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November 11, 1937

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ANN ARBOR, MICHIGAN

REPORT NO. 442

FEEDING HABITS OF TROUT IN WATERS CARRYING A HEAVY POPULATION  
OF NATURALLY HATCHED FRY

On April 30, 1937, Mr. E. R. Kuhne, then Wildlife Technician for the U. S. Forest Service, made a small collection of brook and brown trout in Sweetwater Creek, a small tributary of the Pere Marquette River, in Lake County, T. 18 N., R. 14 W., Sec. 28. This collection was made at the suggestion of Dr. A. S. Hazzard, following an inspection trip made in company with Mr. Kuhne.

Although the collection is small, comprising one brown and fifteen brook trout, it has been considered worthy of some attention. Herewith is presented an account of the results of stomach examination, which is of interest because it allows some comparison of the diet of brook and brown trout inhabiting the same waters; also because, at the time of collection, the stream contained an extraordinarily large number of naturally hatched trout fry, a condition which might be thought to be conducive to cannibalism. The fry were present in such abundance that Dr. Hazzard and Mr. Kuhne were able to pick up several with their hands. Larger trout should have been able to capture them with ease if, as various investigators have claimed, trout normally take the type of food which is most readily available.

The appended tables record the results of stomach examination. Table 1 shows the numbers of each type of organism found, together with the comparative

percentage and the total volume, for each individual fish. Volumes under 0.025 cc. are indicated as a "trace." Table 2 shows the percentages of each group of food organisms calculated on a basis of total volume. It will be seen that the caddisflies, or Trichoptera, bulked more than twice as large as the group next in size, the true flies, or Diptera.

Although the fact could not be shown conveniently in the tables, the greater portion of the total volume of midges (Diptera: Chironomidae) is made up of pupae, larvae being comparatively scarce. The majority of these pupae show, by their stage of development, that they were nearly ready for emergence, and it may be that they were more active, and hence more readily perceived and taken by the fish.

Presence in the stomachs of adult stoneflies, terrestrial beetles, leafhoppers, ants and wasps indicates readiness on the part of the trout to feed at the surface.

It is of especial interest to notice the numbers of snowfleas, or Collembola. Although these were encountered in only one stomach, their numbers and volume were sufficient to compose 8 per cent of the total food taken. As is well-known, these primitive insects are strongly gregarious in habit, often occurring by thousands in a narrowly restricted area. Doubtless one trout happened on to such a swarm on the surface of the stream, and ingested a number sufficiently large to give a misleading impression of the significance of this insect as a trout food.

#### Discussion of Food Organisms by Groups:

The Trichoptera, or caddisflies, alone make up 37.3 per cent of the total volume of food consumed. Six different families make up this portion: Sericostomatidae, 41.7%, the single genus Brachycentrus totalling 34.7%; Limnephilidae, 40.3%; Leptoceridae, 8.3%; Hydropsychidae, 5.5%; Molannidae, 4.2%;

Rhyacophilidae, "trace" only.

The Diptera, or true flies, compose 15% of the total. Of this amount, 76.5% are midge larvae and pupae of the family Chironomidae (sens. lat.); 17.9% deer fly larvae, family Tabanidae; and 5.9% crane fly larvae (Tipulidae).

Fish are represented by two small muddlers (Cottus sp.), forming 9.8% of the total volume.

Crustacea, represented by the single freshwater shrimp species Hyalolella knickerbockeri, make up 8% of the total volume.

Collembola, minute insects sometimes known as "snowfleas", were taken in such quantity by one trout as to make up 8% of the total volume. The specimens all appear to pertain to the common species Podura aquatica.

Plecoptera, or stoneflies, compose 5.7% of the total volume. Of this amount, nymphs of Acroneuria account for 63.6%, adults of the late winter-emerging Allocapnia 36.4%. Allocapnia adults were encountered in the stomachs of five trout, indicating that they were feeding readily on the surface.

Insect debris makes up 4.6% of the total volume. Under this heading are placed insect fragments too finely triturated to admit of certain determination. It was apparent, however, that portions of midge pupae were best represented.

Annelida, or earthworms, compose 4% of the total. This is made up by a single individual, which may have been taken as bait.

Mollusca, in each instance soft-shelled snails of the family Physidae, account for 3.5% of the total.

