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OBSERVATIONS ON THE LIFE-HISTORY AND BREEDING HABITS
OF THE MONTANA GRAYLING*

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The Montana grayling, like all other species of the Thymallidae, breeds in the spring of the year. Milner (1874) gives April as the time of spawning for the Michigan species, while Whitaker (1886) includes March and April ("and perhaps even earlier"). Norris (1883) considered it to be a late spring spawner, referring to April and early May as the breeding period. According to von Siebold (1863) the European grayling begins to spawn in March and may continue into April.

The actual period of spawning for the Montana grayling has been found to vary greatly between different years and between different localities in the same year. While the controlling factors initiating grayling breeding activity have not been carefully studied, it is safe to say that the temperature of the water has great influence. In 1936 the first grayling came into the U. S. Bureau of Fisheries traps March 15 (Lower Odell Creek, Madison River). The peak of the run was attained April 16 and the last individual observed appeared April 24. This same year a few spawners

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were taken in the Meadow Creek traps (a few miles down stream from the Odell Creek station) between May 1 and May 15. The spawning period seems to be much more concentrated in the artificially stocked lakes of the region. Experience has shown that grayling often run in advance of the rainbow and cutthroat trout and that the males frequently appear in advance of the females. At Grebe Lake, Yellowstone National Park, the run usually begins the day after the ice goes off. During the five years previous to 1937 this period occurred at Grebe Lake between May 15 and June 20; at Rogers Lake, Flathead County, Montana, between May 1 and June 1; and at Georgetown Lake, Granite County, Montana, between May 10 and June 5. In these lakes the grayling run is much more concentrated than the trout run, usually lasting not over a week and often being confined to two or three days.

Henshall (1907) reports that the Montana grayling will travel long distances to find suitable spawning grounds. This is in contrast to published records for the Michigan species, which according to Norris (1883) does not migrate as do the trout. Bissel (1893) says of the Michigan grayling, "..... they use the channel of the main stream not seeking the brooklets and shoals as trout usually do." Von Siebold (1893) observed that the European grayling did not migrate during the breeding period. Certain reports describe this species as running with the trout in English streams. There is no doubt but what the Montana grayling migrate during the spawning period. Those in lakes move out into whatever streams are available and those in streams go varying distances depending upon the stream in question. Henshall (1907) had no evidence in support of his contention, however, that the grayling he observed to use Red Rock Creek for spawning grounds came from the Jefferson River many miles below. More than likely most of these fish came from Beaverhead River and the Red Rock Lakes in the vicinity of Red Rock Creek.

No one has recorded evidence to show that either the Michigan or Montana grayling build nests. Heckel and Kner (1858), in describing the nest building process of the European grayling, state that the nest is dug by means of the tail and that after the eggs are laid and fertilized the fish then cover the nest with small stones.

Dr. I. H. Treece (quotation from Laird - 1928) describes the breeding habits of the Montana species as follows: "Grayling are not particular where they spawn, that is they will spawn on a gravel bed or out in the weeds along shore where there is gravel. They pair off to spawn and I never saw any other fish spawn just as they do; the male and the female will get just as close together as you could place your two fingers and then both spawn at the same time. I do not believe they make any effort to cover the eggs with gravel as do trout; in fact I believe the most of the eggs hatch without any cover."

On June 6, 1936, through the courtesy and help of Mr. A. G. Stubbelfield, Superintendent of the Anaconda, Montana State Fish Hatchery, the writer had an opportunity to observe the spawning process of grayling congregated in the inlet creek to Agnes Lake, Beaverhead County, Montana. This small stream (flow about $1\frac{1}{2}$ cubic second feet) enters the lake from the west end and has its source in the not far distant snowbanks. Due to the presence of a newly built beaver dam, only about 100 yards of the stream adjacent to the lake was available for spawning. The water was brownish in color and its temperature on the above date was 10°C . which is rather warm considering elevation and the type of stream. Both the color and temperature of the water were no doubt influenced by the series of beaver ponds immediately upstream. The bottom of the creek was composed of sand and fine gravel at a ratio of about 3:1.

