be "spring holes" in the flows, particularly Brandy Brook, East Creek, Chair Rock, and Dead Creek. The last named has "spring holes" that have gained special names, such as Cucumber Hole, Rasbeck Hole, Black Duck Hole, Sand Hole, etc.

The only trout that we succeeded in catching in any of these places were three in Rasbeck Hole, June 21, which measured, respectively, 5.62, 9.06 and 10.62 inches. At the mouth of Chair Rock Creek, five trout, from 6.73 to 8.34 and averaging 7.54 inches, were caught on June 20. Concerning the fishing in Cranberry Lake in 1922,

Mr. Jesup says: "Fishing in the lake 'spring holes' has been exceptionally good, this season. Brandy Brook has given several catches (in spite of being over-fished) the best fish being 2⅞ pounds.

"East Creek's best was 1¼ pounds, South Creek was unusually good; several catches being made and the best being 2¾ pounds, on a fly in early August. The Dead Creek spring holes were poor, the fish being scattered in shallow water after the early spring, and apparently in waters with muddy bottom."

Convincing evidence afforded by prevailing conditions and testimony of persons of long acquaintance with the region, indicates that the Cranberry Lake region represents the last stand, and that a precarious one, of the original stock of trout in the Adirondacks.

The fact that the region still affords sufficiently attractive fishing to warrant efforts directed towards its perpetuation is probably attributable to its earlier remoteness from the usual line of travel of sportsmen, the locality having been frequented by fewer anglers than had other and more accessible places. With difficulty of access removed, the population of the region, both permanent and transitory, has greatly increased and appears to be still growing.

The trout situation has now reached such a stage that it is deemed necessary to provide more effective measures in order to conserve the species.

It must not be understood from this remark, however, that the decline of the trout is to be attributed wholly to increased amount of fishing or wholly to improper and untimely methods, although both may be contributory factors. As a matter of fact, a decline sometimes appears to be in progress when it is rather a matter of decreased individual catches. Given the same number of trout and an increased number of anglers, the reduced individual catches suggest decreased numbers of trout, whereas the decrease is only apparent. At the same time such a relative decline amounts in effect to an actual decline as concerns the individual fisherman, in that he does not meet with his former success. But sooner or later such a situation would doubtless result in an actual general decrease in the numbers of trout. Therefore, it is necessary seriously to consider the increase in number of fishermen, even if there were no actual decrease in quantity of fish.

In view of the fact, then, that the region is now more easily accessible then formerly and that the number of anglers is annually increasing, the question is not merely how to maintain the present status, but how to increase the fish up to the biological maximum of the capacity of the waters and to maintain them at that maximum.

Fig. 73. Sliding Rock Falls and pool on Six Mile Creek. Photograph by W. A. MacDonald.

Fig. 74. Close up and enlarged view of Sliding Rock Falls. Brook Trout were attempting to ascend this water-fall on June 24 and 25, 1923.

Fig. 75. Six Mile Creek just below junction of outlets of Bassout and Cat Mountain Ponds. Small Brook Trout were found here. June 2, 1923.

Fig. 76. Six Mile Creek just above Olmstead Pond trail. Shows part of old corduroy road over stream. Small Brook Trout were apparently spawning here on Oct. 26, 1925.

It hardly seems possible that legitimate angling alone has been the cause of present conditions which are of so much concern to those most interested in the Cranberry Lake region. If there were no other adverse factors and conditions, it would take many years of legitimate angling to reduce the stock to such an alarming extent as now seems to be true. By legitimate angling is meant observance of the laws and regulations as they pertain to methods, season, and size and quantity limits of catches.

The fact is that decidedly adverse and destructive factors have been in operation for many years, and some of them have not been recognized. One of the earliest of these factors was the erection of the dam at the foot of the lake, or the outlet; but this was only partly disadvantageous to the trout and in some ways perhaps may even have been beneficial. One of the most potent agencies effecting harmful changes in conditions of streams and incidentally of lakes and ponds is that of deforestation. For many years deforestation has been taking place in this region and is still going on. There are but few coniferous tracts left standing, and those few are mostly on state-owned land. Accessible though more or less scattered stands are still being removed. Locally, too, the deciduous forest trees are being cut and others are threatened.

Among the many evil effects of deforestation and lumbering are changed conditions and exposure of the soil, rendering it less retentive of water, and thus subjecting the streams to sudden freshets and causing other fluctuations in volume, particularly lowering the water level in dry seasons.

Both quantity and quality of the food supply of trout is decreased, especially that afforded by insects.

The slash left by lumbering operations often encumbers the streams and in combination with freshets often destroys pools by filling them with sand, mud and débris; and spawning beds are destroyed. Furthermore, it is a recognized fact that slash left upon the ground becomes dry and is the source of destructive fires. Forest fires or slash fires not only destroy the woods and vegetable growth but the soil also, and consequently subject the streams to greater liability to floods, affecting the spawning beds, the food supply, and poisoning the water by leaching of the ashes.

Excepting extensive fires, such damages as mentioned have already occurred in the region in late years. It should be unnecessary to say that further deforestation in the region will irrecoverably destroy the brooks as trout waters.

These brooks are regarded by many as trout nurseries and the source of the stock of the lake, and for that reason there is an urgent demand that they be closed to all fishing, above the level of the lake.

A project of damming the Oswegatchie above Wanakena was and perhaps is still being considered, and strange to say, some of those most interested in the increase and perpetuation of the trout supply of Cranberry Lake appear to be more or less unconcerned about this proposed undertaking. Their range of vision seems to be circumscribed, for the ill effects of such an obstruction upon the general trout conditions would be obvious to anyone giving the subject adequate consideration.

Some of the most ardent proponents of closing the smaller affluents of the lake appear not to realize that if the small streams are to any extent important in maintaining the trout supply of the lake, the extensive Oswegatchie system above the lake is of far greater importance, and that a dam on the inlet would affect the whole Cranberry Lake system both above and below the dam, including the small trout streams.

It is a recognized fact that the inlet is the only stream now ascended or that can be ascended by large trout for breeding purposes. The multitude of a self-maintaining stock of trout in any waters, other conditions being favorable, is in direct proportion to the extent of suitable breeding areas. There can be no doubt that under present conditions the Oswegatchie is the most important factor in the maintenance of the trout supply of the lake.

It may be added here that the perpetuity of the trout supply is far from assured by artificial stocking. The stock is not increased or even maintained by planting of hatchery fish unless supplemented by natural breeding. The question then arises as to what extent natural reproduction can be depended upon, and to what extent it is necessary to make annual plants, in order to raise the trout stock to an adequate level and there maintain it.

In other words, how can the necessary readjustment of conditions most economically be brought about?

It goes without saying that the more the burden of restoration can be placed upon the natural propagation of the trout already present in the waters, the more economically can the maintenance of the species be effected. If by intelligent management and regulations natural reproduction can be made to meet anywhere nearly the requirements of maintenance of the stock up to maximum, then to that extent expenditure of money, time and energy will be saved to the State.

Notes on Spawning Brook Trout of Cranberry Lake Region. The Brook Trout of Cranberry Lake region begin spawning about the second week in October and remain on the beds until about the middle of November. In 1924 the first evidence of spawning was reported from the Oswegatchie River on October 8. More data are available for this stream because of its proximity to hunting camps and frequently traversed trails. Mr. Dobson's camp is within a quarter mile of one of the principal spawning areas of this territory and it happens that a much used trail passes so close to this spawning bed that one can see the fish to good advantage even without leaving the trail. During the hunting season hunters and guides pass this place daily, and since the deer hunting season and the trout spawning season coincide, the trout on this bed are under daily observation by someone from the time of their arrival to their departure. The other streams are not so accessible and it is usually by accident that the spawning beds are located at all.

The greatest part of our time was spent in observations on the trout in the Oswegatchie River and at the spawning beds near Dobson's camp, mentioned above, because conditions here were nearly ideal for making observations. On Six Mile Creek we saw but little evidence of spawning beds, but we took specimens of trout at various intervals from the mouth to a point about 1½ miles upstream. Some of these specimens were spent fish and one had a very few eggs left in the ovaries. On Chair Rock Creek Jr. we found a pair of breeding trout on one spawning bed, November 11, and took the ripe male for a specimen. On Sucker Brook we saw several fish well upstream, but no positive evidence of them on spawning beds. We made no attempt to study spawning fish in Brandy Brook or Chair Rock Creek, because extensive cutting of hardwoods was in progress there and consequently the streams were much disturbed.

Oswegatchie River. This stream furnishes such unusual and diversified conditions for brook trout that before taking up its spawning grounds it seems necessary again to refer to its character. It has its source in Hamilton and Herkimer counties, but nearly all of its lower half is in St. Lawrence County. At a point near where the river crosses the county line is a rather high natural fall known as High Falls (Figs. 63 and 64), which is believed to form an insurmountable obstruction for the trout. It has been said that the trout above this place appear to be of a different strain, that is, of smaller size, and it is believed that they spend their winters in the headwater ponds, of which there are several. Those living below the falls have a summer and a winter home. In the late fall, or shortly after

spawning is over, they retreat to Cranberry Lake for the winter. Shortly after the ice leaves the lake in the spring these trout begin to work their way up the flow, and then ascend the rapids in a relatively compact mass. At this time they are said to create a very interesting spectacle for the public, for during the early morning hours they can be seen at places leaping and splashing about so that the water fairly "boils." This activity is said to last for only a few days; scarcely a week. It occurs ordinarily in the latter part of May, shortly after the long-nosed suckers have completed their spawning migration. A warm rain is said to be the prerequisite for a "run" of trout. In 1923 we made a special effort to observe this phenomenon and consequently had the river under almost daily observation from the third week in May until the second week in June, but we saw nothing of the nature of a "run."

After ascending the river the largest trout take up their summer abode in the deep cool pools commonly known as spring holes. The smaller ones occupy the smaller pools and sheltered places. A good many are supposed to enter the tributary streams, such as Wolf Creek.

As the spawning season approaches the trout ascend the stream as usual, but it appears that there are but two principal places which seem to meet the proper requirements. Both of these occur at the mouth of tributary streams; one on Glasby Creek and the other on Wolf Creek. Both are in close proximity to High Falls, consequently about as far as the fish can get unless they surmount the falls—which, as previously said, is thought impossible.

Hunters and guides who camp at the falls during the deer hunting season have reported that the trout make frequent attempts to ascend the falls during the early part of the spawning season. Last fall (1924) two trout were noted to have been impaled on the sharp prongs of a dead spruce that lay against some rocks at the foot of the falls, evidently by the force of the water (see Fig. 63). We watched at the falls on three different days but saw no fish, doubtless because it was rather late in the season.

Our first observations were made at the spawning bed situated near the mouth of Glasby Creek. At this place the river makes a sharp turn to the left, which has resulted in a rather deep pool on the right side and a comparatively shallow area with sandy bottom on the left. The remains of an old logging railroad lie on the immediate right bank at this place, which is 8–10 feet above the level of the stream. From here the stream can be seen advantageously for a considerable distance upstream and down. The right bank of the

stream is very abrupt, having been built of large broken boulders during the construction of the railway.

The pool which comprised the spawning area was from 10–12 feet wide, about 25 feet long, with a maximum depth of about 4 feet. The bottom consisted of a few large angular boulders interspersed with sand and gravel. The left bank was densely overgrown with alders. The right bank had a few alders, with a low growth of weeds and sedge.

The first arrivals on the spawning beds are said to be males, and these busy themselves in clearing away the débris on the bottom. Mr. Dobson (guide and owner of Dobson's camp) said that the males arrived on this spawning area several days in advance of the females; and as soon as the females arrived there followed great activity, caused either by the males trying to encourage the females to enter the spawning bed, or by the males chasing each other. When a male chased another male great ferocity was frequently exhibited. These observations correspond with those of Theodatus Garlick (1857, pp. 9–10) made near Cleveland, Ohio, under artificial conditions. He writes as follows: "Several male fish had proceeded up the stream, and commenced preparing the bed in which the eggs were to be deposited. This was done by removing all the sediment and sand from certain gravelly locations.

"In the course of 5 days the females made their appearance. They were not nearly so gaudy in their dress, but had a most staid and matronly look.

"The next step was choosing their mates. After the usual amount of flattering attentions to the females, with which they seemed highly delighted, and some battles among the males, this important matter was apparently settled to the satisfaction of all parties."

It is interesting to note that Harris ('02), writing of the "Habits of the Brook Trout" (Louis Rhead book on the Speckled Brook Trout), gives a different account of the activities just mentioned. On page 59 he says that "the female flops with the tail the sand from her nest and uses her nose to push the gravel aside." Nothing is said about the male arriving in advance of the female or of the male's part in preparing the nest, but it is intimated that the sexes arrive at the same time and that the female does all the work in preparing the bed.

In our studies we noticed that the mated females took no part in the activities aside from the actual spawning, but it was the male that

was busy most of the time, keeping away intruders, attending the female and performing other activities associated with the spawning act. At times the males were very greatly annoyed by smaller trout that persisted in approaching the nest, presumably seeking the spawn, and much of their time was devoted to driving these intruders away.

Our first visit to this area was not satisfactory for the day was cloudy and there was some wind, but the second day was quite ideal and we noted several trout on the beds. A number of these appeared to have a weight of four or more pounds, being evidently some of the largest brook trout of the region. On closer examination it was found that there were but two mated pairs, so far as we could see, and the dozen or fifteen others were intruders. One of the pair was very close to shore and by using a clump of sedge grass for a blind we had a fine observatory. These two were very large and of about equal size. The spawning bed was under a projecting willow root and the female remained directly under this root most of the time. The male was extremely busy keeping the other fish away. One of these intruders was as large as the male and was almost always at his side. Back of this intruder in turn were several other fish arranged according to their size, the smaller more distant. This male was very gentle at times in driving away the others, but now and then became vicious and would make a mad rush, with his mouth wide open. Ordinarily the intruders would scatter as soon as the male turned and swam toward them.

We watched this pair nearly two hours before we saw the spawning act. The female made two preliminary attempts by rolling slightly on one side; then after a few minutes she rolled completely on her left side and began moving her tail fin up and down—slowly at first but with rapid increase in frequency, so that the fish moved forward in a snake-like fashion for a distance of three or four feet. This performance required only a few seconds, and during this time six to eight strokes of the tail were made. The female always returned to the starting point after recovery. During the course of the next half hour we saw several exhibitions of this sort, sometimes the fish turned on the left, sometimes on the right. During this time the male took no part in the act but kept on guard. The action of the female roiled the water considerably so that our view was obstructed, but on one occasion we saw two eggs settle to the bottom with the silt. In many instances the vent was in good view but we could see no eggs extruded.

