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FEEDING HABITS AND MORTALITY OF BROOK TROUT FINGERLINGS OF WILD AND HATCHERY ORIGIN UNDER EXPERIMENTAL CONDITIONS

by

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Introduction

A brief progress report on the experiment now being conducted in Diversion Section II-B at the Hunt Creek Experiment Station is submitted herewith, in the belief that results obtained to date may prove to be of interest.

On February 19, 1941, a series of 102 brook trout fingerlings were secured from the Grayling State Fish Hatchery through the courtesy of H. L. Peterson, District Supervisor of Fisheries Operations. This lot of fish weighed 4 pounds; the total length of the individual trout ranged from 3-1/8 to 6-1/8 inches. After the fish were tagged, weighed and measured, half were planted in Section II-B, the other half in III-B. Similar numbers of wild trout of comparable length were seined from the stream, tagged, weighed and measured, and planted in the same sections to provide comparative figures on growth and survival.

The trout were placed in Section II-B according to a plan that, from time to time, equal numbers of wild and hatchery fish would be removed for stomach analysis to determine how soon the hatchery fish would prove themselves able to capture natural food as successfully as the wild fish. A record of mortality was kept, as well as of length and weight changes in the fish as shown by comparing measurements taken at the time of tagging and of subsequent recapture. During the period covered by this report, from the time of planting during the evening of February 19, to April 1, 1941, three collections of trout have been taken and the stomach contents analyzed. Each collection comprised 5 wild and 5 hatchery fingerlings. Air and water temperatures, taken twice daily, are shown graphically at the end of the report.

Mortality

Fifty trout of hatchery origin were tagged and placed in Section II-B at 9:00 p.m., February 19, 1941. The following morning 3 of these fish were found dead against the foot screens. As another 50 hatchery fingerlings were scheduled for planting in Section III-B, only 2 were available to replace the three that succumbed.

Subsequently, one hatchery trout was found dead on each of the following dates: February 23; March 17; and March 31. Therefore, of a total of 52 trout, 6, or 11.5 per cent, perished in a little less than 6 weeks.

Although every precaution was taken in tagging and planting, and although the trout seemed to be in good condition after transportation from the hatchery 50 miles distant, the mortality of 3 trout the morning after planting might possibly be ascribed to shock from planting, tagging, or a combination of the two. However, it should be noted that to date

none of the wild fish similarly handled (except for the fifty mile trip in the tank truck) and planted in II-B have been found dead. Autopsy revealed no discernible cause for any of the six deaths.

Diet and Behavior

The three collections of fish here considered were taken on March 1, March 4 and March 18, 1941. The results of stomach analysis on a volume basis as well as range and average of dimensions at time of capture are shown in Table 1. The figures show that the hatchery trout, a week after liberation, contained on the average less than one-seventh as much as wild fish of comparable length. A little less than four weeks after planting the hatchery fingerlings were apparently feeding almost as successfully as the wild. However, on this latter date, one of the hatchery fish had consumed a single large larva of the showy cranefly Pedicia albivitta. This single larva accounted for nearly one-half of the total volume of food taken by the hatchery series. Without it, the average volume of contents per stomach would be, not 0.110 cc., but 0.060 cc. The findings recorded in Report No. 659[1] support the belief that Pedicia larvae cannot be considered a normal component of the diet of trout in Hunt Creek; not one of the 131 trout stomachs examined from the catch of the 1940 season contained the species. We must, therefore, consider this occurrence of a large Pedicia larva accidental, and bear that thought in mind when appraising the results shown in Table 1.

A consideration of Table 4 reveals that while in each collection the wild trout contained many more food organisms than those of hatchery origin, the number of organisms consumed by the latter almost doubled

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[1] Leonard, J. W. 1941. The feeding habits of legal brook trout in Hunt Creek during the 1940 fishing season. Institute for Fisheries Research Report No. 659.

from first to last. The number taken by the wild fish of the last collection was less than half that of either of the earlier collections, a situation which may be explained in part by the fact that a majority of the Chironomus modestus population had emerged as adults during the fortnight of March 4-18. The steady increase in feeding by the hatchery fingerlings must indicate on their part a growing proficiency in the detection and capture of natural food.

