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GONAD MEASUREMENTS AND EGG COUNTS OF BROWN TROUT (SALMO TRUTTA) FROM THE MADISON RIVER, MONTANA*

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Abstract

Gonad studies were made on 41 female and 15 male wild brown trout, Salmo trutta, from the Madison River, Montana. The left ovary, with some exceptions, was found to be longer and heavier and to produce more eggs than the right. The average number of eggs produced by the right and left ovaries was 589 and 679, respectively, and the average of all eggs per female was 1,285. There seemed to be little or no correlation between the length, weight, condition, or age of these females, and the number of eggs produced. The gonads made up 1.7 per cent of the body weights of the males. The weight of the testes did not show any correlation with the length, weight, age, or condition of the fish studied.

Introduction

During November and December of 1936, while engaged in a study of the incidence of furunculosis in Madison River fishes, the writers had an opportunity to secure about one hundred wild brown trout spawners for gonad

studies. Most of these fish came from the U. S. Bureau of Fisheries' traps in the Meadow Lake region, Madison County, but a few were taken from the Montana State Fish and Game Commission traps above Hebgen Reservoir, Gallatin County, Montana.

Collections were made at random from the traps soon after the fish had entered. Special effort was made to avoid any selection in order that the sample might be representative of the run. However, only those fish were saved for study, which, after examination, showed the egg sacs to be intact or the testes to be firm. Fish in this stage of maturity are referred to as "green" in hatchery parlance. Fifteen males and 41 females were retained for study.

The standard and total lengths of each fish were measured to the nearest 1/8 inch and the weight to the nearest two ounces. Actual counts were made of all eggs. Egg measurements were made with a vernier caliper to the nearest 0.1 millimeters. Our figures represent an average of 15 eggs taken at random from the ovary. Gonad weights were taken by means of a torsion balance accurate to one milligram. All measurements were made while the fish were in a fresh condition, usually within two or three hours after the fish were captured. The age of each fish was determined by the usual method of counting scale annuli and the condition factor (K) calculated from the formula adopted by the Fisheries Board of Scotland (Nall, 1930).

Female Gonad Measurements

A comparison was made between the right and left ovaries of eight individuals as to their length, weight and number of eggs. As shown in

Table 1, the left ovary is generally longer and heavier than the right.

Table 1. A comparison between the length, weight and number of eggs for the right and left ovaries.

Standard length of fish-inches	Weight of fish ounces	Right ovary Length-millimeters	Weight grams	Number of eggs	Left ovary Length-millimeters	Weight grams	Number of eggs
12.25	16	128	29.7	443	153	36.2	550
13.25	18	133	42.3	580	174	47.4	658
13.75	22	156	44.9	600	187	43.9	574
14.25	24	148	44.9	567	175	56.7	721
14.50	24	125	28.7	400	188	61.7	856
15.00	24	151	27.6	368	179	35.0	503
15.12	20	94	17.3	228	150	31.5	431
15.50	24	132	23.7	297	150	28.5	370
Average 14.20	21.5	133.4	32.39	435.4	169.5	42.6	582.9

It also usually contains more eggs. This difference is due primarily to the anatomical arrangement of the organs in the coelomic cavity. In this species, the posterior portion of the intestine usually bends strongly to the right, thus crowding the right ovary at its caudal end. The length of the ovary is proportional to the degree of crowding. However, the left ovary is not always the longest. One fish was observed to have a longer right ovary and it was interesting to note that this specimen had an intestine which bent to the left instead of the right. In one or two cases the ovaries were of approximately equal length, with the intestine bending no more to the right than the left.

The average number of eggs in the right and left ovaries from 38 females was 589 and 679, respectively, showing that the shorter ovary as a rule contains fewer eggs.

Gonad weights and egg counts were made on four females collected

above Hebgen Reservoir, approximately one month before spawning began, and these were compared with five others taken at the same place during the spawning season. Table 2 shows that the ovaries of those collected before the spawning season averaged 3.4 grams as compared to 73.5 grams for those collected during spawning.

Table 2.