The other pair was in midstream and the spawning bed was a clear space between two rocks. The female stationed herself in the shelter

of the rock farthest downstream and at times was concealed from view. She was about 12 inches long and was attended by a male about twice her size. Like the male in the first pair this one also was busy keeping away intruders, of which there were five or six.

We saw no spawning functions on this day, but on the next Nov. 4) saw the female lying on her side, though her actions could not be determined definitely for the wind rippled the water.

On November 5 this pair was still on the spawning bed, and we noted that the male was not chasing his rivals away but was acting in a different manner. He swam above, below or in front of the first fish, sometimes swishing his tail against its head. The intruder was not driven away by this procedure, but the male had another method that seemed more effective. He would swim to an adjacent area and act as though spawning, which at once attracted the intruding fish, and while they were busily engaged apparently in searching the area he would dash back to the female.

About this time the female began the spawning act. The area covered in her movements was about 2 or 3 feet long, and this distance was covered in six to eight strokes of the tail. The female then usually returned immediately to the starting point, but occasionally she disappeared from view for a few minutes. The male never followed on these excursions. After the female had spawned twice the male swam over the same area, and in a similar manner. During our observations we noted that the fish swam on their left side, more frequently than on the right. The female functioned more frequently than did the male, frequently twice as often. This phenomenon however was probably purely accidental and can not be held as the rule. The fish always swam up-stream when spawning and always headed thus while at rest.

The second spawning area is about 30 minutes walk from the place just described. It is situated at the mouth of Wolf Creek and is known as the "root hole." It is said to be the largest and deepest spawning area of the region, and is so deep that the activities of the fish can scarcely be determined with accuracy. It is generally held that this area supports more breeding fish than any other spawning bed. Guides declare that during the height of the season as many as two or three "washtubs of fish" are present.

We made several visits to the High Falls, primarily to determine if any trout were attempting to ascend the falls; but we saw no fish whatever.

A guide ("Johnny" Tender) declared that the trout frequently go to the foot of the falls after the spawning season "to wash their

gills". His theory was that their gills become clogged with a considerable amount of sediment during the spawning activities, and this has to be rinsed out.

Mr. George Muir, who has a year-round camp above the beaver dam near the headwaters of the Oswegatchie River, informed us that brook trout have practically finished spawning by November 5. The largest specimens noted by him would weigh about 1½ to 2 pounds. These trout are very probably permanent residents in the upper section of the river and presumably wintered in the deep holes of the headwater ponds.

This section of the river apparently contains more though smaller trout than does the lower section. Being more distant from populated areas, this part is not overfished. Then, too, there may be fewer natural enemies here to prey upon the young or adults.

Glasby Creek. This small creek, the outlet of Glasby Pond, flows into the Oswegatchie River at the point where we first studied the spawning of brook trout, as described in the previous section. To our knowledge there was but one spawning area in this creek. The trout were about through spawning when we visited the place and we saw only a small number of fish on the bed; but Mr. Bert Dobson, who has a camp a few rods away at the boiling springs, informed us that the largest trout noted on this bed were about two pounds in weight. There were about a dozen of these fish on the beds during the height of the season, but there were in addition several others of smaller sizes.

Six Mile Creek. We visited this stream on November 9, which was rather late for spawning trout. Finding no fish on spawning beds we devoted our time to catching specimens for examination and secured eight small ones. Five of these were taken above the Sliding Rock Falls, two immediately below and the fifth near the flow. We saw one rather large trout below the falls, in shallow water, and this one appeared to be on a spawning bed. We took our specimens with a hook and line. They were very sluggish and it required considerable patience and diligence on our part to secure them.

The five trout taken above the Sliding Rock Falls measured from 4½ to 5 inches in length. It is interesting to note that three of these were spent females; one still had a few eggs in the ovaries. The remaining two were apparently immature males. The two fish from below the falls and the one from the head of the flow were sexually immature. For a comparison of the size and age of trout from above and below the falls see table number 3. Thus it is seen that

trout above the falls and ranging from 4 to 5 inches in length are as old as or older than trout below the falls that are from 6 to 8 inches or more in length.

Chair Rock Creek Jr. This small creek enters Chair Rock Flow only a few rods north of Chair Rock Creek proper. On our visit there, November 11, we found one pair of spawning trout about a quarter of a mile from its mouth. This pair was in a deep hole which was overhung by a large leaning birch. The fish when disturbed found concealment under the projecting roots of this tree. In addition to the breeding pair there was at least one other small trout present. We succeeded in capturing the male of the pair on a worm baited hook and found it was so ripe that the milt flowed from the vent upon the slightest pressure. It was 9½ inches long, but the female was not over 7 inches. While removing the hook we discovered several large trout eggs in the mouth of the male, which seemed to indicate that it had eaten the spawn of its mate.

We also took three specimens from the upper waters of this stream and two from the lower part. Two of the first lot, which measured about 4 inches in length, showed signs of having spawned. The remaining specimens were immature.

The lower part of this stream was adversely affected by lumber-operations which had taken place within the past year. The same operators were cutting logs along Chair Rock Creek proper at this time, so that we made no attempt to study the trout in this creek.

Sucker Brook. We examined this stream on November 10, from its junction with the outlet of Dog Pond to the lake. We fished it nearly the entire distance. The upper end was characterized by comparatively shallow water over clean gravel beds. We noted some trout in the shallow water but these were very shy and retreated to places of concealment on our approach. The sun was shining very brightly and we had difficulty in seeing fish in the water.

The first trout was taken about a mile below the junction, where we began observations. All we secured were very sluggish in taking the bait. Frequently they would take it cautiously and hold it in the mouth without attempting to swallow it. Sometimes they would carry the hook a little distance and then eject it.

We took four trout above the beaver dam and one below it. We saw several as they were seeking shelter. No trout were seen on what might have been spawning beds, but it is possible that some escaped notice since the fish were so shy.

It was quite evident from examination of the specimens that spawning in this stream was about completed. Three of the four specimens taken above the beaver dam appeared to be recently spent fish. Two were males and the third a female. The spermaries of one of the males still contained considerable milt. These males ranged from 5 to 9 inches in length. The fish taken below the beaver dam was a 7-inch female. She had a few small eggs in the upper end of the ovaries and was apparently a spent fish.

Concerning Closing of Brooks. As a general proposition neither the permanent nor the temporary closing of streams ever attains the desired end. But there are specific instances of good as well as of bad results. Conditions differ in different localities and almost every stream presents its peculiar problem. Given a brook in which a certain portion supports trout but other portions are unfavorable, then unless the trout are to be preserved just to look at, or to afford a breeding stock for artificial propagation, no good will be attained by closing it. Better results would likely be derived if a portion of the stream were closed and the remainder left open to regulated fishing. Futhermore, if a stream is to be stocked artificially it would be absolutely necessary that some of the fish be removed. Of course, much depends upon the size and extent of the stream.

Now, in the matter of brooks which are supposed to serve as nurseries for lakes, ponds, or larger streams, it is a question to what extent trout actually may migrate from streams into the lakes, ponds, or larger streams. Doubtless their habits will vary in different waters in this respect.

In the Oswegatchie inlet to Cranberry Lake, large trout spawn and return to the lake. The progeny remain in the stream or its little tributaries for some length of time, and, probably, gradually work down to the lake. But as has been seen, while possibly some trout above High Falls may pass over the falls and thus come down to the lake, a great many remain, breed, and perhaps pass their whole existence above the falls, otherwise there would be no trout above the falls, for the falls is insurmountable.

The same may be said of other brooks flowing into Cranberry Lake, especially the larger streams such as Six Mile Creek, which presents Sliding Rock Falls, an apparently insurmountable water fall. Except for beaver dams and obstructions caused by lumbering operations, other streams such as Cowhorn Pond Stream, or outlet, Brandy Brook, etc., are more easily accessible to trout. But even in these latter streams there is the question as to the extent of migration to and from the lake.

It is quite evident that trout do not attain any considerable size in the upper courses of any of the brooks. There is strong evidence that few if any of the trout of the upper sections of the larger streams go to the lake. In Sucker Brook and in Six Mile Creek it does not seem possible that trout could reach the lake, because of beaver dams and other obstructions, unless possibly in time of overflow; and in these instances, as stated of Oswegatchie Inlet above High Falls, there must be some which remain and breed. If they go to the lake they can not get back to the headwaters. In the case of Six Mile Creek it seems exceedingly doubtful if any trout can surmount the Sliding Rock Falls, although small trout were observed to attempt it, and one individual made its way fully 20 feet upward from the pool below.

The attempt of these little trout to ascend Sliding Rock Falls is evidence that trout run upstream, at least at certain seasons, if they can. Of course it cannot be said that these little fish came from the lake. However, Sucker Brook affords evidence that small trout do ascend brooks from the lake. In September, no trout could be found below the beaver dams anywhere; in June, they were comparatively common there. It cannot, however, be proved that they did not come down stream, which they might have done, as previously suggested, in time of freshet.

That little trout occur in Cranberry Lake is well known. Three were caught in "Rasbeck Hole," June 21, the smallest of which was not quite 6 inches in length.

None of the streams examined, excepting the Oswegatchie, under present conditions can be regarded as affording good trout fishing; and unless a marked change of conditions is effected they never can be of much importance for brook fishing.

In the first place most of the brooks are too small to support a great many trout and their capacity has been greatly lessened by the immediate effects as well as the after effects of lumbering operations. In the second place the trout are not plentiful and those exceeding in size the legal minimum are too scarce to afford more than a "mess" or two in any one season.

In all of the brooks, even in the smallest and most unfavorable appearing rivulets, there appear to be some trout, and in some of the streams they are fairly common but mostly small. In the upper parts of the larger streams, it was seldom that we caught a trout of six inches, as may be seen from the accompanying table.

TABLE NO. 2. RECORDS OF LOCALITIES AND OF SIZES OF BROOK TROUT CAUGHT BY THE PARTY IN MAY AND JUNE, 1923.

LOCALITY	DATE	NUMBER OF SPECIMENS	RANGE IN LENGTH IN INCHES	AVERAGE LENGTH IN INCHES
Oswegatchie Rapids	May 25	6	5.33 to 7.5	6.7
Oswegatchie Rapids	May 26	10	5 to 7.5	.....
Oswegatchie Rapids	May 28	1	3.75	.....
Oswegatchie Rapids	June 5	20	5.5 to 7.25	6
Oswegatchie Rapids	June 6	6	6.2 to 8.2	7.2
Oswegatchie Rapids	June 11	4	5.7 to 7.12	6.33
Oswegatchie Rapids	June 1	1	10.3	.....
Brandy Brook	June 13	20	4.29 to 8.20	5.78
East Creek	June 14	25	3.33 to 6.66	5.25
Sucker Brook	June 15	8	5 to 6.5	5.5
Sucker Brook	June 16	10	4.25 to 7	5.5
Sucker Brook (Lower)	June 16	10	5 to 7.5	6.25
Chair Rock Creek	June 18	16	4.5 to 7.2	5.7
Cowhorn Pond outlet	June 22	15	4.37 to 8	6
Six Mile Creek (Head)	June 2	6	3.5 to 5.5	.....
Six Mile Creek (Olmstead trail)	June 24	10	3.37 to 4.25	.....
Six Mile Creek (from above to Sliding Rock Falls)	June 24	11	5 to 6.75	.....
Six Mile Creek (Sliding Rock Falls Pool)	June 24	3	5.5 to 8.5	.....
Six Mile Creek (Sliding Rock Falls Pool)	June 23	3	6 to 6.5	.....
Six Mile Creek (Sliding Rock Falls Pool)	June 23	1	11	.....
Dead Creek	June 7	21	3.9 to 7.83	5.57
McCarthy Brook	June 9	26	4.25 to 7.12	5.43
Skate Creek	June 4	6	3.5 to 5	.....
Rivulet opposite Ranger School	June 19	7	3.5 to 6	.....
Rivulet to Dead Creek Flow	June 19	2	3.7 to 4.4	.....
Rivulet to Cucumber Hole	June 19	7	4.12 to 5.6	.....
Rivulet to Rasbeck Hole	June 21	13	2.8 to 5	4.3
Rivulet to Black Duck Hole	June 21	4	5 to 5.5	5.4
Rivulet to Black Duck Hole	June 21	1	5.9	.....
Rivulet ¼ Mi. East of Dead Creek	June 7	4	3 to 4	.....
Rivulet ¼ Mi. East of Dead Creek	June 7	1	6	.....
Rivulet beyond Dead Creek to S. & E.	June 7	5	3.25 to 6	.....
Rivulet North of Dead Creek	June 7	2	Small	.....
Rivulet further North of Dead Creek	June 7	2	4 to 5.5	.....
Rivulet near Mouth Chair Rock Creek	June 20	9	3 to 5	4
Clear Pond and Outlet	May 31	6	3.5 to 6	.....
Cowhorn Pond	May 31	25	8.46 to 10	.....
Nicks Pond	June 1	10	4 to 6	.....
Cat Mountain Pond	June 2	6	8 to 10	.....
Cat Mountain Pond Outlet	June 2	1	4.25	.....

It is probable that most of the trout which enter Cranberry Lake come from the lower sections of the tributary brooks. For some reason the trout of the lower portions of the larger streams average larger than those in the upper sections. Furthermore, the small trout of the upper courses of the streams are often as old as or even older than the larger trout of the lower waters, a fact indicated by the following notes.

Six Mile Creek is selected as an example of the prevailing situation as relates to the growth and the age of trout in different sections of the creek from its very source to the lake. Unfortunately up to the present time it has not been possible to examine all the trout from every stream of the region, but it is believed that the facts exhibited by Six Mile Creek do not differ essentially from those of other similar streams.

Notes concerning the trout of Six Mile Creek. Particular attention has been given the brook trout of this creek because from the very beginning of our field investigations in this region it was noticed that there was an apparent stuntedness in individuals taken above Sliding Rock Falls as compared with those taken at points below this natural obstruction. Scarcely any trout in the upper waters reached a size of six inches, and those taken in the late autumn were very highly colored. Examination of the sex organ in the laboratory revealed that many of the stunted individuals were sexually mature. In order to study the relation between size and age of each individual taken in the stream, scales were mounted on microscopic slides for age determination. The results are herewith submitted in tabular form.

TABLE No. 3. SHOWING RELATION BETWEEN SIZE AND AGE OF BROOK TROUT TAKEN IN SIX MILE CREEK, AND STATE OF SEXUAL MATURITY.