The species of food organisms eaten by the two classes of trout indicate clearly a difference in habitat selection amply supported by observation, namely, that the hatchery trout thus far have tended to congregate in the relatively quiet water a short distance above the foot screens, while the wild fish at once dispersed themselves generally throughout the section in the fast water, seeking shelter in the myriad minor irregularities of the stream bed and bank. The current-loving caddis larvae were of general occurrence in the stomachs of the wild fish, but were exceedingly rare in those of hatchery origin. The same applies to stoneflies. Adult dytiscid beetles and water boatmen, which shun fast water, occurred only in the stomachs of the hatchery fingerlings.

When the fish were planted, both classes were introduced in quiet water just below the head screens. It was noticed that the wild fish almost immediately scattered, darting off in every direction and plunging into whatever shelter was found. The hatchery fingerlings, on the other hand, lay in a group in the quiet water and were dispersed only as occasional swirls and eddies swept them away, one or two at a time. Once they were in the full force of the current (2 to 2.5 feet per second) they seemed, without exception, quite helpless, and were borne rapidly downstream without regard for orientation, now sideways, now tail foremost, frequently bumping obstructions in the bottom and making only

convulsive, apparently uncoordinated attempts to right themselves. This passive progress was arrested about 25 to 30 feet above the lower screens. Here the channel suddenly increases in width, and this factor, together with the slight head built up by the screens, cuts the current velocity to less than 1 foot per second. A certain amount of cover in the form of submerged branches and logs permitted the fish to find shelter here. It is significant that in the period covered by this report, seining to collect samples has never revealed the presence of hatchery fish except in this zone of relatively quiet water. Wild tagged trout, on the other hand, have been found generally and quite evenly distributed throughout the section.

The behavior of wild and hatchery fingerlings when planted at the same time in Section III-B completely duplicated that just recorded for those in Section II-B. If we may permit ourselves a brief indulgence in speculation, we should like to point out some of the possibilities with which such a situation is fraught. If hatchery fingerlings planted in swift streams during periods of low water temperature lie thus at the whim of the current, what possible fates may await them? For that matter, might not the continued action of the current itself in tumbling them about willy-nilly have an adverse effect on their rate of survival? Apart from that, an unknown percentage of such a planting might be carried downstream beyond the limits of suitable trout habitat, or over a dam or other obstruction which would block any effort they might make to return. Or, without covering a significantly great distance, trout from such a planting might still be deposited by eddies in a large pool, a pool of the type often dominated by one or two resident trout of generous dimensions and cannibalistic proclivities, which might give the newcomers short shrift. These hazards did not jeopardize the lives of the trout

in Section II-B, for all other fish had been removed before their introduction, and the foot screens not only prevented their being swept on indefinitely, but created an area of slack water where the hatchery fingerlings might regain control of their own movements. Yet, with these factors favoring them, those in II-B have so far sustained a mortality of over 11 per cent.

Generalizations cannot, of course, be safely drawn from a single experiment of small scope and brief duration. The plans of the station provide for repetitions of this experiment, with minor variations, at other seasons and under other conditions. Only by such deliberate and painstaking methods can a body of tested, proven conclusions be obtained. But in the interim the foregoing results of observation may at least be kept in mind; and on that basis there might be offered the tentative suggestion that it might be profitable if hatchery fingerlings, for three or four weeks prior to planting and while still under the protection of hatchery conditions, were to be subjected to current velocities of 1 to 1.5 feet per second, to develop their latent instinct for orientation to current. The added exertion might produce a slight lowering in condition factor, but this might be offset by a higher ultimate survival rate.

Growth and Condition

Reference to the temperature record (Graph 1) shows that low water temperatures prevailed throughout the period covered by this report. The air temperature fluctuated through a range of 45 degrees Fahrenheit, but that of the water varied within a limit of only 6 degrees, from 33° to 39°F.

With such low temperatures prevailing, little growth would be expected, especially within such a relatively short period of time.

However, continuing attention is being given to growth and possible changes in condition of the populations in II-B.

Table 2 shows the slight changes noted in both the wild and hatchery trout from time of release to subsequent recapture. The figures shown are averages, employed to conserve space and simplify interpretation of results, although data on individual fish, traceable by tag numbers, are on file for reference.

It will be seen that during the last two periods the hatchery trout made slight gains in length and sustained small losses in weight. This situation would suggest that, when they were deprived of hatchery feed, they continued to grow on the strength of accumulated fat, even though hardly any natural food was taken. The wild fish, on the other hand, showed no appreciable change in size or condition on the first date of collection, but thereafter displayed a slight but consistent gain in length, weight and condition. Condition factors, based on averages, are shown in Table 3. These figures clearly demonstrate the wide disparity in condition existing between the wild and hatchery fingerlings. The latter, at time of tagging, appeared to be exceptionally fat and deep-bodied, in marked contrast to the lean, undernourish-looking wild individuals. Since the wild fish may be considered as adjusted to the natural food supply, it is not surprising that the hatchery fingerlings should undergo a lowering in condition.

