# THE FOOD OF RAINBOW TROUT, BROWN TROUT AND BROOK TROUT FRY AND FINGERLINGS FROM FIVE SOUTHWESTERN MONTANA STREAMS

by

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## The Author

I was born in Cut Bank, Montana on September 3, 1936, and attended public schools there, graduating from high school in 1954. In September 1954 I enrolled at Montana State College and received a Bachelor of Science degree in Fish and Wildlife Management in June, 1958. Most of my summer employment during high school and college was with the Great Northern Railroad and in the oil fields near Cut Bank, however I spent the summer of 1958 working as an Assistant District Fisheries Manager in northeastern Montana. I was married to Gayle M. Royal in September, 1958, and enrolled in the Graduate Division at Montana State College in October of the same year.

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Abstract

Samples of rainbow trout (Salmo gairdneri), brown trout (Salmo trutta) and brook trout (Salvelinus fontinalis) fry and fingerlings were obtained for stomach analysis during the spring and summer of 1959 from five southwestern Montana streams. An attempt was made to secure samples from the time trout began to feed until they reached a length of approximately 4 inches. Stomachs from 356 rainbow trout, 356 brown trout and 116 brook trout were examined. The predominant food of all three species of fish was the larva of Tendipedidae, although Baetidae was nearly as abundant in the brook trout stomachs.

## Introduction

Very few workers have reported substantial information on the food of trout less than 4 inches in length. Clemens (1928) studied the stomach contents of 155 small brook trout (Salvelinus fontinalis) and seven small rainbow trout (Salmo gairdneri). Ricker (1930) examined stomachs from 41 small brook trout, while Hazzard and Madsen (1933) studied the food of 48 small cutthroat trout (Salmo clarki).

The present study was initiated during the spring of 1959 in which juvenile rainbow trout, brown trout (Salmo trutta), and brook trout were collected for stomach analysis from five Southwestern Montana streams. An attempt was made to secure samples from the time trout began to feed until they reached a length of approximately 4 inches. The first collection was made April 22 and subsequent collections were secured at about 2 week intervals terminating September 22.

Stomach analyses were made on 356 rainbow trout, 356 brown trout, and 116 brook trout. Results compare the food of the different species in relation to location and date of capture.

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## Methods

Collecting was accomplished during the daylight hours (8:00 a.m. to 7:30 p.m.). The time required for each collection was 1-3 hours. Early in the season trout fry and fingerlings (usually less than 3 inches in length) were captured with a 4-foot "common sense" seine (one-eighth-inch mesh) operated by one person. Later in the season, when fish were usually in excess of 3 inches, an 8-foot seine (one-fourth-inch mesh) was employed. This was operated by two persons and was effective in faster, deeper water, where many of these fish were found. An electric shocker (d.c.) was used for procuring the last collection from the Madison River.

All specimens were immersed in a solution of 10-percent formalin immediately after capture. A few fish were observed after immersion and none was seen to regurgitate food. Also, no regurgitated food was found in the collection jars after preservation. Fish were placed in a fresh solution of 10-percent formalin, 1 or 2 days after capture, and then stored for later study.

Water temperatures were taken at the time of each fish collection. Turbidity was determined only on those collection dates when the water was noticeably turbid.

Where numbers permitted, 20 fish of each species, from each collection, were randomly selected and their stomachs examined. When less than 20 specimens were present in a collection, all were examined. Each specimen was opened on the ventral side and the esophagus and stomach were removed for analysis. The organisms found were determined to families,

whenever possible, and counted. All Diptera larvae were identified to family, however pupae and adults were placed in the category of miscellaneous Diptera. It is probable that a large proportion of those placed in this category belonged to the family Tendipedidae. Organisms, exclusive of terrestrial insects and fish, were classified using Ward and Whipple's Fresh Water Biology (Edmondson, 1959). Terrestrial insects were identified using An Introduction to Entomology (Comstock, 1957).

Weights or volumes were not determined because of the small quantities present.