LOCALITY	Date	Total length, inches	Age, years	Sex	Condition of reproductive organs
Six Mile Creek, near head of stream	June 2, 1923	3.65	2+	Male	Immature.
" " "	" "	4.10	2+	Female	Would have spawned that fall.
" " "	" "	4.25	3+	Female	" " "
" " "	" "	4.64	2+	?	Immature.
" " "	" "	4.75	3+	Female	Would have spawned that fall.
" " "	" "	5.95	4+	Female	" " "
1⅓ miles or more above mouth of stream	Sept. 12, 1922	2.60	2+	?	Immature.
" " "	" "	3.03	2+	?	"
" " "	" "	3.42	2+	Female	Probably would have spawned that fall.
" " "	" "	3.90	2+	Female	" " " "
" " "	" "	4.05	3+	Male	Immature.
" " "	" "	4.05	3+	Male	Would have spawned that fall.
" " "	" "	4.10	2+	Male	Immature.
" " "	" "	4.17	3+	Female	Would have spawned that fall.
" " "	" "	4.17	2+	Female	" " "
" " "	" "	4.20	2+	Female	" " "
" " "	" "	4.33	2+	Male	Immature.
" " "	" "	4.57	2+	Male	"
" " "	" "	4.69	3+	Female	Would have spawned that fall
" " "	" "	4.95	2	Female	" " "
" " "	June 24, 1923	6.64	3	Female	Nearly ripe.
" " "	" "	3.24	2	?	Immature.
" " "	" "	3.65	2	Male	"
" " "	" "	3.98	2	Male	"
" " "	" "	4.17	3	Female	Would have spawned that fall.
" " "	" "	4.20	3	Female	" " "

$1\frac{1}{3}$ miles or more above mouth of stream	June 24, 1923	4.42	3	Female	Would have spawned that fall.
" " " "	" "	4.65	3	Female	" " "
" " " "	" "	4.94	3	Male	" " "
" " " "	" "	5.05	3	Male	" " "
" " " "	" "	5.24	3	Male	Immature.
Sliding Rock Falls Pool	June 24, 1923	5.40	3	Male	Would have spawned that fall.
" "	" "	7.56	3	Female	" " "
" "	" "	8.20	4	Male	" " "
" "	June 23, 1923	5.62	3	Male	" " "
" "	" "	5.86	3	Male	" " "
" "	" "	6.50	2	Male	" " "
Below Junction of Cowhorn Stream to mouth of Six Mile Creek	Sept. 11, 1922	5.50	3	Female	Immature.
" " "	" "	6.70	4	Male	"
" " "	" "	6.80	3	Female	Nearly ripe.
" " "	" "	10.65	3	Male	Immature.
" " "	June 23, 1923	5.20	4+	Female	Would have spawned that fall.
" " "	" "	5.95	4+	Female	" " "
" " "	" "	5.95	4+	Female	" " "
" " "	" "	7.09	4+	Female	" " "
Oswegatchie (Wanakena)	Sept. 5, 1922	2.36	1+	Female	Immature.
" "	May 25, 1923	5.35	1+	?	"
" "	" "	7.55	1+	Male	"
" " rapids	June 6, 1923	6.22	1+	Female	Would have spawned that fall.
" " "	" "	6.62	2+	Male	Immature.
" " "	" "	6.93	2+	Female	"
" " "	" "	7.55	3+	Male	"
" " "	" "	8.20	2+	Female	"
" " "	" "	8.24	2+	Male	"
Cranberry Lake, Rasbeck Hole	June 21, 1923	9.06	2+	Female	"
" "	" "	10.62	3+	Female	"
Brandy Brook	Sept. 11, 1922	10.35	3+	Female	Would have spawned that fall.

The foregoing figures indicate that most of the trout of Six Mile Creek, which were collected in the same place, much over a mile above its mouth, on September 12, 1922, and June 24, 1923, belong to the same year class, as do also some of those taken below the Sliding Rock Falls. But the latter have grown faster. It is also to be noted that the trout in the Oswegatchie River, although younger in some instances and of the same age in others, have attained a larger size in the same period. It is further important to note that, while the majority of small trout in the upper waters of Six Mile Creek would have spawned in the year in which they were collected, trout of considerably larger size but of the same age in the Oswegatchie and elsewhere were still sexually immature. For instance, trout above 4 inches and less than 4.5 inches total length, of upper Six Mile Creek, which were to spawn that fall, were of the same age as trout from about 7 to over 8 inches long but still sexually immature, of the Oswegatchie. These facts are of significance when measures for the regulation of trout fishing are under consideration. They indicate that, as previously remarked, each stream or body of water presents its own peculiar problem in regard to its fishes.

Such being the case, it would appear that each tributary stream of Cranberry Lake might require its own special regulatory measures, governed by the character of the stream and the purpose to be served.

In view of the fact that there are many who prefer brook to lake fishing, whose interests are entitled to equal consideration with those of the lake fisherman, it would appear that, other things being equal, a reasonable amount of brook fishing might be allowed when no harm to the larger interests of conservation is likely to ensue.

If the present conditions of the stream even approximated the former natural conditions it might be well to give protection to certain sections of the larger streams flowing into Cranberry Lake, excepting the Oswegatchie. In view of the facts set forth in previous pages of this report, it would appear that the most rational procedure would be to close their upper and lower sections and permit fishing in their intermediate sections; and of course imposing limits as to size and number of trout to be taken by any one person in any one day, and perhaps in any one season. Whether or not a seasonal limit should be imposed would depend much upon the intensity of the fishing, in other words, upon the seasonal number of anglers.

Some such provision as the foregoing would protect the small trout of the upper waters of a stream, and the surplus would perhaps work downstream or up into headwater ponds if accessible. The trout of the lower section would be more or less reinforced by the trout from

Fig. 77. Six Mile Creek, below Olmstead Pond trail, during high water. Oct. 26, 1926.

Fig. 78. Outlet of Cowhorn Pond near its junction with Six Mile Creek. Shows pools and falls. Oct. 26, 1925.

Fig. 79. Chair Rock Creek with recently cut logs and brush left in the stream by lumbermen. June 18, 1923.

Fig. 80. Chair Rock Creek. Stream blocked with brush and peeled logs.

the intermediate section and from the lake and would perhaps gradually increase the stock of the lake, particularly if the streams were to be artificially stocked in a rational and efficient manner. Small brooks and rivulets might be closed throughout their whole extent. It appears possible that the shorter rivulets and brooks are likely to contribute a larger proportion of trout to the lake than are the larger streams.

It should be borne in mind that the brook trout (*Salvelinus fontinalis*) is naturally a stream fish and that its occurrence in ponds and lakes is probably incidental.

The immediate question with which the present investigation was concerned was the advisability of closing the affluent streams of Cranberry Lake. But of course this means actually the conservation of the trout of the lake as well, for the only purpose of closing the streams is to improve the lake fishing. Consequently, in addition to closing the streams, other measures should be considered, for no one measure is sufficient in itself to accomplish the desired results.

The following recommendations are made in the belief that they offer the most effective means for restoration, improvement and maintenance of trout fishing in the region, if such be at all possible under present conditions. It must be borne in mind, however, that the investigation was incomplete and more or less cursory and that before a complete or thoroughly rational policy can be formulated an exhaustive and intensive biological survey should be made of the entire system.

Fish Cultural Recommendations. Closure of Streams. In the tributary streams of Cranberry Lake the earlier natural conditions no longer exist. The trout numbers in these streams are much depleted and no stream apparently contains more than a comparatively few fish above the minimum legal size limit. A certain proportion of the trout of the streams find their way to the lake, where, due probably to a more abundant food supply, they attain a larger size than is possible in the tributaries.

In view of these considerations it is recommended that *all streams, except the Oswegatchie, directly tributary to Cranberry Lake be closed to all fishing throughout their extent, for a long term of years.*

Minimum Size Limit. The Oswegatchie is the principal resort and possibly also a source of supply of larger trout. It is well known that trout as large as 8 or 9 and even 10 inches total length often have not reached sexual maturity, and since the Oswegatchie is in-

tensively fished with bait and fly, and many small trout are taken, greatly reducing the supply in recent years, it is recommended that the minimum legal *size limit* for trout in the Oswegatchie, from Cranberry Lake up to High Falls, be set at not less than 9 inches from tip of snout to end of tail, or not less than 6 inches from gill opening to base of tail, in case the trout has been cleaned. Perhaps it might be well to fix the legal measurement from the gill-opening to the tail, saying nothing about total length. It is recommended further that the daily catch shall be limited to not more than 10 fish of any size. For Cranberry Lake itself the same minimum size limit is recommended as for the Oswegatchie.

Discussion. One person with whom the size limit was discusssed was opposed to increasing it much if any above six inches, on the ground that it would divert anglers from certain places where small trout are common, but as a rule smaller than the recommended minimum size limit, and would concentrate them in Brandy Flow where the trout run larger. He maintained that it was only in the latter place that large trout could be caught during the summer, and that only small trout were found in the other places. He did not believe that trout in these other places would ever attain a large size.

This idea appears inconsistent with his expressed belief that the brooks were the source of supply of Cranberry Lake trout. If it is not permissible to catch six-inch trout which have reached maturity and which perhaps already have spawned in the stream, there can be no sound reason for permitting the taking of 6-, 7- or 8-inch immature trout in the lake, which have never spawned.

Another argument of the same man is important to mention because it represents a point of view doubtless entertained by many experienced fishermen and on the surface has just sufficient plausibility to appear convincing. It was this: Against our contention that in order to have trout of good size in Cranberry Lake the fish must be given opportunity to grow; that the taking of both large and small trout meant simply burning our candle at both ends; and that the present custom, if continued, would mean the progressive reduction in the numbers as well as the maximum size of the "large trout"—against all this he countered that he had fished the region for fifteen years, and that no such reduction had taken place!

Now, the fact is of course that fifteen years is a short time in a matter of this kind. It takes perhaps ten or fifteen years to produce a four or five pound trout under natural conditions. Who actually knows? At any rate, assuming that a trout, after having attained a

length of 10 inches or a weight, say, of a third of a pound, in three years, increases at the rate of a pound a year, it is going to take over three years for it to grow to four pounds, at which rate only four or five generations of trout are represented in fifteen years. Furthermore, if those little trout which are caught in the lake never were to attain a larger size, then it would savor of class legislation to compel the person whose favorite fishing is found in the brooks, to fish in the lake. In other words it seems to be of no more harm to catch a small trout in the brook than in the lake, considered in relation to the trout supply of the lake.

Protective Measures. There should be an efficient and effective warden service, particularly on the lower sections of the streams, and on the Oswegatchie. We do not think that there is likely to be much illegal fishing on the upper waters of most of the streams, since the fish here are too small to attract anglers. It would be practically impossible to patrol all of the streams for their full length.

It is reported by reliable authority that there is considerable illegal netting of trout in the Oswegatchie Flow late in the season. If true, this should of course be stopped.

Artificial Stocking. Under no conditions should any other species than brook trout (*Salvelinus fontinalis*) be planted in any waters of the Cranberry Lake or the Oswegatchie system above the outlet dam.

No trout fry should be planted in the lower sections of larger streams. They should be distributed along the courses of the small rivulets and little brooks. It is a waste of time, money and fish to plant them in the lake or directly into a large stream. Some of the rivulets and small brooks previously enumerated in this report afford excellent nurseries for trout fry, if the fish can be transported to them and properly planted. Particular mention may be made of the little stream which enters Chair Rock Flow, not far from the mouth of Chair Rock Creek. A trail could be made along this stream, and the cans transported by hand, for the stream is not very long.

A rivulet entering Oswegatchie Flow nearly opposite the State Ranger School is another excellent and convenient water for planting fry. The same may be said of McCarthy Brook, which may be reached both at its mouth by boat, and by horse and wagon (providing a bridge is made passable) from Wanakena. Dead Creek and a small brook about a quarter of a mile east of it are also worthy of mention.

There appears to be one condition which, unless corrected, will prevent utilizing these more distant but excellent tributaries for planting fry. That is the usual arrival of the fry at Cranberry Lake station on the late train, and the fact that usually only one or two of the persons to whom they are consigned are present to receive them. The late arrival affords insufficient time for conveying the fish to the farther points on that day. The consequence is that they are taken by those who are present and planted in the most convenient places, regardless of their suitability.

We witnessed one instance of such careless planting where several cans of trout had been received. Some of the fry were dumped into the deadwater at the lower end of the rivulet near Chair Rock Creek, previously mentioned. Four cans (2000 fry) were dumped at the foot of the falls at the mouth of Chair Rock Creek, where the pool was literally alive with redfins and horned dace. When a can had been emptied the water soon after appeared to boil with fish! A day or two later some small trout which were caught here were found to contain several fry in their stomachs. If all of the fry had been placed in the above mentioned deadwater rivulet their chance of survival, although slender enough, would have been better.

It would be an economical method, comparatively speaking, to have *trained caretakers or the local game protectors accompany* the fish and supervise the planting. But in any event fish for the region in question should arrive earlier in the day.

If feasible it would also be an excellent and undoubtedly economical measure to construct a retaining pool somewhere near the lake where the fry could be reared to a larger size before distribution. Yearlings could be planted in larger streams than are suitable for fry. But even fingerlings and yearlings should be distributed along the course of a stream. It is worse than useless to plant fry, fingerlings or yearlings directly into a lake.

Deforestation and Trout Conservation. Above all, it may be repeated that if the trout of the region are to be saved and their perpetuation assured, further deforestation should be stopped. Should it be allowed to continue, then, rather than closing the brooks, it would be far better to open them to the public with no restrictions and let the people get all the fish there are in the region, so that they may at least derive some benefit from the money thus far expended in attempting to arrest the decline of trout.

There can be no doubt that Cranberry Lake is dependent upon the tributary streams for its trout supply. There are few if any

spawning places in the lake itself. An old resident of the region (Mr. George Bancroft) stated that big trout do not breed in Brandy Brook, but that a small number breed at the lower end of the brook, i. e., the upper end of the flow.

"Joe," a lumber camp clerk working for a logging jobber in Chair Rock Flow, told us that he had seen trout spawning in this flow in the fall of 1924. They were on three beds of clean sand and gravel, well toward the end of the flow on the left (south) side. "There were a good many fish present," he said, although he didn't go very close for fear he might disturb their activities. "In 1925," he said, "the water was too high and too turbid to make any observations here." Mr. Howland (caretaker of Buck Island) told of seeing a similar activity back of one of the small islands between Sucker Brook Flow and Chair Rock Flow. This, he declared, was the only place in the lake where he had seen them spawning. He is an elderly man who has spent the larger part of his life in this vicinity.

Small trout breed in the streams, and large trout in the Oswegatchie deadwater. There are few, if any, and certainly no extensive breeding places in the rapids below the upper end of the Oswegatchie near the deadwater.

The maintenance of the streams and rivulets is essential to the maintenance of trout in the lake. And streams, be it repeated, cannot be maintained if further lumbering in the region is permitted.