INSTITUTE FOR FISHERIES RESEARCH

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Table 1. Size, and average volume of stomach contents, of wild and hatchery brook trout fingerlings from Section II-B, Hunt Creek

Date	Source	Total length in millimeters		Standard length in millimeters		Weight		Average total length, inches	Average weight, ounces	Average volume of stomach, cc.
		Range	Average	Range	Average	Range	Average			
March 1	Wild	89-142	120.3	74-120	101.0	5.5-20	12.2	4.75	0.42	0.185
	Hatchery	105-143	122.0	89-123	103.4	10 -26	16.6	4.8	0.59	0.025
March 4	Wild	103-172	138.1	87-145	116.3	9 -38	21.5	5.5	0.76	0.305
	Hatchery	102-140	119.2	86-120	100.8	9 -24	15.6	4.7	0.55	0.040
March 18	Wild	79-153	125.3	66-128	105.5	4 -27	15.8	4.9	0.56	0.125
	Hatchery	108-152	126.0	90-129	106.2	13 -28	17.8	5.0	0.63	0.110

Table 2. Gain or loss in length and weight by wild and hatchery brook trout fingerlings planted February 19, 1941, in Section II-B. Lengths given in millimeters, weights in grams. (+) indicates gain, (-) indicates loss. Date headings show dates of collections. All figures based on averages. Five wild and five hatchery fish in each sample.

	March 1			March 4			March 18		
	Total length	Standard length	Weight	Total length	Standard length	Weight	Total length	Standard length	Weight
Hatchery fish									
At tagging	120.6	101.6	16.4	118.4	99.6	16.3	122.8	103.2	18.1
At capture	122.0	103.4	16.6	119.2	100.8	15.6	126.0	106.2	17.8
Gain or loss	+1.4	+1.8	+0.2	+0.8	+1.2	-0.7	+3.2	+3.0	-0.3
Wild fish									
At tagging	126.6	106.2	16.1	144.6	121.4	23.6	132.0	110.8	16.7
At capture	126.6	106.4	16.1	145.2	122.2	24.0	134.6	113.4	18.2
Gain or loss	0.0	+0.2	0.0	+0.6	+0.8	+0.4	+2.6	+2.6	+1.5

Table 3. Condition factors of wild and hatchery brook trout fingerlings from Section II-B, based on average measurements at time of tagging and time of subsequent recapture.

Date of collection	March 1	March 4	March 18
Hatchery trout			
At tagging	1.564	1.600	1.647
At capture	1.502	1.552	1.511
Wild trout			
At tagging	1.343	1.301	1.243
At capture	1.343	1.322	1.247

Table 4. Numbers of food organisms consumed by wild and hatchery brook trout fingerlings planted in Section II-B on February 19, 1941. Each sample based on a series of 5 wild and 5 hatchery fish.

	March 1, 1941		March 4, 1941		March 18, 1941	
	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild
Isopoda	...	...	...	1	...	...
Gammarus	...	1	...	1	...	...
Ephemerella	...	1	...	1	...	...
Baetis	5	279	32	202	49	111
Libellulidae	...	...	...	...	1	...
Leuctra	...	2	...	1	...	3
Capnia	2	8	...	6	...	2
Isoperla	1	1	...	4	...	1
Nemoura	...	...	...	2	...	1
Corixidae	1	...	...	...	...	...
Dytiscidae	...	...	...	...	2	...
Hydroptilidae	...	2	...	...	...	1
Rhyacophila	...	...	1	1	...	1
Mystrophora	...	2	...	...	...	...
Hydropsyche	...	3	...	8	...	1
Limnephilidae	...	4	...	3	2	...
Brachycentrus	...	2	...	2	...	2
Suboptera Tip.	...	...	...	1	...	...
Pedicia	...	...	...	...	1	...
Rhaphidolobis	...	1	...	...	...	...
Bittacomorpha	...	...	1	...	...	...
Simulium	4	9	4	21	4	9
Chironomus mod. L	13	21	16	50	...	5
Chironomus mod. P	4	6	1	12	...	...
Chironomidae L	7	12	1	24	9	5
Ceratopogonidae P	...	...	...	1	...	...
Total	37	354	56	341	68	142

Graph 1