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THE GRAYLING IN MICHIGAN*

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I. INTRODUCTION

FEW of our fishes have commanded as much interest as the magnificent grayling. It is regarded by many as the most beautiful of our game fishes, and the mystery of its disappearance is intriguing. Once the most abundant fish in many of our northern streams, it has now been reduced in numbers to a few individuals, which survive in the Otter River in Houghton County.

Under pressure from fishermen and naturalists generally the State Department of Conservation of Michigan has tried to culture and replant the deserted waters with this highly prized fish, but without success. This may in part be attributed to deficiency in our knowledge of its life history.

Recently a few specimens from the Otter and Au Sable rivers in Michigan and some of the very closely related Montana grayling have come into our hands for study through the courtesy of the Cranbrook Institute of Science and the Museum of Zoölogy of the University of Michigan. We are thus able to make a study which is concerned with the growth of the grayling in the Otter River as determined from the scales. We hope that it will stimulate further study of the grayling. It is to be desired greatly that at least enough of these unique fishes may be raised to save the species from extinction, even if numbers sufficient for sport fishing be impractical or inadvisable to maintain.

II. FORMER DISTRIBUTION OF GRAYLING IN MICHIGAN

The rivers, lakes, and bays mentioned by Michael (1905, p. 24) as formerly inhabited by grayling include the following: Muskegon,

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Manistee, Jordan, Cheboygan, Rifle, and Au Sable rivers; Pine and Portage lakes; Great and Little Traverse bays and Thunder Bay. Milner (1874, p. 731) says that the grayling occurs in Pine Lake, in the upper tributaries of the Muskegon and Manistee rivers, and in the Boardman, Jordan, Au Sable, Rifle, Marquette, and Au Gres rivers. Mershon (1923, pp. 142–181) in his *Recollections of My Fifty Years' Hunting and Fishing* states that brook trout were unknown in the Southern Peninsula except in a few streams flowing directly into Lake Michigan in the extreme northern part. The grayling, according to the same writer, occurred rather generally throughout the areas in the Southern Peninsula where brook trout are now found. Mershon took grayling in the Black River as late as 1903. The first specimen of grayling from the Otter River is recorded by Jordan and Evermann (1896, p. 518).

III. GRAYLING PLANTS IN THE OTTER RIVER

It is unfortunate, at least for any taxonomic study of the grayling, that an effort was made to plant the closely related Montana grayling in the Otter River. The first mention made of plantings of these fishes in this river is in the *Twenty-first Biennial Report of the Michigan Fish Commission.* Under the record of grayling plants the following entry is found (p. 212): "Houghton County, Otter river; 25,000." These plantings were fry obtained by hatching eggs of the Montana grayling. Whether or not they were successful cannot be determined. In view of the survival of the species up to the present day in the Otter River it seems necessary to assume at least that conditions may have been favorable for plantings and that some of the fry may have survived.

IV. PREVIOUS STUDIES OF THE OTTER RIVER GRAYLING

During the year 1922 the grayling were the object of a mostly unpublished study of considerable scope by John N. Lowe. In the *Biennial Report of the Department of Conservation for 1925 and 1926,* (p. 126) he estimates that there were in 1925 between 600 and 700 individuals in the river. About 125 of these were removed to the lower part of the state and were planted on the Gladwin game refuge in an old beaver pond, which is now a cat-tail marsh. Quite naturally these transplantings seem to have been entirely unsuccessful.

V. SPECIFIC STATUS OF THE OTTER RIVER GRAYLING

If the 1914 planting of grayling in the Otter was successful, the present race may possibly, but not probably, be hybrid in origin. Experts are much puzzled in their effort to separate the various isolated groups of grayling. This species appears to have been a relict of the Great Ice Age and to have persisted in favorable cold water sites and has been separated from the circumpolar grayling since that time. Quite probably there is no specific difference between the currently recognized three species of North American grayling. Our study shows a marked difference in growth rate, but since in each instance there are sufficient data from only one locality, environmental differences cannot be ruled out. It is also possible, but not likely, that the Otter River grayling is racially different from the one formerly occurring throughout the northern section of the Southern Peninsula. For the present purposes the name *Thymallus tricolor* Cope, 1865, may be used in connection with the Otter River specimens, with the reservations noted above. Studies are now in progress by other workers on the specific status of the existing Michigan grayling.