Summary of Recommendations. Considering that Cranberry Lake and the Oswegatchie River are regarded as the finest brook trout waters and are producing the largest trout in the Adirondacks, it is important to bear in mind the value of these waters from the viewpoint of the people of the State as a whole. With this idea in mind the following series of recommendations is made:

1. That all streams directly tributary to Cranberry Lake, except the Oswegatchie River, be closed to all fishing throughout their extent for a long term of years.

2. That the legal size limit of trout in the Oswegatchie, from the lake up to High Falls, be set at 9 inches, and the daily catch limited to 10 fish.

3. That the minimum legal size for Cranberry Lake brook trout be 9 inches.

4. That the game warden service be increased on the lake to execute these recommendations.

5. That no trout be planted directly in Cranberry Lake; and that no other trout than brook trout be planted in its tributaries above the

outlet dam. Such important trout waters should be reserved exclusively for brook trout.

6. That no trout fry be planted in the main sections of the larger tributary streams of the lake. They should be distributed along the courses of the small rivulets and brooks.

7. That fry shipped for planting reach their destination early in the day so as to allow proper time for planting. The planting should be supervised by experienced men.

8. That since deforestation of the region is distinctly detrimental to trout waters, it should be given due consideration as an essential feature, if it is desired that the region be preserved as one of the unique trout waters of the State; and likewise,

9. That the proposal to dam the Oswegatchie above the rapids near Inlet House, be carefully considered as to its unfavorable features from the viewpoint of trout conservation—features which it undoubtedly presents.

PART II. NOTES ON THE ASSOCIATED COARSE FISHES OF CRANBERRY LAKE AND ITS TRIBUTARY STREAMS, WITH SPECIAL REFERENCE TO THE FAMILY CATOSTOMIDAE.

It is common practice to regard all other than game fishes as coarse fishes and as more or less undesirable. Some of these are thought and others known to be more or less inimical to the desirable forms. But it is hard to determine to what extent and in what way certain "coarse" species affect the more popular fishes. It is certain that each indigenous species must originally have had its proper place in the natural economy of the waters of this region. They all doubtless have been mutually useful in some way. They may be so now, for all we actually know. But the natural balance has been greatly disturbed, if not completely upset.

The trout have become much scarcer than formerly. At present suckers, horned dace and redfins are extremely abundant. Yet it is impossible to say whether they are more abundant now than formerly. The probabilities are that they are relatively if not actually more abundant, for a regulatory factor in the form of large trout has been greatly reduced. Furthermore, other animals which preyed extensively upon these species are now scarcer. Such predators are herons, sheldrakes and kingfishers. Many sportsmen do not now, and never have, recognized that these birds are far more beneficial than harmful to trout, particularly in the way of reducing the coarse fishes mentioned. It is, nevertheless, a fact. A flock of sheldrakes or mergansers on a stream will devour hundreds of suckers, dace and shiners to one trout. It is only in exceptional instances that the great blue heron is able to destroy trout, and even then the destruction is very limited. Our attention was called to alleged depredations of "cranes" (great blue heron) on the spawning beds of trout, in a limited area in Glasby Creek, not far from the Oswegatchie. It was stated by guides who were camping in the vicinity, that these herons captured a considerable number of trout and that at one time 8 or 10 specimens were found on the shore, the fish having been killed by herons but abandoned because they were too large to be swallowed. The herons were later killed and their "depredations" thus ended.

We saw no dead trout near this spawning bed.

Eaton ('09, pp. 254 and 256) also attributes great trout destroying propensities to the heron and writes as follows:

"This heron is undoubtedly the most destructive enemy of all our native birds to trout streams and fish ponds. As it visits the ponds at night when the trout are feeding in shallow water, a few herons will often levy a toll of several dozens of fingerlings in a single night. When visiting trout ponds early in the morning, I have occasionally found fish which had been speared by the heron's daggerlike beak and drawn ashore only to be discarded because they were too large even for his capacious gullet."

This paragraph does not appear to bear close analysis, if it pertains to wild waters and not to fish cultural ponds. In the first place, unless he killed the birds and counted the fish he could not be positive concerning the quantity eaten. The large trout killed were only occasional. It is doubtful if a heron could draw a struggling large fish ashore although it is possible that it might kill one and the dead fish drift ashore. Furthermore, when herons were far more common than they are now, the trout were also more numerous. It has been ascertained by actual examination that the food of the heron consists of frogs, fish, and aquatic insects. It feeds in still water, and it is seldom that one is seen in localities frequented by trout, excepting perhaps in small ponds or artificial enclosures.

Kingfishers, likewise subsist largely upon shiners, crustaceans, water insects and other small aquatic animals. It does not feed in rippling water nor exclusively on small fishes.

The mergansers or sheldrakes are perhaps, more likely to catch trout in running water, but, as has been ascertained by examination, the bulk of the fishes eaten by them are such as suckers, chubs and shiners.

Based upon actual observations, our firm belief is that it is a mistaken notion that killing the birds mentioned can be appreciably effective in the conservation of trout.

But to resume. In connection with the principal object of our investigation in the Cranberry Lake region it was important and necessary to study the associated fishes of the brook trout as well as the trout themselves. It so happened that the investigation of the inlet streams of the region during the last week in May and all of June, 1923, began at the precise time of the spring breeding migrations of some of the "coarse" fishes, and we were thus very fortunate in being able to make observations on the breeding habits of these fishes, in conjunction with our principal study.

Fig. 81. Sucker Brook. Pool about a mile above the beaver dams where Brook Trout were taken. June 15, 1923.

Fig. 82. Sucker Brook, showing pool at junction of Curtis and Dog pond outlets. June 16, 1923.

Fig. 83. Sucker Brook with pools and falls below beaver dams, characteristic of this section. June 16, 1923.

Fig. 84. East Creek. Typical scene at upper section. June 14, 1923.

As previously noted, the associated fishes which we have here designated as "coarse," comprise 12 species. Some of these are small, and a number are of importance as trout food. The largest are the catfish, called also horned pout and bullhead, and one or possibly two species of sucker.

Our principal observations on these associated fishes pertained to the suckers and the redfin, but in the following account each of the other species also is given brief mention.

CATFISH FAMILY (*SILURIDAE*)

This family is represented in the Cranberry Lake region by only one species, the common horned pout or bullhead. The family is of wide distribution east of the Rocky Mountains, from Canada to the Southern states in the Mississippi Valley, and on the Atlantic seaboard.

Horned Pout (*Ameiurus nebulosus*). While the horned pout may occur in other waters of the present system, we found it only in Cranberry Lake and in Clear Pond.

It is a fish that seldom attains much over a pound in weight and usually is considerably smaller. It is a bottom feeder and also more or less of a scavenger; but it is an excellent fish for the table, either fried or in a chowder. It is most readily caught at night. Its breeding season is in the spring or early summer.

This species probably exerts no seriously harmful influence upon its associates in Cranberry Lake.

SUCKER FAMILY (*CATOSTOMIDAE*)

The sucker family is of wide distribution in North America and is represented by many genera and numerous species, some of which are well defined and others are not. The genus *Catostomus*, which includes the common sucker, is in need of revision, but such revision should be based upon many individuals from many representative localities.

Although, with the exception of suckers from the Cranberry Lake region our material representing these species is limited, we have ventured to make some suggestions concerning their relationships, which facts seem to warrant.

In Northern waters there are two groups of suckers which have been regarded as separate and distinct species, but each of these appear to us to comprise more than one species, or at least more than one race.

The two generally recognized species are the common sucker which in recent works has been designated as *Catostomus commersonii* and the long-nosed or red-sided sucker called *Catostomus catostomus*. In its geographical range the first named extends farther southward than the other, and the second farther northward, perhaps, and surely farther westward than the first mentioned, occurring not only in Alaska but locally also in Siberia, according to Berg.

As long ago as 1882, Fred Mather ('86) made a survey of the fishes of the Adirondack region and reported two small suckers which he regarded as new species. He described one as the June sucker (*Catostomus utawana*) and the other as the dwarf sucker (*Catostomus nanomyzon*). He also listed the common sucker as *Catostomus commersonii* and the long-nosed sucker as *Catostomus longirostris*.

Subsequent writers make no mention of the small suckers as possibly separate species, but classify them as dwarf forms or races of the common and long-nosed suckers, respectively. Bean ('03, p. 102) thus states that, "a small race of the common sucker occurs in certain cold mountain streams of the Adirondack region, where it is dwarfed in size and changed in color but does not differ in essential characters."

During our investigations in the Adirondacks from May 25 to June 27, 1923, we found small suckers of quite uniform size that apparently were similar to those which Mather found and described as *Catostomus utawana*. The majority of these fish ran from 4 to 6 inches in length. However, in the same locality in the Oswegatchie River a female sucker about 12 inches long was taken. While some of the small fish were in breeding condition, this large individual had already spawned. It could not be distinguished from the common sucker. It was the only individual of that type of fish which we secured in that region.

In order positively to determine whether or not the small and the large individuals are specifically identical, statistical study of numerous individuals of each sort may be necessary, but there is considerable evidence that they are distinct and we are inclined so to regard them. If only dwarf forms were found in one body of water and only large forms in another, there would be less reason for regarding them as distinct. But if our large individual is the common sucker, then both the dwarf and the large forms occur in Cranberry Lake. Furthermore, in Big Moose Lake, in a tributary of which Mather states he found the small form, he also found a large fish which Bean identified as *Catostomus commersonii*.

We have not met with the so-called dwarf common sucker elsewhere than in the Cranberry Lake region, and have no knowledge of its occurrence elsewhere, unless those mentioned by Hankinson ('19, p. 35) are such. He collected 20 fish each of which "was about ten inches long and very dark colored, almost black, dorsally; and the sides jet black. They were very different in appearance from other Common Suckers associated with them on this shoal. These were probably all or mostly females and had the ordinary coloration of the species." This was perhaps a sexual difference.

One naturally assumes that a stunted animal has been deprived of an adequate amount of food or food of the proper kind. Considering the diversified diet of the common suckers and the amount of food available at Cranberry Lake in the form of fish spawn, insects, crustaceans, algae, etc., it is hard to believe that these fish were starved. We watched them follow the long-nosed sucker during their breeding activities, and certainly quantities of food were available at that time, although it is possible that they do not feed during migration. Although they were numerous it seems improbable that overcrowding was creating too much draught on the available food. The finding of the larger and healthy common sucker in association with the smaller forms, as mentioned on page 282, combined with the fact that these fish were in good condition, indicate that the food supply is normal.

The phenomenon of the association of a mature "dwarf" sucker with a larger and "normal" representative of this group of fishes is not restricted to these two forms. In some of the New England waters Kendall ('18, p. 510) mentions two distinct sizes of long-nosed suckers. He writes as follows: "There appear to be two distinct sizes of adult longnose suckers which have been generally regarded as this one species, the smaller size reaching only about 8 or 9 inches and the larger 18 inches or more in length. In some waters the smaller size only occurs—the Connecticut Lakes [N. H.], for example, where breeding fish 3¾ to 5⅔ inches long were found—and in others only the larger form is found, as in the Rangeley Lakes. But there are other waters where both distinct sizes occur, as in the Eagle Lakes of Fish River in Aroostook County [Maine], where the small form ranged from 5⅙ to 7⅔ inches in length. The two forms having somewhat different breeding seasons even in the same waters suggests the possibility of their being distinct species." The little breeding fish have a very different coloration from that of the large form, being more or less mottled with no distinct red lateral stripes.

The dwarf suckers of Cranberry Lake were quite thoroughly examined and compared with specimens of the common sucker from other localities. It seems to us that the conclusion is justified that the nominal *Catostomus commersonnii* is a comprehensive species. That is to say, there are several, at least, "small species," races, or whatever they may be called, comprised in the species *commersonnii* as at present understood.

The tendency of past years has been to lump species. Some still do it, but there is a more recent tendency amongst some ichthyologists to recognize finer divisions, particularly in Western fishes. Old species have been divided up and new ones described. We are almost ready to believe that the proper relation of species in the East has not been recognized and that some species have been relegated to synonymy. Of course much depends upon what one regards as constituting a species. The species of some ichthyologists are the genera of others. Subspecies of freshwater fishes cannot be distinguished as can those of birds, reptiles, mammals, etc.

It seems to us that where there are constant differences, or so long as differences appear to be constant, no matter how small, as for instance only one ray in a fin, the fish constantly exhibiting such a difference in a large number of specimens should be regarded as a distinct species. Our only way of recognizing them under the present system is by name, either specifically with a binomial or subspecifically with a trinomial. Trinomials in freshwater fish nomenclature are not to be recommended, because, as previously mentioned, these do not have the same meaning when applied to fishes and to terrestrial animals.

As concerns the suckers, the problem cannot be solved until a good many specimens from many representative localities have been examined.

Our dwarf sucker shows differences from other suckers which have in the past been regarded as *Catostomus commersonnii,* fully as great as are shown by descriptions between *C. commersonnii* and *C. ardens* of the Rocky Mountains. We do not know what other localities may have yielded dwarf suckers that have been identified by collectors as *Catostomus commersonii,* but there are marked differences between the sucker from Allegany State Park, N. Y., and those which we have before us from Maine. In fact, the former appears unique in some respects, and this may be significant.

In order to establish the systematic position of the dwarf sucker, it would be necessary to examine paratypes of *Catostomus commersonnii,* but this is manifestly impossible since Lacépède's *Syprinus*

commersonnii is *sine patria.* In fact, we doubt if this *"Cyprin commersonnien"* is a sucker at all. Lacépède says that it had 8 or 9 rays in each pectoral fin, which is far from correct, as is also another of his statements, "scales very small." If we do not accept this name, and we do not think we should, the next in order is Mitchill's *Cyprinus teres.* But even that has a doubtful reference as pointed out by DeKay, for the tail of his fish is described as "almost even." However, Mitchill's fish was a New York specimen, and if it was a sucker it was, in all probability, the same as DeKay's *Catostomus pallidus,* which was stated to be abundant near Peekskill. Our Palisades, N. Y., specimens should probably be referred to this same species.

Now if Mitchill's *Catostomus teres* is eliminated it would appear that probably the name for the common sucker (or one group of this form) should be *Catostomus communis* of LeSueur, based on a form which came from the Delaware River. With this in mind it would be necessary to get Delaware River specimens and compare them with those from Palisades.

Comparing our "dwarf" with the three Palisades specimens in our possession it is seen that in the head characters alone there are considerable differences. The longest head in the latter lot is not as long as the shortest head in the former, the averages being as follows: Palisades specimens, 24.93% of length; dwarf specimens, 26.47%. In the Palisades fish the depth of head is greater: 57.86% of length of head, as against 53.84% in the dwarfs. The interorbital width in the Palisades fish is greater than in the dwarf: 40.26% of length of head as against 33.38%.