Ephemeroptera, or mayflies, represented by nymphs of the family Baetidae, make up 2% of the total.

Coleoptera, or beetles, form 1.6% of the total. This group is represented by the aquatic family Hydrophilidae. Fragments of terrestrial beetles were found in the stomachs, but not in large enough quantity to be of significance in calculating percentages.

Hymenoptera, or wasps, make up 0.5% of the total. Only one insect, a large wasp of the family Sphecidae, is large enough to affect the volume. Two stomachs, however, each contained a small gall wasp (Cynipidae), and one contained an ant (Formicidae). This again indicates surface feeding.

Hydracarina, or water mites, and Homoptera, or leaf hoppers, occurred, but too sparingly to affect the volume.

Conclusions: A larger series of both brook and brown trout taken from the same water at the same time would be required to determine possible disparity in food selection by these two species; it is interesting, however, to note that the single brown trout yearling had consumed the same types of organisms dominant in the diet of brook trout of similar size range.

Although the sample of trout examined was small, and was taken on one day, the absence of trout fry from these stomachs indicates that cannibalism may not be a significant factor in limiting the survival of naturally hatched trout fry in a nursery stream such as Sweetwater Creek.

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TABLE 1  
Individual Analyses of Stomach Contents

Fish No.	Annelida		Mollusca		Crustacea		Hydracarina		Collembola		Ephemeroptera		Plecoptera		Homoptera		Coleoptera		Trichoptera		Diptera		Hymenoptera		Insect Debris		Cottus		Vol. in CC.
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
1					3	5.9													2	23.5	1	70.6							0.425
2																			1	tr.					1	100.0			0.475
3											1	tr.							4	100.0									0.200
4					2	16.7							2	8.3					4	16.6	9	33.4							0.300
5			1	10.0							1	tr.							3	90.0	4	tr.							0.250
6													1	tr.					13	100.0									0.125
7					1	tr.							3	25.9	1	tr.			9	66.7					7.4				0.675
8					1	tr.					2	tr.	1	tr.					8	75.0	4	12.5	1	12.5					0.200
9	1	57.1	1	14.3	1	tr.	1	tr.									2	21.4	2	7.1	2	tr.	1	tr.					0.350
10			1	18.2	8	27.2							3	9.1	1	tr.	1	tr.	2	9.1	± 37	18.2			18.2	Few bones			0.550
11											4	tr.							2	50.0	3	50.0							0.050
12							1	tr.			4	40.0							6	60.0	5	tr.							0.125
13					2	66.6					1	tr.							2	33.4	5	tr.	1	tr.					0.075
14					1	tr.					1	tr.							13	90.9	± 10	9.1							0.275
15					1	tr.					10	16.7	5	8.3					10	24.9	± 30	50.0							0.300
16					2	5.6			1,500	83.3									4	11.1	8	tr.							0.450

Ave. vol. per stomach 0.302  
Ave. vol. No.'s 4-16 0.287  
Ave. vol. no.'s 1&3 0.367

Explanation

Table shows number and per cent by volume of food organisms in each stomach. Last column shows total volume of contents of each stomach.

\* Brown trout, 151 mm. standard length

\*\* Contained 1 fish hook

No.'s 1 & 2. Brook trout, 180 & 186 mm. standard length respectively.

No.'s 4-16. Brook trout, range 87-140 mm. standard length. Ave. 114.1 mm.

TABLE 2

Major Groups of Food Organisms in Terms  
of Percentage of Total Volume

Caddisflies (Trichoptera) .....	37.3%
Diptera (True flies) .....	15.0
Fish ( <u>Cottus</u> sp.) .....	9.8
Freshwater shrimp (Crustacea) .....	8.0
Snowfleas (Collembola) .....	8.0
Stone flies (Plecoptera) .....	5.7
Insect debris .....	4.6
Angleworms (Annelida) .....	4.0
Snails (Mollusca) .....	3.5
Mayflies (Ephemeroptera) .....	2.0
Beetles (Coleoptera) .....	1.6
Ants & wasps (Hymenoptera) .....	0.5
Water mites (Hydracarina) .....	trace
Leafhoppers (Homoptera) .....	trace
	<hr/>
	100.0%