At the time we approached the stream there were between 100 and 200 fish in the available section. These were mostly congregated so that several pairs were together, with a scattering of odd males, the latter moving slowly at random in the stream. One of the larger groups was composed of 13 males and 8 females. The ratio of the males to females for the entire section was about 3:2. Most of the fish were concentrated directly downstream from riffles, although several pairs were in the swiftest water of the riffles. We were surprised at the lack of fear exhibited by the fish. After our first approach they seemed to completely ignore our presence, even though we moved slowly about. This is quite in contrast to the reactions of trout under similar circumstances. Because of this fortunate condition, it was possible to stand in the stream immediately adjacent to the fish (a distance of 2-3 feet) and make the following observations.

There was no indication that these grayling had built or were attempting to build nests. All of them seemed to move around at random, changing positions frequently. In one instance a male came abreast of a female so that their bodies were 2-5 inches apart. They were situated in a swift riffle where the water was very clear and 8-10 inches deep. The bottom consisted of coarse sand and was perfectly smooth. After the fish had remained in the above position for two or three minutes, the male moved nearer to the female until his body touched hers for a good share of their length. As he did this the huge dorsal fin was extended and arched so that it folded over her back. She then moved away quickly in an upstream direction, soon to be followed by the male, whereupon the original position of the pair was again established. This whole activity was repeated three different times, with but one interruption by another male which moved in directly behind the spawning pair. After several sideward motions of the

body, the spawning male chased the intruder away but not with as much pugnacity as is usually exhibited by trout. The fourth time the spawning male moved toward the female she did not move as previously described, but seemed to crowd nearer to him so that their bodies were in direct contact from the head to the vent and at the same time the dorsal fin of the male was completely and tautly curved over her back. The fish at this moment were parallel with the current and as near abreast as one could have placed them.

Immediately upon contact, their bodies seemed to stiffen and then vibrate--the motion increasing in intensity to a climax which was reached in 10-12 seconds. During the last part of this activity the tails of both fish approached the bottom so that their bodies were at an acute angle with it. As a result of this position and the vibration of their caudal fins, the sand beneath was greatly agitated and stirred momentarily into the lower layer of water, making a shallow (3-4 inch) depression and decreasing the visibility so that it was impossible to see eggs or milt that might have been extruded. A screen was placed directly behind the fish in an attempt to recover any eggs which might float downstream with the current. None appeared, however, and as the pair moved apart, sand was scooped up from both sides and the bottom of the depression which was fast filling with sand from upstream. About 20 soft, newly laid eggs were found, no more in the pit of the depression than on either side. It was quite apparent that the very adhesive nature of the eggs had enabled them to become completely covered with the agitated sand grains and by means of this added weight be carried into the depression below, there to be at least partially covered and protected. The adhesiveness of the eggs may represent an adaptation to spawning in a current over sand or fine gravel without a previously prepared nest.

Many water-hardened eggs, most of them of odd shape as compared to the round eggs kept under artificial conditions, were found in the sand over the spawning areas of this stream. The oldest embryos from these eggs had reached a stage similar to the 9-day old individuals kept under hatchery conditions at a water temperature of 50°F. We secured no information regarding the further development of eggs deposited here.

Three other pairs of grayling were observed to spawn in this same stream, and in one case a female repeated the spawning act twice in 45 minutes, with two different males. It is probable that the egg laying interval for individual fish lasts about 2-4 days.

The spawning procedure itself should not have been greatly altered by the semi-artificial conditions afforded at Agnes Lake, but there was no opportunity here to test the selection which might have been exhibited by these fish as regard to the type of stream and kind of stream bottom. The question still remains unanswered as to what constitutes a natural spawning ground for this species. An attempt was made to locate the spawning grounds of the Madison River grayling, but without success.