Specimens recently examined by us represent the following localities: Allegany State Park, N. Y., one specimen; Erie County, N. Y., five specimens; Palisades Park, N. Y., three specimens: Maine, ten specimens.

In average length of head, beginning with the longest, these specimens stand in the following order: Dwarf, Oswegatchie (one large specimen), Palisades Park, Allegany Park, Erie County, Maine. In average depth of head: Palisades Park, Allegany Park, Maine, Oswegatchie (large), Erie County, dwarf. In interorbital width: Oswegatchie (large), Palisades Park, Allegany Park, Maine, dwarf. In number of scales: Allegany Park, Oswegatchie (large), Erie County and dwarf (equal), Palisades Park, and Maine.

In other characters, while the dwarf overlaps in most of them, there are still differences in averages, but not usually so great as in the head dimensions.

We may mention it is a possibility that if suckers from the Ohio River and from the Allegheny River basin were to be compared we should find them alike, and sufficiently different from suckers from other localities eastward and from those of the Great Lakes drainage, to justify resurrecting Rafinesque's *Catostomus flexuosus.* The Quaker Run [Allegany Park] specimen differs in appearance from and has a larger number of scales than any other form we have previously examined.

While obviously the material at our disposal has been insufficient to permit positive conclusions, we suspect nevertheless that our eastern suckers are of western origin; that they had become widely distributed prior to the glacial period. Referring to the genus *Catostomus* alone, the changes of environmental and climatic conditions incident to the approach, duration and close of the ice age, brought about divergences of form as well as of distribution among the ancestral stock of *Catostomus.* The most marked changes would naturally be among those nearest to the ice. These are represented to-day by the northern fine scaled, long headed suckers of the *C. catostomus* group. The antithesis of this group would then be found at the opposite or southern extreme of distribution of the genus *Catostomus.*

Of course the fact must be recognized that the nominal (taxonomic) type of the common sucker category does not necessarily represent an extreme. And the same may be said of *C. catostomus,* although with this form the possibility is greater.

It seems possible then that when we come to study material from many and diverse localities in connection with the recorded geographical distribution of *Catostomus* we shall find at least three postglacial distributional trails leading northward and eastward; that we shall find the Mississippi forms differing from the Atlantic seaboard and the Great Lakes suckers. It is a probable fact that some of the more southern forms have geographically overtaken some of the northern and intermediate forms on the distribution trails.

A study of suckers, particularly of the north, and their associates, will yield important evidence. But at the same time the southern distribution still requires investigation, and we may add the West and the Northwest, also. *Catostomus catostomus* has been found in the mountain streams of West Virginia and also in Alaska. A similar if not identical form occurs in Montana, Wyoming and Utah, and Berg records *Catostomus catostomus* from Siberia. Whether one distinct species or not, they all belong to the same category. Thus there appear to be two main branches of the ancestral *Catostomus:* the longnosed, fine scaled one, and the short headed, coarser scaled

one, with intermediates (not intergrades) in each category. One of these intermediates appears to be Mather's *Catostomus utawana* (nearer the southern form), and another his *Catostomus nanomyzon* (nearer the northern form). In glacial or postglacial times these two forms were probably intergrades, but through isolation, have become specifically distinct. Each now represents a terminal twig of one of the two main branches mentioned, *Catostomus commersonnii* (*teres*?) and *Catostomus catostomus,* respectively. They do not intergrade, therefore are not subspecies. They show constant structural and physiological differences from other terminal twigs, and therefore should be regarded as true *species.*

Common Sucker (*Catostomus teres*[?]). If all the forms which have been given this name are specifically identical, even omitting the dwarf form, the geographical distribution of the species is extensive. It is stated to occur in "streams and ponds from Quebec and the Great Lakes to Montana, Colorado, and southward to Missouri and Georgia; the commonest of the suckers, excessively abundant from Massachusetts west to Kansas" (Jordan and Evermann, '96). It is also very abundant east of Massachusetts, through New Hampshire, Maine, and New Brunswick and Nova Scotia. Mather records it from Big Moose and Meacham Lake, N. Y. It attains a length of at least 18 inches.

The sucker subsists largely upon bottom life, such as aquatic insects and aquatic stages of insects, small mollusks, etc. It is accused of eating the eggs of other fishes. The Senior author has found it gorged with whitefish eggs in northern Maine.

From lakes and ponds, when possible, it ascends tributary streams to spawn, usually in May and June, much depending upon seasonal conditions. Far north it may breed later.

When taken from pure, cold water and properly prepared it is by no means a bad food fish.

June Sucker (*Catostomus utawana*). Mather writes: "This small fish I was disposed to consider as a dwarfed mountain form of *Catostomus commersonii,* but the fact [remains] that the latter fish is found in waters inhabited by this species, and while it grows to a length of twelve inches there, this little sucker barely reaches five. Added to this fact [it was noted] that the larger species had finished spawning in the inlets in May, while this fish was found in masses in the swift cold mountain streams which tumble rapidly over rocks in the latter part of June, depositing their eggs, thereby showing that they are adult fishes.

"On June 23, I found these fish in a little cold mountain brook emptying into Minnow Pond, one of the tributaries of Blue Mountain Lake. Three days later I found them in a stream of similar character which empties into the North Bay, Big Moose Lake. In the latter stream there were but few fish, but their eggs were so plentiful that it was evident that their season was nearly over and that most of the fish had returned to the lake. Both this species and the next are never seen except when spawning. I have named it from one of the lakes in the Blue Mountain chain where it may probably be found. Utawana is an Indian name meaning sunshine, and while the translation may not be appropriate to a fish which inhabits deep water all the year, except for about ten days in the breeding season and then seeks shady woods, it is a good sounding name and one that no other fish bears, two reasons that seem to me to outweight any other objection."

Our first observations were in the Oswegatchie River on May 25, where quantities of these little fish in association with horned dace and redfins were ascending Little Falls above Wanakena. We made collections of them on several dates, and observed that they were dark colored, especially on the sides, slender, and dissimilar to the common sucker of like size from other localities. Subsequently collections were made at various intervals in this stream, as well as in Dead Creek, Cucumber Hole Brook, Six Mile Creek, and Chair Rock Creek, Jr.

Examination of the suckers taken in the Oswegatchie River in late May and early June, which were about 6 inches in length, showed that some of the larger specimens would have spawned that same year. The majority of the 4- to 5-inch size specimens would have spawned the following year. There was, however, a female much larger than the others (about 12 inches long), which had spawned earlier in the season. This specimen had the appearance of a typical common sucker.

Specimens taken June 19 and 20 from Cucumber Hole Creek and Chair Rock Creek, Jr., were all in spawning condition, even the little fellows which frequently were only 4 inches long.

From the foregoing data it seems quite probable that the "June Suckers" found by Mather in the Adirondacks are similar to those we found at Cranberry Lake in 1923. The breeding dates practically coincide, and the descriptions are much the same. Although we found but one large sucker similar to the ordinary common sucker, yet this is a record indicating that the form is present. It is not

surprising that more of this kind were not seen for it seems to be their habit to seek deeper waters after the breeding season.

Carefully made measurements of preserved specimens of these small suckers and of like-sized specimens of suckers from other regions revealed the following differences: The Adirondack specimens have a longer and somewhat more slender head, and narrower interorbital width. The dorsal fin of this Adirondack sucker is shorter and lower, while in many specimens the lateral line is very much interrupted or broken, and occasionally a specimen shows the line ending before it reaches the tail.

Although these differences are not very pronounced they appear to be constant, and, when combined with the difference in color, form and breeding season, give sufficient reason to separate the two groups.

It was very interesting to note that the spawning female suckers bore pronounced dermal tubercles or so-called pearl organs. These are usually found only on the males, according to most authorities, although they were found on some females of the supposed dwarf form of the red-sided sucker collected in northern Maine, about twenty years ago. In most cases these organs were not as fully developed on the females as on the males, but in some cases they were much alike, so that careful examination was necessary to determine the sex from external features. The pearl organs on the scales of the females posterior to the dorsal fin were more pronounced than those on the males. Some of our female specimens have pearl organs on the anal and lower caudal fins as large as those of the males, although it appears that these are exceptional cases.

Reighard ('20) has recorded many interesting and valuable observations on the breeding behavior of the common sucker near Grand Rapids, Michigan, and concerning pearl organs he writes as follows: "Effective pearl organs occur on the male in the following situations. (1) Large sharp pointed organs are found on the anal fin and on the lower part of the caudal. They may be visible to the naked eye for a distance of three or four yards. (2) The caudal margins of the scales on the sides bear small hemispherical organs which are effective behind the dorsal. (3) The upper surfaces of the pectorals and both surfaces of the pelvic fins bear small organs. (4) The rays of the dorsal fin bear small organs. Pearl organs do not occur in the female."

These observations by Reighard on the Michigan suckers agree to a certain extent with ours on the Adirondack fish. The principal

difference is that pearl organs occurred on our female as well as on our male specimens, as mentioned on page 289. The pearl organs on the dorsal, pelvic and pectoral fins of the males are quite inconspicuous. Some of the breeding males have the sides and the head quite profusely covered with these tubercles, which are uniformly arranged one on each scale.

Detailed Field Notes on the Dwarf Suckers. We found dwarf suckers in the Oswegatchie River, Dead Creek, Six Mile Creek, Cucumber Hole Brook and Chair Rock Creek, Jr., on various dates throughout our stay, and it seems desirable to present our observations somewhat in detail and by streams.

Oswegatchie River. Toward evening on our second day in the Adirondacks (May 26) we discovered masses of fish at Little Falls, about one mile above Wanakena. These were mostly suckers, but horned dace, redfins and chub minnows were associated with them. Further observation revealed the fact that these fish were in the act of ascending the falls, and large numbers of them were making definite progress toward its accomplishment.

At Little Falls is a rock island in midstream. The water on the west side is deep and very swift while that on the east side, except for the main channel, is comparatively shallow and only moderately fast. The majority of the fish were ascending the falls on the east side. Coming up the river they first congregated in a large pool at the foot of the falls, then worked their way by steps up the falls until reaching a higher shelf near the top, which was more difficult to ascend. Before reaching this shelf, there were two levels with protected pools in which the fish occurred in masses. The first or lower level was in the shelter of a large boulder and below an old log that projected into the stream. To reach the second level the fish preferred to pass under the log, in the shallow water, rather than seek the deeper and swifter water around the end. This was a fairly easy passage, and the fish assembled under the log and just ahead of it, preparatory to the final and greatest effort. We measured this final slope and found it to be 5 feet 2.3 inches, with a vertical height of 1 foot 6.9 inches. The water on the slope over which the fish were ascending was scarcely an inch in depth, and near the shore merely a film of water flowing over the moss covered rocks. The suckers always left the pool with considerable speed, but usually lost it before they reached the top. Should the fish obtain a poor start or encounter some obstruction such as moss, projecting rocks, or a riffle on the way, the force of the water would send them tum-

bling back, or frequently wash them to the shore or into shallower water where they could cling to the moss covered bottom and rest. It usually happened that unless the first attempt was completely successful the fish were eventually forced back to the starting pool, though the efforts exerted by them seemed very strenuous. Fish in such situations are indifferent to intruders, and frequently one could place one's hands over them without exciting any struggle on their part. There were fish on the slope at all times.

On the following morning the fish were less numerous here, although many were still ascending the falls. It is quite likely that their movements are greatest at night. A large pool at the top of the falls contained many fish, and we caught over 200 suckers in one haul with a 15 foot minnow seine. Some of these specimens, including one near a foot in length, were saved and several others were examined to determine the condition of the gonads and the stomach contents. The water was much lower than on the previous day and we found a pocket in the rocks where 56 fish had become trapped by the receding water.

That many fish were attempting also to ascend the higher falls on the west side of the island was evident from the large numbers that were clinging to the rocks on the margin of the island. Here they were making very slow progress. The situation was very difficult, for when they happened to get beyond a certain limit the rushing water would carry them down the rapids to the eddies of quiet water below. In another place, just a few inches from the main channel, we found several suckers wedged by the head into a V-shaped crevice, their tails pointing downstream. These had evidently been carried back by the swift water and thus entrapped. The one on the top was still alive, those immediately below had recently died, while those at the bottom were decomposing.

On May 30 we found no suckers going over the falls, but there were quantities of them in a pool below, and we captured 280 in one haul of the 15 foot minnow seine. A few were saved for specimens.

Other dwarf suckers were observed in the rapids at Wanakena bridge in association with the redfins (*Notropis cornutus*) and the red-sided sucker. During the spawning of the last named it appeared as though the dwarf suckers were feeding upon their eggs, but we had no positive proof of it.

Dead Creek. At Dead Creek we encountered the dwarf suckers on all our visits. On June 2 they were associated with the red-sided sucker and, as noted above, apparently feeding on their eggs. On

June 7 they were present in large numbers and then seemed much darker in color. Some of these also showed little evidence of the pearl organs.

Cucumber Hole Brook. On June 19 we found small suckers at Cucumber Hole Brook. These were in shallow water on gravel beds, when we first saw them, but they soon took shelter behind rocks and in crevices. We collected 10 of these and upon examination in the laboratory found that 7 were ripe or partially spent males, 4-5 inches in length, and with the fins and scales dotted with tubercles or pearl organs. The anal and the lower half of the caudal fins were more studded with tubercles than were the other fins. All the scales except those on the ventral side contained tubercles. The females, in addition to being a little larger than the males, were seasonally slightly more advanced, one specimen being nearly spent. Tubercles were found on all three specimens. Those on the anal and caudal fins were not so conspicuous as those on the males. The scales on the posterior part of the body, and especially in the region of the caudal fin, also contained tubercles.

Chair Rock Creek, Jr. The following day (June 20) we found the dwarf suckers in this creek, but in relatively small numbers. An examination of 4 females and 3 males showed that spawning was in progress and that one of the females was nearly spent. These specimens were similar to those from Cucumber Hole Brook, in respect to tubercles.

Six Mile Creek. At Six Mile Creek we found the dwarf suckers attempting to surmount the falls. At Sliding Rock Falls on this creek, brook trout were leaping up one side of the falls, and suckers on the other, giving us an opportunity to compare the two. The efforts of the trout were more effective.

From the foregoing account it seems quite evident that the small or dwarf suckers spawn in the latter part of June, on gravel beds in the small streams. The fish running up the Oswegatchie River in May were presumably headed for the deadwater above the rapids, and it is quite likely that they stay there in the deep holes until autumn. We do not know of course whether they breed in the deadwater or not, but since they are partial to rather swift water, or riffles, it is quite likely that they either spawn on the rapids above the deadwater, or else seek the small inlet streams of the river.

Red-Sided Sucker (*Catostomus catostomus*). This sucker, otherwise known as long-nosed sucker, northern sucker, etc., in the United States, occurs from Maine to the upper Columbia River,

Fig. 85. Middle section of East Creek. The creek for a considerable distance along here is concealed and protected by overhanging alder growths. June 14, 1926.