Age	Standard length-inches	Weight of fish-ounces	Weight of ovaries-grams	Total number eggs	Number old eggs
Females taken one month before spawning began - October 9, 1936					
3	14.5	16	4.4	862	3
4	15	20	2.7	2,070	1
4	15	24	3.2	1,776	2
4	16	24	3.6	1,425	28
Average 3.75	15.12	21.0	3.47	1,533	8.5
Females taken during spawning period - November 18, 1936					
4	14.25	24	101.6	1,288	0
4	15.0	24	62.9	871	4
4	15.12	20	48.8	659	6
4	15.5	24	52.2	667	1
5	15.5	28	102.0	1,073	10
Average 4.2	15.07	24.0	73.50	911.6	4.2

If this sample is representative, the ovaries increase about 20 times in weight during the month prior to spawning. The number of eggs in those females taken early averaged 1,533 as compared to 912 for those taken later, while the weight of the females in the last group averaged four ounces greater than those taken earlier.

Day (1887) reports that early spawning trout have smaller eggs than those from the latter part of the run and that the size of eggs increases with age and probably with condition of the parent. Our collections did not include specimens from the early and late run and therefore

throw no light on this point.

Egg counts

Actual numbers of eggs for each of 37 females are given in Table 3. The average number of eggs produced was 1,285 for females having an average total length of 15.72 inches and an average weight of 21.35 ounces. This is very near the number reported by Vladykov and Legendre (1940) for a wild brook trout of comparable size. The largest number of eggs was from a fish 16⅝ inches in total length, which weighed 26 ounces, and the smallest number from a 17 1/4 inch fish which weighed 20 ounces.

Hayford and Embody (1930), in selection experiments with hatchery brook trout, found that selected females produced on an average, 1,164 eggs per female their first spawning year as compared to an average of 272 for like females of the general hatchery run. Second year spawners of the selected fish produced an average of 1,916 eggs (fish 16-16⅝ inches total length). They discovered much variation within the group studied, however. Some of the larger females produced the smallest number of eggs. In general, they conclude that the fast growing, larger females produce the most eggs.

Table 3. Showing size, age, condition, and number of eggs for 37 Madison River brown trout.

	Standard length-inches	Total length-inches	Weight of fish-ounces	K	Age of fish	Weight of ovaries	Number of eggs	Number of old eggs
	12.25	13.75	16	0.901	3	65.9	993	0
	12.25	14	14	0.747	3	73.2	1,045	2
	12.5	13.75	18	1.014	3	87.0	1,884	3
	12.75	14.37	18	0.888	3	89.4	1,532	1
	13.25	14.62	16	0.843	2	89.7	1,238	1
	13.25	14.75	22	1.003	3	113.6	1,435	8
	13.25	14.87	18	0.801	3	92.9	1,310	6
	13.25	14.87	20	0.890	4	98.2	1,410	0
	13.25	15	16	0.694	3	77.0	1,077	0
	13.25	15	20	0.867	3	89.2	994	1
	13.37	14.87	20	0.890	3	105.5	1,299	8
	13.5	14.87	18	0.801	3	93.1	1,454	0
	13.75	15.25	20	0.825	3	79.9	1,503	3
	13.75	15.25	22	0.908	4	88.8	1,174	0
	13.75	15.5	20	0.786	3	94.1	1,328	2
	13.75	15.5	20	0.786	3	85.2	1,374	0
	14	15.62	22	0.845	3	117.1	1,688	0
	14	15.75	20	0.749	3	108.2	1,794	1
	14	16	20	0.715	5	76.8	1,196	0
	14.12	16	20	0.715	3	78.7	1,337	1
	14.25	15.5	24	0.944	4	101.6	1,288	0
	14.25	16	20		3	69.1	1,166	51
	14.25	16.12	22	0.769	4	90.2	1,174	0
	14.5	16.12	24	0.839	4	100.0	1,377	0
	14.5	16.12	24	0.839	4	80.9	839	0
	14.5	16.25	24	0.819	4	90.4	1,256	0
	14.5	16.25	24	0.819	5	124.3	1,744	0
	14.5	16.5	22	0.717	4	97.4	1,067	8
	14.75	16.5	28	0.912	4	106.0	2,352	0
	14.75	16.62	24	0.765	4	80.2	865	3
	15	17	24	0.715	4	62.6	871	4
	15	17	26	0.796	3	106.1	1,682	0
	15.12	17.25	20	0.570	4	48.8	669	6
	15.25	17.25	24	0.685	5	95.6	1,104	0
	15.5	17.25	26	0.682	4	141.2	1,299	71
	15.5	17.25	28	0.799	5	102.0	1,073	10
	15.5	17.5	24	0.700	4	52.2	667	0
Average	14.02	15.73	21.35	0.784	3.57	90.5	1,285	5.13