VI. AGE AND GROWTH STUDIES OF GRAYLING FROM MICHIGAN AND MONTANA

The specimens of grayling at our disposal consist of individuals from Michigan and Montana. Specimens from Montana are included in this account to give some idea of the comparative growths.

The scales used in this study were obtained from the side of the fish above the lateral line and below the middle of the dorsal fin. They were cleaned and mounted in the sodium silicate, glycerin medium. Readings and calculations of the age and growth of the grayling were made from a typical fish-scale projector (for methods see Creaser, 1926, pp. 10–12).

The scale of the grayling is exceptionally easy to decipher. The growth-cessation marks are quickly established and are clearly marked. Since the grayling spawn early in the spring, activity at this time merely serves to accentuate the winter mark.

Our material of the Michigan grayling consists of thirteen specimens, and all except one are from the Otter River. Very fortunately this Otter River series varies in size from 90 mm. ($4\frac{3}{8}$ inches) to 242 mm. ($11\frac{1}{4}$ inches) and permits the construction of a tentative

growth curve of specimens from this river. All year groups from 0 to III are represented, and to this information we have added computations of length based on scale measurements. The scale of the grayling shows conclusively that it undergoes a very definite period of growth cessation, as will be noted in Plate XCVII. Computations and measurements show that the average growth of the Otter River grayling for the first growing season is about 86 mm. standard length, or about 4⅛ inches total length. At the end of the second growing season they have attained a size of 178 mm., or about 8⅛ inches. At the end of the third growing season they have attained a standard length of 232 mm., or a total length of about 10½ inches. The growth increment in the fourth growing season cannot be given with any degree of surety. We have examined a single specimen preserved at the end of its fourth growing season. This specimen, now in the Cranbrook Institute of Science, was removed from the Otter River at the beginning of its third growing season and placed in a hatchery stream. At or near the end of its fourth growing season it was 242 mm. long, or 11¼ inches total length (see Fig. 46).

The single specimen that we have seen from the Au Sable River at Grayling, Michigan, at the end of its third growing season (Sept. 1, 1900) was 258 mm. long standard length, or 11½ inches total length. The computed length for the first growing season is 86 mm., or about 4⅛ inches, and for the second growing season 191 mm., or about 8¾ inches.

The Montana grayling from Georgetown and Rodgers lakes, according to our computations, measurements, and scale readings of seven specimens grow considerably faster than the Michigan grayling from the Otter River. The computed length for the first growing season is 91 mm., or about 4⅜ inches total length; for the second growing season, 234 mm., or about 10⅜ inches (about as long as the average of the Michigan grayling from Otter River one year older). At the middle of the third growing season the Montana grayling averaged 292 mm., or about 13¾ inches total length. Two specimens from Rodgers Lake collected in the middle of their fifth growing season averaged 341 mm. standard length, or about 15½ inches total length (see Fig. 46).

Such data as are available to us indicate that there is little if any difference in growth which may be attributed to sex.

From our evidence it seems certain that the grayling in the Otter

River mature at the end of their second growing season. The single female specimen of about this age (caught late in the second growing season) which we have from this river shows the eggs in early stages of development, whereas a specimen from Montana of slightly