Fig. 86. Brandy Brook near the lower lumber camp showing débris in the stream. June 13, 1923.

Fig. 87. Brandy Brook about three-fourths of a mile above the flow. Several of the larger trout in our collection were taken here. June 13, 1923.

Fig. 88. A cove in Dead Creek flow, showing stumps, tree trunks, etc., the result of raising the water level of the lake by the dam at the outlet. June 16, 1923.

upper Missouri, and locally southward in the Appalachians to West Virginia. It may attain a length of 2½ feet, according to Jordan and Evermann ('96). Not much has been written concerning its habits. It is a deep water inhabitant in lakes, apparently, at least in the southern part of its range. Mather states that it is common in most Adirondack waters, and is readily distinguished by its long nose. We were fortunate in being able to observe the run of this sucker in the Oswegatchie River and made some observations on its breeding habits.

As in the case of the common sucker this fish is also supposed to be represented in the Adirondacks by a dwarf form, according to Mather ('90). Since the breeding seasons of the two forms differ it is barely possible that we may have been in the region at the wrong time, or perhaps overlooked them entirely, for the fish we observed were not dwarfed but were quite uniformly 10-12 inches in length.

The breeding season, of the larger form at least, varies with different localities, but in most regions it is earlier than in Cranberry Lake. Thus Surber ('20) found them breeding in the Mississippi River, between Wolf Lake and Lake Bemidji, early in May. Later he says: "In the waters near Bemidji it spawns during the first half of May, the run beginning about the middle of April and continuing for two or three weeks. During 1911 they spawned at Lake of the Woods the first half of June." Kendall and Goldsborough ('08) found that in the Connecticut Lakes, New Hampshire, the breeding season of the small form is in June or July; and Kendall ('18) says that in some waters of Maine it spawns in June.

Less than a week elapsed between the time of the first arrivals and the last departures of the long-nosed sucker run that we saw at Cranberry Lake, which is contrary to what happens in other localities, as noted in the above quotations. The breeding season apparently depends to a large extent upon the temperature of the water. This was about 60° F., in 1923. In 1924 we were at Cranberry Lake on the same date on which suckers began spawning the year previous, yet there were no signs of the fish; but the water was some 12 degrees colder. In Sucker Brook, at Cranberry Lake, according to reports, this fish is usually taken on the spawning beds in large quantities, about June 1.

We saw this sucker in the Oswegatchie River and in Dead Creek, and it is quite likely that it spawns in all the larger inlet streams of this territory. At least local guides report suckers as being numerous in Sucker Brook, Brandy Brook and others, at certain times. But since it often happens that fish with a sucker-like mouth are popularly

all placed in one category as "suckers," we could not be certain whether the reference was to this or some of the other species of sucker.

Oswegatchie River. In the Oswegatchie River we first observed the red-sided sucker on May 29, at about 11 a. m., from the road bridge at Wanakena, which is just above the dead water on the rapids and only a few rods from our headquarters. The water was about 60° F. We believe the first arrivals came during the morning, or perhaps the previous night at the latest, since we had this particular stream under constant observation for a run of trout that was daily expected. The fish were apparently all working upstream over the rapids and continued to increase rapidly in number. An hour or two later we observed the fish in the sexual act. This performance was easily seen from our observation point on the bridge, for the water was rather shallow, and clear except for a slight bog stain. The bottom could be clearly seen over a considerable area, excepting a few places of deeper water. There appeared to be a superabundance of male fish, but this may merely have been an impression due to their bright coloration and conspicuousness. At any rate, the females remained in the background, so to speak, until ready to spawn, and then retreated or were lost to view. When a female entered the shallow rapids where the water was flowing moderately fast over fine gravel beds, she was followed by several males, sometimes as many as 8 or 10. Usually only two males take part in the spawning act (one on each side), but we have frequently seen more and in one instance there was but one. If more than two males take part, the others assume a position directly above the female. In a case where one male was concerned, the female entered the spawning area unaccompanied, but the male was in the vicinity, and, approaching, crowded the female against a rock about a foot in diameter.

The females entered the spawning areas so leisurely that we were uncertain whether they came on their own impulse or were herded in by males in the rear. At any rate they were easily possessed by the males at the proper time.

During the mating act the bodies of the fish concerned are in close contact, especially the regions of the anal and caudal fins. The heads are separated at an angle. The sexual act lasts but a few seconds, but there is a vigorous lashing of the tails and a quivering of the bodies of all the individuals concerned. After the completion of the spawning act the group moves on, the surplus males in many cases following with the rest. The males at this time seemed con-

stantly on the move, especially those not connected with any spawning group.

As soon as a group of mating fish had left the spawning bed a school of redfins, chubs and dwarf suckers, but mostly the first mentioned, would enter with a rush to devour the eggs. Frequently also we saw them following in the wake of mating individuals. Some of these fish would assume a nearly vertical position, thrusting their heads into the gravel or into crevices in the rocks. Just how many eggs were thus devoured we cannot say, but probably all those that had not been covered, as well as some that had, judging from our observations. The mating fish made such vigorous movements with their tails that nearly all the eggs were covered with gravel and sand. On several occasions we were close to the spawning fish and took possession of the area before the spawn eaters had discovered it. We did not find many eggs on the surface of the gravel, but a considerable number by digging into it. One handful of sand and gravel contained about twenty-five eggs. We also captured several redfins on these spawning areas and examined the contents of their stomachs. Although we found no entire eggs in the stomachs of those examined in the field, we noted a yellowish fluid resembling partially digested yolks; but examination of specimens in the laboratory revealed several eggs in the stomachs of some individuals, especially the males.

The number of breeding red-sided suckers in the Oswegatchie River was rather difficult to determine with any degree of accuracy at the height of the season. With the proper light reflection we could see several hundred fish from the bridge. A special effort was made to determine how far the fish ascended the stream, and we noted that the upper limit was about one-third to one-half mile above the deadwater of the flow at Wanakena. This upper limit was fairly sharply defined, although there was no insurmountable obstruction, and the rapids beyond were similar to those below. We rather expected the fish to reach Little Falls, about half a mile farther upstream, but to our knowledge none went so far. The river averaged about 75 feet in width where we saw the fish.

Dead Creek. On May 31, while on our way to the headwater ponds of Six Mile Creek, we found the red-sided sucker spawning in Dead Creek, near its mouth where the trail crosses. It was very abundant, the number in a given area being greater than in an equal area of the Oswegatchie River. This creek was only about four feet wide, with natural obstructions about sixty yards upstream, so that the fish were limited in their range. These suckers were fairly tame,

consequently we were able to catch them with our hands at will, from under the banks and rock ledges. They were all ripe specimens and the eggs and milt would stream from their bodies as we picked them out of the water. These suckers were accompanied by numerous dwarf suckers, redfins and horned dace, as in the Oswegatchie River.

On our return two days later the suckers were more numerous, but it was very apparent that the fish were now about through spawning, for they were very sluggish and their eggs were abundant everywhere. At the lower end of the pool, where the trail crosses, we noted a large quantity of eggs mingled with a mass of leaves, brush, sand, etc., the whole extending across the creek where it had been carried downstream by the current. The mass was several inches thick and in places, especially on top, consisted almost entirely of eggs. On later trips we collected some of these eggs and found nearly all of them fertile. Below the mass of eggs were redfins, chubs and dwarf suckers in great numbers, all headed upstream.

On our return to the Oswegatchie River on June 2, we discovered that the red-sided suckers had evidently returned to the lake. They apparently had only recently left, so that the length of their stay on the breeding grounds was limited to four or five days.

Unlike many other species of fish when in the act of breeding, the red-sided suckers were very gentle and peaceful among themselves. We did not observe the males fighting at any time although in some instances there were six to eight or more males endeavoring to reach the same female. Those beyond reach seemed content to wait for a more favorable opportunity. Even the associated species were unmolested, although they were very abundant and took possession of the spawning area at every opportunity.

The description of the red-sided sucker as given by Bean ('03), in "Fishes of New York," checks fairly well with the Cranberry lake specimens. The latter, however, were seldom over 15 inches in length, and the scales in the lateral line were usually less than 100 in number.

The males were very highly colored, and in favorable light presented a beautiful sight. There was a broad bright blood red stripe along each side, from head to tail, and above this the color was a very dark olive, appearing black at a distance. The underparts including the fins were pure white. When the fish were removed from the water the bright red stripe immedately began to assume a darker hue, like the color of venous blood. The red color of our preserved specimens had entirely disappeared in less than two months time. The anal, and the lower half of the caudal fins of the

males are in general slightly tuberculate; but all the other fins are also more or less tuberculate, and this is true of the scales as well, especially those on the posterior dorsal region. The tubercles become somewhat smaller toward the head. One tubercle on each scale is the usual number.

The apparent scarcity of the females might be attributed to their inconspicuousness as previously suggested. Their olive-brown color with a slight tinge of red blends well with the surrounding rocks and gravel. The females were generally best discerned when they were being followed by groups of males.

The scales on the females, in an area extending from just in front of the anal fin to the base of the caudal fin and dorsally to the lateral line, were equipped with numerous tubercles, several on each scale arranged in a semicircle. The scales of the males in this area had fewer tubercles. In addition to these tubercles on the female there are others on the remaining scales, which are similar to those of the males. This is especially true of the posterior dorsal region. One female in our collection has very prominent tubercles on the anal and on the lower half of the caudal fins, much as in the males.

The habits of the red-sided sucker are not well known because it inhabits the cooler and deeper parts of the lake, except during the breeding migration. It is said that none is ever taken on a baited hook, in this region. The natives of Wanakena seldom notice it during its breeding migration, except in its relation to the trout. It is said that the brook trout "run" of the Oswegatchie in the spring usually follows the breeding migration of the suckers. According to reports, suckers in some localities follow trout and salmon to their breeding grounds, in the fall, in order to feed upon their eggs. We have no authentic reports that the Cranberry Lake suckers follow the trout of that region for such a purpose.

Except in a few instances the red-sided suckers are not generally taken by fishermen for food purposes. One man at Wanakena caught about a hundred in Dead Creek, with a dip-net, but saved only the portion commonly called the tail—which in reality consists of about one half of the fish. These, he said, he shipped to a friend "down state" to be salted for summer use. Guides and old residents report that quantities of "suckers" are taken from Sucker Brook in the spring, by lantern light; but as we have stated elsewhere, it is not certain which species of sucker is found there. It is quite likely that it is the red-sided sucker, for the other species is small and therefore likely to be deemed of little value. Small boys were observed trying to capture the red-sided sucker in the Oswegatchie River, by

means of "snatch hooks." While we saw none of the fish actually taken in this manner there was evidence that some had been secured, for we saw scales, entrails, ovaries, etc., along shore where the fish had been dressed. In general, of course, the natives prefer the brook trout, which is common enough for local demands.

From May 22 to 26, 1924, we again visited the Cranberry Lake region, but saw no red-sided suckers. However, the temperature of the water was only 48° F, while on the same dates of the previous year it was approximately 60° F, and the suckers were then just arriving.

MINNOW FAMILY (*CYPRINIDAE*)

This group is usually referred to as the carp family, since the carp is one of its most widely known representatives. It comprises, however, not only the carp and the minnows, but all the chubs, dace, shiners, etc., of fresh water. Representatives of the family are widely distributed in all the countries of the northern hemisphere.

In the Cranberry Lake region we found six species, the most generally abundant of which were the horned dace or black spotted chub (*Semotilus atromaculatus*) and the redfin (*Notropis cornutus*). The horned dace appeared to be more widely distributed here than the redfin and was found in waters more remote from Cranberry Lake. The redfin appeared to be restricted to Cranberry Lake, and the streams in its immediate vicinity; at least we found it most abundant there.

The other species found were the red-bellied minnow (*Chrosomus erythrogaster*), black-nosed dace (*Rhinichthys atronasus*) and chub minnow (*Couesius plumbeus*). All of these species appear to be representative of the St. Lawrence and Great Lakes System.

Red-bellied minnow (*Chrosomus erythrogaster*). The center of abundance of this little minnow, as based on published records, appears to be in the middle west, from Ohio and Michigan to Iowa and Northern Alabama; but it is doubtless much more widespread, for it has been found in Maine, New Hampshire, northern New York and elsewhere.

Mather records it from Little Moose Lake, July 1, spawning in small streams.

This species is said to attain a length of three inches, but we have never seen one so large. It resembles the black-nosed dace when in the water, and we could not make positive identification until collections had been made. Its common name of "red-bellied minnow" is misleading for its belly is, instead, yellow or orange-yellow, except

for a short time during the breeding season when the belly, as well as the bases of some of the fins of the males, becomes red.

We found large numbers of this minnow in some of the headwater ponds of the Cranberry Lake watershed, and a few were taken from the Oswegatchie River. Cowhorn, Clear, and Cat Mountain ponds were especially well supplied with it. From Cowhorn Pond we obtained 65 specimens, June 1, in a minnow seine. These were enticed into the seine by baiting with bread crumbs. Examination in the laboratory revealed that a large portion of this collection consisted of females with bodies well distended with eggs. The males showed no signs of the reddish color nor of pearl organs, so we assumed that spawning would not take place for some time. Mather ('89, p. 155) states that on July 2 he noted this fish spawning in the small streams in the Adirondacks. The ova of those we took would undoubtedly have been ripe by that date.

In Clear Pond, in the shallow water, quantities of *Chrosomus* were associated with sunfish and horned pout, and we saw many more along shore, feeding on the refuse from our table. We also secured several specimens from the stomachs of large brook trout caught in Cat Mountain Pond. Only two specimens were obtained in the Oswegatchie River. These were taken with migrating suckers and redfins at Little Falls. Both were females and would have spawned that season.

Horned dace (*Semotilus atromaculatus*). This fish, otherwise known as chub, mud chub, blackspot chub, etc., is common from Maine and Eastern Canada to Missouri, Wyoming and Colorado, according to published records. It seldom exceeds 10 inches in length.

Under the name of *Semotilus corporalis,* which, if strict priority is adhered to, is probably the correct name rather than the one commonly used, the fish is listed by Mather for the Adirondacks, but he mentions no definite locality. He states that he found it abundant everywhere.

The fish derives the name horned dace, from the fact that the breeding males have pointed conical tubercles or "horns" on their heads. It feeds upon insects, crustaceans, and other small aquatic animals, as well as other small fishes. It readily takes a fly and often proves annoying to anglers casting for trout. It is not in favor as a food fish.