In our sample there was no marked correlation between the size and weight of the fish and the number of eggs produced. As shown in Table 3, the fish with the greatest length produced 667 eggs, only about one half of the average; on the other hand a specimen almost as large had the highest egg count. Several of the smaller females had better than average counts. Fish with a standard length between 12 and 13 inches averaged 1,364 eggs; between 13 and 14 inches, 1,300 eggs; between 14 and 15 inches, 1,300 eggs; and between 15 and 16 inches, 1,131 eggs.

The condition of the fish seems to lack significance when considering egg production. At least, our sample shows no correlation between condition and the number of eggs. The specimen with the highest K, however, did produce the largest number of eggs.

According to Nall (1930), female sea trout produce 700-800 eggs per pound of fish, but he recognizes a great deal of variation from this figure. He observes that the smaller fish have more eggs per pound of fish but that the eggs are of smaller size.

Dahl (1917) reported that the weight of the roe per pound of fish is less in young females but that the number of eggs decreases as age and weight of females increase, i.e., young trout are more prolific but produce smaller ova.

The females of our collection showed from 2 - 5 scale annuli but egg counts do not seem to show significant variation between the different age groups, although Needham (1938) reports that, "The number of eggs depends naturally upon the age of the fish" in brook trout. In our sample, one 2-year-old brown trout had 1,238 eggs; 18 three-year-olds averaged 1,383 eggs; 17 four-year-olds, 1,155 eggs, and 4 five-year-olds, 1,279 eggs.

Old eggs, i.e., eggs apparently held over from the previous year, were present in 50 per cent of the females studied. They ranged from a single egg to 71 in numbers per female, or an average of approximately 5 old eggs per fish.

Egg diameter measurements were made for 31 females. The average diameter was 4.94 millimeters. The size of the egg in this sample could not be correlated with the size or age of the fish or the number of eggs produced.

Male gonad measurements

Only 15 males were studied. Their body weights and lengths and gonad weights are given in Table 4. This small sample shows no correlation between the size or condition of the fish and the weight of the testes. The testes averaged 9.9 grams, 1.7 per cent of the body weight. The lack of correlation may be due to the inadequate sample or to the different degrees of "ripeness." There is no reason to believe from this sample that the age of the fish has anything to do with the weight of the testes.

Table 4. Showing the size, weight, age, and condition of male brown trout as compared to gonad weight.

	Age-annuli	Standard length-inches	Total length-inches	Weight-ounces	K	Weight of testes-grams
	4	11.75	13.25	10	.629	8.6
	2	12	13.5	16	.952	13.5
	4	12.25	13.5	14	.833	5.2
	3	12.50	14.25	16	.810	8.9
	4	12.75	14.25	18	.911	8.9
	4	12.75	14.75	16	.810	4.9
	5	13.25	15.5	20	.786	6.1
	4	13.5	15	20	.867	8.0
	4	13.75	15.25	20	.825	8.1
	4	13.75	15.5	20	.786	13.0
	5	14	16.25	22	.750	13.1
	3	14.25	16.25	20	.682	7.4
	3	14.5	16	20	.715	7.5
	4	14.75	16.5	24	.782	14.3
	5	15.37	17.12	28	.817	16.0
Average	3.9	13.41	15.1	18.9	.797	9.6

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