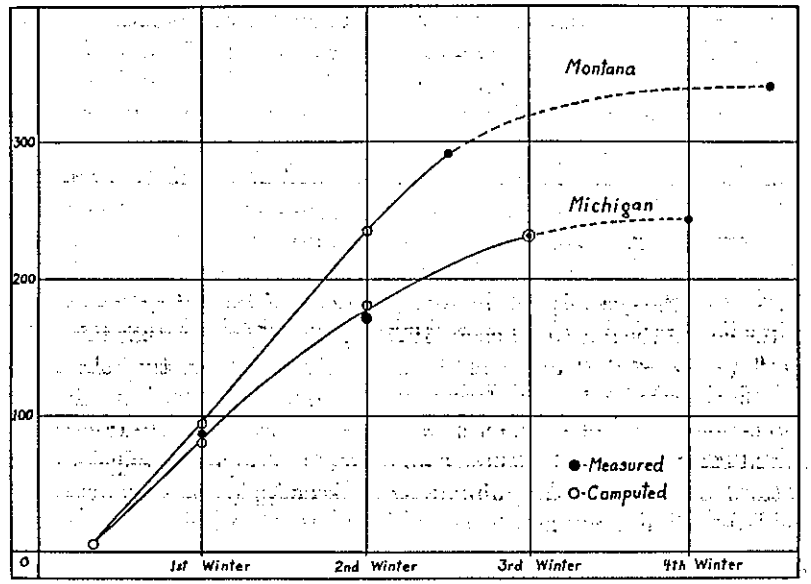

FIG. 46. Comparative growths of the Montana and the Michigan grayling. For the Montana grayling the unbroken line represents individuals from Georgetown Lake; the broken line, two from Rodgers Lake. These last two were not used in the computations. For the Michigan grayling the unbroken line represents individuals from the Otter River; the broken line, a single specimen from the Otter River, which was removed to a hatchery at the beginning of its third growing season. This specimen was not used in the computations

younger age has ripening ova. Spawning probably takes place at the beginning of the third season. The males are almost mature late in the second growing season. The Otter River grayling thus reach maturity at an average size of 178 mm., or about 8⅛ inches.

The comparative growths of the brook trout, the rainbow trout, and the grayling are of interest. Ricker (1932, pp. 77–81) states that in the Mad River, Ontario, the brook trout late in the summer have an average length in their first growing season of 2 inches; in their second growing season they are 4.9 inches long; in the third growing

season they are 7.6 inches long; and those which are in their fourth season are 10.4 inches long. Hazzard (1932, pp. 347–349) gives the following information about the average lengths of wild brook trout in New York. The average standard length at the end of the first growing season is 9.4 cm. ($4\frac{1}{4}$ inches total length); at the end of the second growing season, 13.5 cm. (about 6 inches total length); at the end of the third growing season, 16.8 cm. (about $7\frac{3}{4}$ inches total length). The brook trout quite clearly is a more slowly growing fish than the grayling.

Mottley (1932, pp. 148–151) gives some data on the Kamloops rainbow trout (*Salmo kamloops* Jordan). He found a different growth rate correlated with environment of lakes and streams. The stream rainbow trout grew more slowly, but even they had attained a length of about 7 inches at the end of the first growing season; 14 inches at the end of the second; 16 inches at the end of the third; 19 inches at the end of the fourth. Leach (1923, pp. 34–35) states that rainbow trout (*Salmo shasta*) under artificial conditions attain the following lengths: at the end of the first growing season, 8–10 inches; at the end of the second, 12–14 inches; at the end of the third 16–18 inches. Leach surmises that the trout would average 2 inches smaller under natural conditions. The rainbow trout seemingly grow faster than the Otter River grayling.

VII. NATURAL HISTORY NOTES

The Michigan grayling was formerly a very prolific species. Probably the closest approach to its numbers in the state today is that of the smelt, *Osmerus mordax*. Like the smelt, the grayling is a spring breeder. During the breeding season in the past century thousands of grayling were caught. Parker (1889, pp. 83–87) records that vast numbers were taken in the Hersey branch of the Muskegon River in the early spring breeding run. These fishes were slaughtered by the thousand, and no less than a half-dozen wagon-loads were hauled away. Hinsdale (1932, p. 15) digests information given by H. B. Roney [1] which testifies to the former abundance of these fishes. "A party of two gentlemen and two ladies who encamped upon a stream for about a fortnight caught 3,000 greylings, 2,000 of which were taken to Chicago, the other 1,000 not being in sufficiently good state of preservation to be transported. Another party from Chicago caught, during an expedition of 4 weeks, 5,000 greylings."

[1] *The Importance of More Effective Legislation for the Protection of Game and Fish*, Michigan Sportsmen's Association for the Protection of Fish, Game, and Birds. 1879.