We found the horned dace very abundant in the Oswegatchie River and at the mouths of the larger brooks and creeks. In the Oswegatchie, during the last of May, we found quantities of them

associated with dwarf suckers and redfins at Little Falls. Some specimens 8-10 or more inches in length were taken with hook and line on the west side of the falls. The larger specimens were all males, and near breeding condition. They were beautifully colored with iridescent tints of pink and red. The heads were adorned with large robust "horns." These fish took a worm-baited hook very readily but did not fight, as compared with trout of similar size.

About the middle of June we hooked a good many of this species in Six Mile Creek, while we were obtaining specimens of brook trout. In fact, they were so plentiful and greedy in the pool at the foot of Sliding Rock Falls that a hook baited with worm or a piece of fish would no more than reach bottom before a large dace would have it. Most of these specimens were large males and all of about one size. As in the case of those from Oswegatchie River, these likewise exhibited breeding coloration.

A large pool at the mouth of Chair Rock Creek was literally swarming with horned dace of various sizes, and we caught a number of them for examination. Several very large males that were present secured most of the bait.

It is quite evident that the horned dace compete severely with the brook trout for the available food.

Redfin (*Notropis cornutus*). The redfin or shiner, according to Jordan and Evermann ('96), inhabits the entire region east of the Rocky Mountains, excepting the south Atlantic States and Texas. It may attain a length of 8 inches, but as commonly found is not so large.

Under the name of *Luxilus cornutus* Mather records it as a very common fish in most Adirondack waters. Among its synonyms he mentions "Red fin.—Males in spring or breeding dress," and "Shiners.—Females, and males as in autumn."

He states that "It runs into streams in June to spawn, and then the males are exceedingly brilliant. Their length is about five inches, and the sexes are so different in appearance at spawning time as to be taken by many for two different fish. It was only by opening many specimens that I convinced a dozen or more of the guides that they were male and female, showing them that while eggs were always present in their shiners, the 'red fins' were always filled with milt."

Mather mentions that he had taken large trout with this redfin in their stomachs.

This interesting little minnow was present in great numbers in the Oswegatchie River, during our investigations. It was found all

Fig. 89. Beaver dam at outlet of Cat Mountain Pond. Very little water was passing through the dam on June 2, 1923.

Fig. 90. Second beaver dam at outlet of Clear Pond. June 1, 1923.

Fig. 91. "The Carter hole" on the Oswegatchie River near the Plains. Brook Trout were breeding extensively here on Nov. 4, 1924.

Fig. 92. The "Carter hole," the following fall. The water was now much higher and swifter, so that very few trout were seen. They were apparently not spawning. Oct. 16, 1925.

the way from the dead water at Wanakena to Little Falls. Usually it was in association with dwarf suckers and horned dace, but when it was spawning these species were not present. It was a very easy matter to distinguish the redfins, especially the males, because of the brilliant breeding colors of their fins and to a lesser extent on the throat, belly, etc. The males were equipped with large sharp tubercles on the head and smaller ones on the scales.

Our first observations on the redfin were made at Little Falls, where they were grouped with dwarf suckers and like them were endeavoring to ascend the falls. Later we noticed quantities of them hovering about the spawning beds of the long-nosed sucker and feeding upon the spawn as soon as it was discharged. Frequently large schools of them were seen following in the wake of a group of spawning suckers. We have seen groups of them occupying the entire channel of a water course and all headed upstream, apparently waiting for eggs that were being carried along by the current, for examinations of the stomachs of these fish showed that eggs were being eaten.

The first evidence of spawning of the redfins was observed in the Oswegatchie River about the end of the first week in June, just after the red-sided suckers had vacated the rapids. We observed quantities of these fish over a fine gravel bed situated partly behind two sheltering rocks, near shore. Over this bed the fish were enmassed and wriggling so actively that it was difficult to determine just what was taking place. At first we thought they were seeking sucker eggs, for some were "standing on their heads," but we discovered that they were in the act of spawning.

At times it appeared as if the individuals of the entire mass were moving synchronously, and this is quite possible for every fish seemed to have contact with one or more other individuals. At other times only certain units of the group were active. Although we found it difficult to see because of the ripples on the surface, nevertheless, the movements of the tails and the vibrations of the bodies suggested that they were spawning. Of course we could not determine in this wriggling mass how many males were mating with each individual female. There appeared to be no system whatever, but contact with any individual seemed to be a sufficient stimulus to produce the spawning act. In other regions, however, they are said to be more systematic in their spawning habits, like other fishes.

Quantities of redfins occur in the Oswegatchie River and near the mouth of some of the larger creeks or brooks. They will bite on a worm baited hook very readily, and frequently will rise to a fly.

In one pool near a sheltering rock we half filled a fine meshed landing net with this species at a single dip.

At Wanakena, trout fishermen use the females for bait, which are said to be excellent for this purpose at certain times; but the males are a little too large and are not frequently used.

Chub minnow (*Couesius plumbeus*). This is another fish of wide distribution in the northern section of the country, occurring in lakes and streams from New Brunswick to Lake Superior, and perhaps beyond. It attains a length of six inches.

Mather was uncertain about the identification of his specimens, which he lists under the name of Lake Chub and refers to it by two different generic names, *Couesius* and *Ceratichthys,* using the specific term *prosthemius* with both. As synonyms, he mentions Morse Lake minnows and Seventh Lake minnows, used by Adirondack guides.

This minnow occurs in very limited numbers in the Oswegatchie River, but late in May we were able to secure ten specimens for our collection. These measure 2½-5 inches in length. Most of them were taken at Little Falls, in a general collection, but some are from the rapids just above the Wanakena bridge.

We were not fortunate enough to observe these fish breeding, but several of our specimens were attired in breeding colors. The base of the pectorals, the gill covers, and the corners of the mouth were adorned with a reddish color or hue. Examination showed that all were breeding fish and that some were entirely or partially spent. The males were well supplied with tubercles or pearl bodies, but the females contained only a few small ones. On the males the tubercles were particularly prominent on the upper side of the pectoral fins and on the throat, but they occurred also on the head, and as far back as the dorsal fin, on the back. The pectoral fins were longer and thicker than those of the female and the rays contained one or two rows of good sized pearl bodies. Those of the head and back were small but very numerous. On the female, the pearl organs were noted on the pectoral fins principally, and to a lesser extent on the scales about the head. The females in our collection were much larger than the males, but more slender.

Our chub minnows were well supplied with food. We noted *Simulium* (black fly), chironomid (gnat) larvae and portions of small adult insects, in their digestive tracts.

Black-nosed dace (*Rhinichthys atronasus*). This small minnow is an inhabitant of brooks, principally, but sometimes occurs in lakes,

from New Brunswick and Maine to Minnesota, northern Alabama and Virginia. Its maximum size is about 3 inches.

The only specimens of the species secured by Mather were obtained in Fourteenth Creek, near the village of North River, a tributary of the Hudson; in Fourth Lake, Fulton Chain, and in Moose River. Mather remarks that he never saw one over 2¼ inches long.

In the Cranberry Lake region we collected it in Oswegatchie River, Cowhorn Pond, Clear Pond, East Creek, Chair Rock Creek, and in Sucker Brook below the beaver dam.

In Cowhorn Pond it was associated with the red-bellied minnow (*Chrosomus*).

SUNFISH FAMILY (*CENTRARCHIDAE*)

This family comprises numerous species, all but one of which occurs east of the Rocky Mountains, from Canada to the southern and eastern states. Some of them are excellent food fishes, and two of them, namely, the black basses, are of wide repute as game fishes.

Sunfish (*Lepomis gibbosus*). This is the common sunfish, pumpkin seed or sunny, of the northeastern states. It is found from the Great Lakes region to Maine and New Brunswick, and southward east of the Alleganies to Florida, but is said to be rather rare in the Carolinas and in Florida. It is said to attain a length of 8 inches.

Under the name of *Eupomotis aureus,* Mather reports it as occurring in most of the Adirondack waters, where he believed it to be the only species of sunfish. He says that the largest specimen in the collection was taken in Fourth Lake, Fulton Chain, and was 5½ inches in length. According to his correspondents, the sunfish was not found in Wilmurt, Cold, Scuts, Murphy, Warner, Bug, G. and T. lakes, nor in Willis Pond.

In Cranberry Lake the fish appears to be uncommonly small—too small to be of any importance as a food fish, but is very abundant. Its abundance may be due to freedom from enemies, and perhaps its small size may be attributable to relative scarcity of suitable food, for competitors for the food supply are here also very numerous.

The sunfish subsists at first upon Entomostraca, then largely upon insects of the same kinds as those eaten by catfish, cyprinids, suckers, trout, etc.

Besides being found in Cranberry Lake it occurred also in Clear Pond, where we secured a specimen 3¾ inches long and in Chair Rock Creek where we got one 5 inches long.

SCULPIN FAMILY (*COTTIDAE*)

The freshwater sculpins, known also as miller's thumbs, blobs, bullheads, rockcusk, etc., comprise numerous species, inhabiting northern waters from the east to the west coast. Nominal species are most numerous in the North Central States and in the West. Apparently there is only one species in the Adirondacks, but others occur within the State of New York.

Sculpin (*Cottus gracilis*[?]). Jordan and Evermann give the geographical distribution of this little fish as "Streams of New England and New York, recorded from tributaries of the Connecticut, Lake Champlain, Hudson, Delaware, and Susquehanna."

DeKay described it as *Uranidea quiescens,* from Lake Pleasant, Adirondack region. Mather says that "this little fish seldom exceeds three inches in length, although Mr. A. R. Fuller, of Meacham Lake, tells me that in streams about Malone they are found twice that length."

We saw one which was found in Skate Creek Mill Pond, by a guide who thought it was a pickerel, and was much puzzled. A number of old guides who examined it did not know what it was. A specimen was found also in Dead Creek. Doubtless the species is of general distribution in the Cranberry Lake region, but it is a form rather difficult to secure, and our collections are insufficient to determine its actual status in the territory covered by this report.

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THE STORY OF KING'S POND

By Dr. F. A. Lucas*

Honorary Director of the American Museum Natural History

GENERAL CONTENTS

The Story of King's Pond.....F. A. Lucas
Its Fish Cultural Significance.....W. C. Kendall

The average person is apt to think that if he has put a few bass in the nearest pond, or has had them put in for him—which is much easier—he has insured good fishing for himself and friends for all time to come.

Of the factors involved in bringing that particular lot of fish to maturity he has little idea—still less of the problems involved in keeping up the supply. Fishes—even little fishes—do not live on air nor on water; they need something more substantial even if microscopic, and if that something is not forthcoming they die or are stunted.

Having had practical experience running over twenty years, with three species of fish foreign to New England waters, the writer feels that it may be instructive and throw some light upon the difficulties and also the dangers of introducing new fish, to recount his experience.

King's Pond near Plymouth, Massachusetts, is a body of water some forty or fifty acres in extent, mostly shallow, abounding in water plants of many kinds, with but about ten acres of open water. Fifty years ago it harbored only native fish, in their order of abundance as follows: Perch (*Perca flavescens*), shiners (*Notemigonus chrysoleucas*), horned pout (*Ameiurus nebulosus*), sunfish (*Lepomis gibbosus*), and minnows (*Fundulus diaphanus*). A few brook or brown pickerel (*Esox americanus*) are also found in this pond, as well as in the near-by Sabey's Pond. It was noted for the size and abundance of its perch, individuals of a pound weight were not uncommon and occasionally one somewhat larger was taken, while specimens of a quarter of a pound were legion. In contrast to this the shiners—with which the pond abounded—were a stunted race, three or four inches in length, just right for bait. The catfish, likewise numerous, were also stunted; that I caught—and killed—twenty-one in one day's fishing shows their abundance. The life of the pond was balanced, even the "shore fry" (*Fundulus*) were able

* Died February 9, 1929.

to thrive and attain their maximum size, for this was one of the few Plymouth ponds into which pickerel had not been introduced. About 1860 the small-mouth bass was brought to Plymouth and placed in a few of the larger ponds and, later, pond after pond was stocked by the simple process of carrying a few bass in a bucket or can from one pond to another, as had previously been done with pickerel.

The immediate results were almost wonderful—the bass increased and multiplied, and it was a common thing for one man to take from ten to twenty fine bass in a day's fishing. There was no size or bag limit, but no self-respecting angler would be seen with a bass of less than a pound weight. King's Pond was one of those stocked and they who fished there between 1875 and 1890 had the sport of their lives. And then the bass began to decrease as the anglers increased, and they decreased rapidly and without visible reason, although fishermen complained that in some places the bass had "driven away" the minnows. When after the lapse of many years I came again to fish in King's Pond the bass were practically gone*—as for the minnows, they were completely gone—if one needed them for bait it was necessary to stop and seine in West Pond, and good sized minnows were scarce there.

But if the bass were gone the perch were there, and while the "big fellows" of the pond were almost never caught, yet up to three-quarters of a pound they abounded. Nevertheless, my record perch, one pound ten ounces—now in the American Museum of Natural History—was taken there in 1915.

While fishing here one day, it occurred to me that it might be possible to lay up a few fish against the old age which began to loom up in the distance, and knowing the pond and knowing the fish, it seemed that the large-mouth bass would do well in King's Pond. My friends in the Bureau of Fisheries agreed with me, and by the courtesy of the Commissioner in 1905, we (Mr. Nickerson did the actual work) placed 200 fry in the pond; incidentally 100 were dropped in West Pond. Two years went by and nothing happened and again 200 fry were put in—again with no visible results. Doubtless the big perch appreciated the introduction of the fry and looked upon them as a pleasant—if temporary—addition to their diet.

A third time, 1912, we tried, this time with 150 fingerlings, 3 to 4 inches long. The next season, in fishing for perch, we took three young bass of three-quarters pound weight—a pretty good growth

* So far as I know the last bass, a veteran of 4¼ lbs. weight, was caught in 1914, having been hooked several times before.

for a year. The next year the bass weighed a pound to a pound and three-quarters, and we saw numbers of little basslings along the shore—evidently we had provided a supply of fish for our old age. There was, so to speak, just one fly in the ointment. The bass we caught lacked the energy of those taken in New York and Canadian waters; they were fat and lazy, and after a short run dove into the weeds with which the pond abounded, and were ignominiously hauled out by hand—the center of about a peck of eel grass. The third year the bass weighed two and a half pounds, but alas, they were no gamier though we hoped they would improve. After that the bass, so far as I was concerned, would bite no more. I was sure there were plenty of them, the more since a poacher early one summer took from their spawning grounds thirteen weighing from three to six pounds, but the two or three bass I have taken in late years weighed under half a pound.

This was bad enough, but there is, or was, worse to follow. Up to 1915 perch fishing was still good and my note book for that year records many. And, as our colored brother would say, "den he was gone," and since 1916 not a single perch have I even seen in that pond; the shiners, once so numerous around the edges of the pads and rushes, that they were taken for bait, have also disappeared, nor have I seen or known of a horned pout from that pond. The place thereof knoweth them no more.