There has been considerable discussion among fish culturists as to the number of eggs produced by an individual female grayling. Whitaker (1886) describes one Michigan grayling as producing 3,555 eggs. This female weighed only 9 ounces after the eggs were removed. In a discussion of Mr. Whitaker's paper, a Mr. Clark describes having taken 25,000 eggs from 6 or 8 females also that he took 5,200 eggs from one fish that weighed $1\frac{1}{4}$ pounds.

According to reports, the Montana grayling trapped at Grebe Lake in 1935 averaged 1650 eggs per female. One $\frac{3}{4}$ pound specimen taken from this lake in 1936 had 5,563 eggs by actual count. Two other $\frac{1}{3}$ pound (2 year old) fish taken at the same time contained 1,248 and 416 eggs respectively.

Two grayling taken from the traps at Rogers Lake in 1936 contained 9,059 and 4,904 eggs respectively. Counts made on 9 females from the same place in 1937 (total lengths ranged from 12 $\frac{3}{4}$ - 14 $\frac{1}{2}$ inches; average weight 15 ounces) showed a maximum of 7,068 and an average of 5,828 eggs per fish. Three large females from Coergetown Lake (average weight 2 pounds) contained 12,946, 12,642 and 8,135 eggs respectively. In comparison with trout, grayling males produce very small quantities of milt. It is often difficult in artificial spawning operations to secure enough sperm to fertilize the eggs.

The interim between fertilization and hatching has been found to vary between 11 and 22 days depending upon the water temperature and certain other factors not understood. When the water temperature is 50°F., the average time is about 16 days with a variation of seven days.

The hatching process is ordinarily of short duration, lasting only a day or so. For many years fish culturists expected about a 40% mortality in grayling eggs during the period before hatching. According to Mr. Fred J. Foster of the U. S. Bureau of Fisheries, the mortality of the grayling hatched at Grebe Lake has not exceeded 10% in the past few years.

Grayling fry, although considerably smaller than trout fry, grow much faster than the latter for the first year or so of life. Norris (1883) gives the age and length of the Michigan grayling as follows: first year 6 inches; 2nd year 10-12 inches; 3rd year 13-15 inches; 4th year 16-17 inches. Hatchery reared Montana grayling reached one inch in length at the end of the second month; 2 $\frac{1}{2}$ inches at the end of five months; and 7 inches at the end of a year.

A considerable number of the Montana grayling spawn at the end of their second year. The majority of spawners taken at Grebe and Rogers Lakes were in the three and four year classes as determined by scale studies.

LITERATURE CITED

- Bissel, J. H. 1893. Grayling in Michigan. Trans. Am. Fish. Soc. 1891
(1893), 27-29.
- Heckel, Jacob and Kner, Rudolf. 1858. Die Süßwasserfische der
"Österreichischen Monarchie. Wilhelm Engelmann. Leipzig.
pp. 242-246.
- Henshall, James A. 1899. Some notes on the Montana Grayling. Trans.
Am. Fish. Soc. 1899. pp. 80-85.
- _____. 1907. Culture of the Montana Grayling. Bur. of Fish.
Doc. No. 628. 7 pp.
- Laird, James A. 1928. Graylingⁱⁿ the East. Trans. Am. Fish. Soc. Vol. 58.
pp. 167-169.
- Milner, Jas. W. 1872-1873. Publ. 1874. Notes on the Grayling of North
America. Part II. Report of the U. S. Commissioner for
1872 and 1873.
- Norris, Thaddeus. 1883. The Michigan Grayling. Sport with Gun and Rod
in American Woods and Waters. Century Co. New York.
pp. 493-506.
- Siebold, C. Th. E. v. 1863. Die Süßwasserfische von Mittle-Europa.
Wilhelm Engelmann. Leipzig. 267-270.
- Whitaker, Herschel. 1886. The Michigan Grayling. Trans. Am. Fish-
Cultural Assn. 15th Annual Meeting 1885. pp. 59-67.