At the present time graylings occur in vast numbers in Alaska. Here, as formerly in Michigan, they take a fly very readily in the bright daylight. In spite of the fact that they bite readily they are rather difficult to land, since their mouths are very tender. They are largely insectivorous and live in rapidly moving waters. The ease with which they may be caught with a fly doubtless contributed to their decrease in numbers.

The former remarkable numbers of this species of fish may in part be attributed to its fecundity. Jerome (1879, p. 29) records that 3,555 eggs, as determined by a count were taken from a female which weighed nine ounces after their removal. A large brook trout is much less prolific.

In the literature there has been much discussion regarding the taste of this fish. There is rather general agreement that it does not taste like either the brook or the rainbow trout. According to some fishermen, it tastes like the whitefish. Mr. Hanselman of Ann Arbor, who has caught grayling in the Manistee River (Pl. XCVIII), says that the taste and the texture of the flesh differ little from those of our native ciscoes.

The causes underlying the disappearance of the grayling are unknown. Several theories have been advanced. Overfishing has been repeatedly mentioned as the reason for its near extinction. Acid pollution from cedar logs, sawdust pollution, and log driving, have been advanced as factors in the depletion of the species. Mershon (1923, pp. 170–171) says, however, that after the log drives had ceased the grayling again became abundant. He favors the view that the introduction of the rainbow and the brook trout were contributing factors in the disappearance of the grayling in the Au Sable and Manistee rivers. The grayling have, however, persisted for some time in the Otter River in company with other trout. The interrelationships of the various species may have had some bearing upon the final extinction of the grayling. A theory which has not received much consideration concerns the temperature requirements of this species. The clearing of the forests and the subsequent burning most certainly caused a rise in the average summer temperatures

of the streams, perhaps beyond the toleration point of these fishes, as has been indicated for the brook trout (Creaser, 1930). It should be recalled here that the grayling is a glacial relict which became established at the edge of the retreating glacier in ice-fed rivers and persisted since that time in favorable situations. Mershon (1923, p. 178) mentions that the temperature of the water on the Au Sable River on April 30, 1874, was 40° Fahrenheit. This appears to be the only temperature record made of the water of the Au Sable during the days when it was inhabited by grayling.

VIII. PROBLEMS OF PROPAGATION

From the standpoint of propagation, the relative growth rates of the Montana and the Michigan grayling are extremely important. There is a great possibility that the differential growth rate of grayling in the two states may be genetic rather than environmental in nature. If this be true and if the grayling should prove to be desirable, the Montana grayling should be the one reared for sporing purposes. The advisability of restocking our lakes and streams at this time with Montana grayling is extremely questionable. The ease with which they take the fisherman's fly removes most of the element of sportsmanship in this pastime. They are too easy to catch. Moreover their food habits render them competitors of some of the other well-established species of trout. Also attempts to plant grayling in the past have apparently met with no success at all. Finally, it is strongly desirable that more information be available on its environmental requirements before plantings are attempted.

For scientific purposes if for no other the Michigan grayling should be maintained and every effort should be now extended in this direction. Perhaps it is even now too late.

IX. SUMMARY

The Michigan grayling formerly occurred widely distributed throughout the northern part of the Southern Peninsula. It still persists in rapidly diminishing numbers in the Otter River in the Northern Peninsula.

The Montana grayling has been planted in the Otter River, complicating studies of a systematic nature.

The grayling in the Otter River grows more slowly than the corresponding species in Montana. The brook trout grows somewhat more slowly than the Michigan grayling; the rainbow trout seemingly grows faster.

Notes and testimony on the former abundance of the grayling are given. The reasons underlying its disappearance are considered with special attention given to the neglected temperature theory.

The desirability of saving the Michigan grayling from extinction is mentioned. The wisdom of further attempts at planting Montana grayling at the present time is questioned.