There is another chapter to this story which has to do with the blue gill, or as he is termed in Pennsylvania, the bream. Now the bream, a sort of glorified sunfish, is a good pan fish, in New York waters averaging half a pound, and under particularly favorable conditions reaching three-quarters or rarely a pound. He is mainly a vegetarian—but also an eater of insects and mollusks—and he, too, seemed a desirable addition to our stock of fishes, the more since he would add another source of food for the bass, and knowing the poverty of New England waters, he was introduced with the double object of affording food for man and fish. Not being carnivorous, he would have no injurious effect upon other fishes. So in 1909, after dropping 100 by the wayside in West Pond, 200 were planted in King's Pond and their advent in numbers patiently awaited and hoped for. The bream was true to schedule and appeared promptly in 1913, when I asked my daughter to bait with a cricket and drop over. A little later, in 1915, the bream was present in numbers, but again, alas, small, not even a quarter of a pound in weight, let alone the half pound we had every reason to expect, and he continued to increase in numbers, but not in weight. But if he did not furnish

food for man, he did for bass, though how he managed to increase so numerously after he became the sole support of the bass is a mystery, the probable explanation being that possibly he was protected by his parents from the attacks of the small bass until he became big enough to look after himself and hide from the larger ones.

There *is* another explanation that may fit the case. The large-mouth bass, as a rule, rises to catch his prey and the majority of the breams keep near the bottom; hence the quick, but high swimming shiners were eaten out of existence while the slower bream survives, quite the contrary to what usually happens. Still, no one can tell what a year or two may show, and here endeth the story of King's Pond so far as the facts are concerned; what follows is an attempt to explain some of the facts.

What we know is that first the small-mouth bass absolutely wiped out the "shore fry" and reduced the perch, only themselves to die out later on, the perch then resuming their ascendency. Still later the large-mouth bass exterminated the perch and shiners. This much is evident.

What we do not know is why the shiners once abundant in this pond were a stunted race, and why the bream, following in their footsteps—wake would be a better term—are also dwarfs, while even the low-lived horned pouts are undersized. The stunting is most likely connected with the question of food, there is something—we don't know what—lacking. My own surmise or guess is that it is small "snail" shells such as are found in numbers west of the Hudson, and I may say that a few—all that could be obtained—were put in King's Pond in 1915 and that many more were introduced in 1925.

It can hardly be due to lack of food, such as it is, for the pond is not now supporting the amount of fish life that it did when perch, shiners, and horned pouts were numerous.

The dying out of the large-mouth bass is probably due to lack of small fish to carry them through the stage when the young bass come inshore and begin to prey on other fishes, and with the extermination of chub (*Fundulus*), perch and shiners, there were no young fish to feed upon.

The problem is still more complex because the perch in this pond were unusually large. Perch, however, are omnivorous, eating almost anything that comes their way, even their small relatives.

Here was a pond where the conditions were carefully studied, where there seemed to be an abundant food supply for all fishes

concerned, and yet where the bass completely exterminated the native fishes* while the bream, though present in numbers, failed to attain their normal size.**

THE ORIGINAL INHABITANTS OF KING'S POND AS THEY WERE UP TO 1870

Yellow Perch, *Perca flavescens.*

Abundant, individuals of a pound weight not uncommon, and larger examples occasionally taken.

Sunfish, *Lepomis gibbosus.*

Occasional—of normal size.

Horned pout, *Ameiurus nebulosus.*

Common but small, under one-half pound. Twenty-one taken in one spot in one day.

Chub, shore fry, *Fundulus diaphanus.*

Common, reaching a good size.

Brook Pickerel, *Esox americanus.*

Rare and small, under a quarter pound.

Shiners, *Notemigonus chrysoleucas.*

Abundant but small, three to four inches long; in West Pond, half a mile away, of normal size, six to seven inches long.

CONDITIONS KNOWN BY REPORT ONLY, FROM 1870 TO 1904

About 1875, small-mouth bass (*Micropterus dolomieu*) introduced; they increased rapidly, and catches of ten to twenty from two to four pounds were common of an afternoon.

1904. Small-mouth bass very rare, yellow perch (*Perca flavescens*) scarce, minnows (*Fundulus diaphanus*) gone.

1905. Put in 200 large-mouth bass fry (*Micropterus salmoides*). No results followed.

1908. Introduced 200 large-mouth bass fry. No result.

1909. Introduced 200 blue gills (*Lepomis incisor*). Small.

1912. Introduced 150 large-mouth bass fingerlings, 3 to 4 inches.

1913. Take three large-mouth bass, three-quarters of a pound each.

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* "To the best of my knowledge and belief." For the past few years I have not even seen a perch or shiner.

** Since this paper was written I have had an opportunity to examine blue gills from the great Kensico Reservoir and find them precisely like those from King's Pond, sexually mature but stunted, not reaching even a quarter of a pound in weight. This I feel, is additional evidence that the stunting is due to the lack of proper food.

1914. Take three large-mouth bass, from one and one-half pounds weight to one pound ten ounces.
Take three small blue gills.
Last small-mouth bass taken.

1915. Large-mouth bass weigh two and three-quarters pounds.
Young large-mouth bass abundant in shallow water.
Small blue gills numerous, no normal sized individuals seen.
Perch still abundant, but with one exception no examples weighing a pound taken for last ten years. The exception was a specimen taken this year weighing 1 pound 10 ounces.

1916. Large-mouth bass common but small.
Perch very rare.
Blue gills common but small.

1919. Shiners (*Notemigonus chrysoleucas*) apparently gone and perch almost lacking.

1924. Blue gills abundant, State Commission seined 400, only two of which weighed one-quarter of a pound.
No perch, no shiners.
Commission puts in 5,000 perch, 10,000 shiners.

1925. See many small blue gills, one or two small bass, no perch, no shiners.
Local Commission put in several hundred *Planorbis*.

ITS FISH CULTURAL SIGNIFICANCE

By Dr. William C. Kendall
Ichthyologist, Roosevelt Wild Life Experiment Station

The story of King's Pond, so well told by Doctor Lucas, would with a little change of details in one way or another be but a repetition of the stories, were they told, of many other ponds the country over since the beginning of distribution of fish for fish culture.

The basic facts providing foundation for such a story are implied in five words of the last line of the introductory remarks to the Story of King's Pond: "dangers of introducing new fish." (See Roosevelt Wild Life Bulletin, Vol. 2, No. 3, pp. 214–220.)

In reviewing the Story of King's Pond it is seen that, according to the author, in the beginning there was a "balance." In order of abundance the native species of fish concerned in this balance were perch, shiners, horned pout, sunfish, minnows, and a few brook pickerel. Later small-mouth and large-mouth basses were successfully introduced, and still later blue gill sunfish were planted. Aside

from these facts, what is there upon which to base an answer to Dr. Lucas' query concerning the dwarfing or "stunting" of certain species?

Perch were very numerous and ran large; concerning them definite size data are given.

Shiners are stated to have been "stunted."

The introduced black basses, especially the small-mouth, grew to a large size.

The introduced blue gill was "stunted."

Dr. Lucas is probably correct in attributing the disappearance of the minnows, perch and shiners to the two predacious black basses. Except by inference the subsequent disappearance also of the black basses is not accounted for, but the reference to increasing number of anglers and to poachers suggests a possible cause.

Dr. Lucas associates the stunting of the fishes with the question of food, in which he doubtless is correct. He indicates also that something is lacking, but is not certain as to what it may be. He thinks it can hardly be lack of food, since fish to eat it are scarcer than formerly. It is, however, not impossible that the food supply was greatly reduced by the former greater number of fishes.

At certain stages of their existence each of the species concerned eats essentially the same sort of food. Young perch, black bass, sunfish, blue gills, horned pouts, pickerel, all subsist upon plankton, which largely consists of Entomostraca. The growing fishes as well as some adults also subsist to a great extent upon the aquatic stages of insects. The "shiners" and minnows are also extensive plankton feeders. Large perch and particularly black bass, are pronounced fish eaters, and scarcely any species is exempt from their attacks. Therefore, by the introduction of black basses into the pond new competitors for the food supply and even direct enemies of most of the other species, were added. The biological carrying capacity, so to speak, of any body of water, large or small, is limited. A pond can support so much life and no more. When any addition to or subtraction from the organic components, or perhaps it should be said, participants of the "balance" or equilibrium of life, to which the author referred, are made, there is a resulting disturbance of the balance in direct proportion to the amount added or subtracted.

The history of King's Pond is a long one of both addition and subtraction and the resulting disturbance of the "balance" is of some magnitude. The additions were in the form of competitors and predators. The subtractions were apparently made by both competitors and predators and perhaps assisted by anglers and poachers.

If our interpretation of the story is correct, the final manifestation in King's Pond is that of undue subtraction. The story leads to the conclusion that about the only fish left in the pond is the undersized blue gill.

Why is the blue gill undersized?

It is not hard to imagine that by the time this species was introduced, suitable food for young blue gills was considerably reduced in quantity because of the heavy demands of the inhabitants already established in the pond. In the absence of "enemies" to regulate the multiplication of the blue gills, these soon became too abundant for the food supply. Underfed young would be likely to result in undersized adults, for which the food was also reduced in quantity by their predecessors, i. e., the basses, the perch *et al.* Under exceptionally favorable breeding conditions the blue gills may have progressively increased in number, which would have still further retarded the production of food for the young, and reduced the food for adults to a minimum.

If this were the case, the introduction of univalves alone would hardly stem the rising tide of inferior blue gills, or the ebbing tide of the food supply for young fish. The data offered are too meagre to afford basis for positive conclusions, consequently much of the foregoing argument is speculation. Yet the evidence, although circumstantial, suggests that Kings' Pond exhibits the accumulated results of over-stocking.

The following quotations may be particularly appropriate in this connection:

"Over-stocking may be effected in two ways:

(1) By introducing too many kinds of fish, and

(2) By planting too many fish of any kind."

"The size attained by any species depends largely upon the quantity and quality of the food supply, and having sufficient time in which to grow." (Roosevelt Wild Life Bulletin, Vol. 2, p. 278. 1924.)

"It has been observed that too great production of young fish in a given year prevents many of the halfgrown fish from attaining edible size through too serious competition for the available food."

(Fisheries Service Bulletin, U. S. Bureau of Fisheries No. 94, p. 3, Feb., 1923.)

THE ROOSEVELT WILD LIFE MEMORIAL

As a State Memorial

The State of New York is the trustee of this wild life Memorial to Theodore Roosevelt. The New York State College of Forestry at Syracuse is a State institution supported solely by State funds, and the Roosevelt Wild Life Forest Experiment Station is a part of this institution. The Trustees are State officials. A legislative mandate instructed them as follows:

"To establish and conduct an experimental station to be known as 'Roosevelt Wild Life Forest Experiment Station,' in which there shall be maintained records of the results of the experiments and investigations made and research work accomplished; also a library of works, publications, papers and data having to do with wild life, together with means for practical illustration and demonstration, which library shall, at all reasonable hours, be open to the public." [Laws of New York, chapter 536. Became a law May 10, 1919.]

As a General Memorial

While this Memorial Station was founded by New York State, its functions are not limited solely to the State. The Trustees are further authorized to cooperate with other agencies, so that the work is by no means limited to the boundaries of the State or by State funds. Provision for this has been made by the law as follows:

"To enter into any contract necessary or appropriate for carrying out any of the purposes or objects of the College, including such as shall involve cooperation with any person, corporation or association or any department of the government of the State of New York or of the United States in laboratory, experimental, investigative or research work, and the acceptance from such person, corporation, association, or department of the State or Federal government of gifts or contributions of money, expert service, labor, materials, apparatus, appliances or other property in connection therewith." [Laws of New York, chapter 42. Became a law March 7, 1918.]

By these laws the Empire State has made provision to conduct forest wild life research upon a comprehensive basis, and on a plan as broad as that approved by Theodore Roosevelt himself.

Form of Bequest to the Roosevelt Wild Life Memorial

I hereby give and bequeath to the Roosevelt Wild Life Forest Experiment Station of The New York State College of Forestry at Syracuse, for wild life research, library, and for publication, the sum of ..... or the following books, lands, etc.

ROOSEVELT WILD LIFE BULLETIN, Vol. 3, No. 1. February, 1925.

1. The Birds of the Yellowstone National Park.....Milton P. Skinner.
2. Current Station Notes.....The Director and Editor.

ROOSEVELT WILD LIFE BULLETIN, Vol. 3, No. 2. March, 1925.

1. The Muskrat in New York: Its Natural History and Economics....
Dr. Charles E. Johnson.
2. Current Station Notes.....The Director and Editor.

ROOSEVELT WILD LIFE BULLETIN, Vol. 3, No. 3. September, 1926.

1. The Summer Birds of Central New York Marshes..Aretas A. Saunders.
2. Additional Notes on the Summer Birds of Allegany State Park.....
Aretas A. Saunders.
3. Current Station Notes.....The Director and Editor.

ROOSEVELT WILD LIFE BULLETIN, Vol. 3, No. 4. October, 1926.

1. The Economic and Social Importance of Animals in Forestry, with Special Reference to Wild Life.....Charles C. Adams.
2. The Land-Economic Survey in Michigan.....R. A. Smith.
3. Current Station Notes.....Charles C. Adams

ROOSEVELT WILD LIFE BULLETIN, Vol. 4, No. 1. October, 1926.

1. The Relation of Birds to Woodlots in New York State.....
Waldo L. McAtee.
2. Current Station Notes.....Charles C. Adams

ROOSEVELT WILD LIFE BULLETIN, Vol. 4, No. 2. June, 1927.

1. The Predatory and Fur-bearing Animals of the Yellowstone National Park .....Milton P. Skinner.
2. Current Station Notes.....Charles C. Adams.

ROOSEVELT WILD LIFE BULLETIN, Vol. 4, No. 3. July, 1927.

1. A Trout Survey of Allegany State Park in 1922.....
William C. Kendall and Wilford A. Dence.
2. A Preliminary Survey of the Fish Life of Allegany State Park in 1921 .....Thomas L. Hankinson.
3. Current Station Notes.....Charles C. Adams.

ROOSEVELT WILD LIFE BULLETIN, Vol. 4, No. 4. July, 1927.

1. The Beaver in the Adirondacks: Its Economics and Natural History....
Charles E. Johnson.

ROOSEVELT WILD LIFE BULLETIN, Vol. 5, No. 1. March, 1928.

1. A Preliminary Wild Life and Forest Survey of Southwestern Cattaraugus Co., N. Y.....Victor H. Cahalane.
2. A Preliminary Report on the Trout Streams of Southwestern Cattaraugus Co., N. Y.....Wilford A. Dence.