SUMMARY OF GRAYLING DATA

Locality	Date	Age and sex	Standard length in mm.	Total length in inches	Computed lengths in mm.			
					I	II	III	IV
Otter River, Mich.	Fall, 1932	III	242	11¼	65	139	193	
	Fall, 1922	II ♂	228	10½	85	181		
	do.	II ♂	224	10⅛	78	175		
	do.	II ♂	229	10¼	72	182		
	Sept. 10, 1925	I ♀	152	6⅞	88			
	do.	0	90	4⅜				
	do.	II ♀	238	10½	79	174		
	do.	II ♀	241	11	83	193		
	do.	I ♂	182	8¼	82			
	do.	I ♂	173	8	87			
	do.	I ♂	188	8⅝	88			
	do.	I ♂	166	7¾	82			
Au Sable River, Mich.	Sept. 1, 1900	II	258	11½	86	191		
Georgetown Lake, Mont.	May 29, 1926	II ♀	250	11½	102	239		
	June 15, 1933	II ♂	314	14⅝	78	233		
	do.	II ♂	298	13⅞	70	223		
	do.	II ♀	311	14⅝	102	251		
	do.	I ♀	252	11⅞	104			
Rodgers Lake, Mont.	July, 1933	IV ♂	344	15⅝	160	292	312	332
	do.	IV ♂	338	15½				

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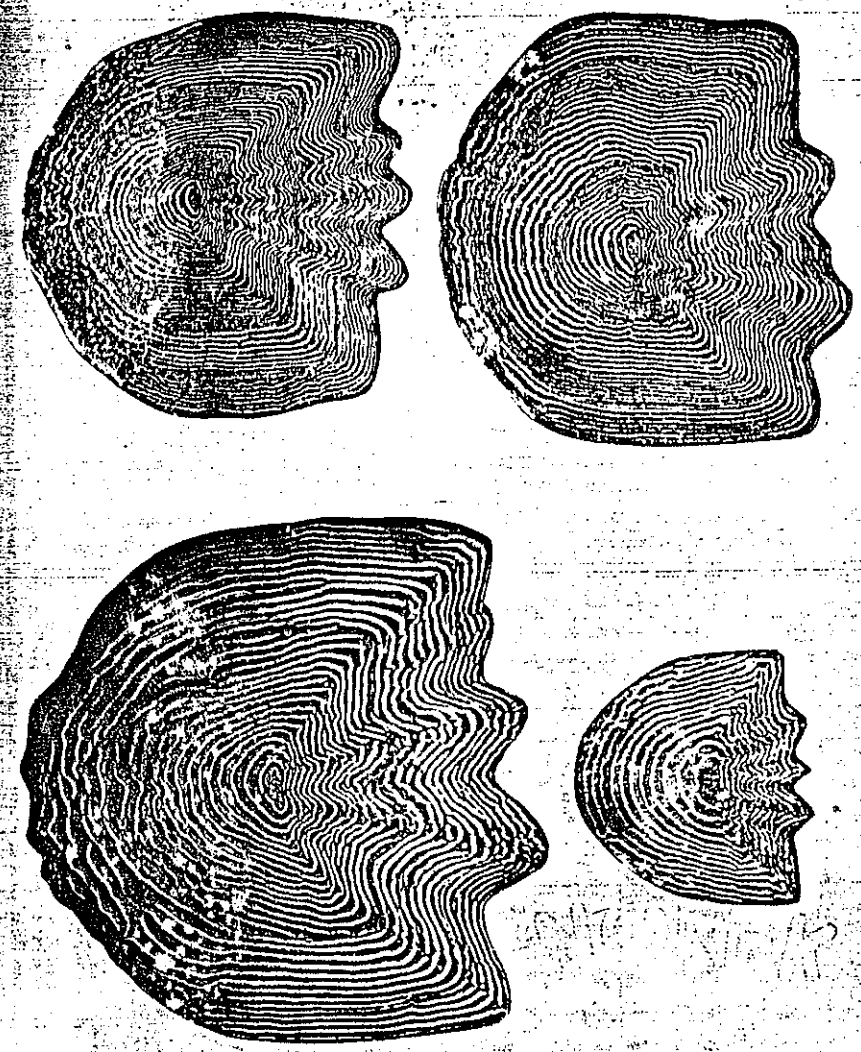

Scales of Michigan grayling: lower left, at end of first growing season; upper left, at end of second growing season; lower right, at end of third growing season; upper right, at end of fourth growing season

PLATE XCVII