## Description of Study Areas

Five collecting stations were established as follows: Madison River drainage - North Meadow Creek, Madison River proper, South Fork of the Madison River, Duck Creek; Gallatin River drainage - Trout Creek. Stations were generally located in the shallow, protected portions of streams. With few exceptions fish were captured in slow moving water, less than 2 feet deep, where bank vegetation was submerged or overhung into the stream, or where aquatic vegetation was abundant. The smallest fish were captured in very shallow water, usually in association with sand or silt bottoms. Collections were most readily obtained from areas where spring-seeps entered the stream. As the season progressed and fish became larger, they were also captured in deeper, faster water. Larger fish were found more commonly beneath undercut banks or in pools, rather than in shallow sandy areas.

### North Meadow Creek

This station included about 800 lineal feet of relatively straight

stream, which had an average width of 17 feet. The average depth was 9 inches and the velocity ranged from 0.0 to 2.5 feet per second. The maximum water temperature was 69° F. on June 23 and the minimum was 50° F. on September 22. There was no noticeable turbidity and water levels remained relatively stable. The bottom was predominantly gravel and rubble with small areas of sand. A few small spring-seeps were present and these were choked with watercress (Rorippia islandica). Stream banks were bordered with scattered willows (Salix sp.), grasses, and sedges that overhung into the water. The surrounding area was flat pastureland.

## Madison River

This station included a relatively straight portion of stream along the north bank of the river. It was approximately 900 feet long and about 10 feet wide except at the lower end where it included a small island. Here the width was approximately 200 feet. The average depth was 10 inches and velocities ranged from 0.0 to 4.0 feet per second. The maximum water temperature was 71° F. on July 25 and the minimum was 60° F. on June 23. There was no noticeable turbidity. Water levels varied considerably due to irregular releases from Hebgen Reservoir, which was located one-fourth mile upstream from the station. Bottom materials consisted largely of boulders, rubble and gravel with areas of sand and silt adjacent to the island. Some strictly aquatic vegetation was present and, in addition to this, grasses and sedges along the edges of the island were inundated during periods of high water. The North river bank was sharply cut and bordered with grasses and sedges. The surrounding area was a

steep, rocky canyon partly covered with conifers.

On August 15, an earthquake made access to this station impractical. As a result, the last collection was made 10 miles below the original collecting station and 5 miles below a landslide that dammed the river. The water level was reduced about 2 feet from normal and the flow in this area was limited to water from a few springs and some seepage through the landslide. The water temperature was 54° F. and there was noticeable turbidity. Fish were collected from remaining pockets of water beneath a bridge.

South Fork of the Madison River

This station contained parts of two large meanders of the river, and was about 1,000 feet in length. It included about 8 feet of stream along each bank except for several pools over 3 feet deep. These were not included in the station because collecting methods were not effective in deep water. The average depth was 10 inches and velocities ranged from 0.0 to 3.5 feet per second. The maximum water temperature was 56° F. on July 25 and the minimum was 43° F. on June 23. There was no noticeable turbidity except on September 1, after the earthquake, when it was 70 p.p.m. Water levels did not vary appreciably. Bottom types included gravel and several large areas of sand in the riffle areas and silt in the backwater areas. Water buttercup (Ranunculus sp.) was abundant in the smaller backwaters and on some sheltered sandy areas. Tall grasses, sedges, rushes, and willows lined the river banks. Some of the banks were undercut, as much as 5 feet. The surrounding area was a relatively flat

valley floor, largely covered with willows, and conifers were predominant at higher elevations.

## Duck Creek

This collecting station included a 150-foot section of relatively straight stream with an average width of 35 feet and an average depth of 11 inches. Velocities varied from 0.0 to 3.0 feet per second. The maximum water temperature was 69° F. on July 25 and the minimum 54° F. on September 1. There was no noticeable turbidity except on September 1, after the earthquake, when it was 64 p.p.m. Water levels remained relatively stable. The bottom was predominantly gravel with a few large deposits of sand. Silt was present in the backwater areas. Dense beds of water buttercup covered the sandy areas and cattails and rushes were present along a few gradually sloping banks. Most banks were sharply cut and bordered by overhanging grasses and sedges. A portion of this station was beneath a highway bridge. The surrounding area included gently rolling foothills near one edge of the Madison River valley, where vegetation was predominantly coniferous forest and sagebrush prairie.

## Trout Creek

This station included about 1,500 feet of meandering stream with an average width of 5 feet, and an average depth of 8 inches. The velocity ranged from 0.0 to 2.5 feet per second. The maximum temperature was 60° F. on July 21 and the minimum was 45° F. on April 22. Turbidities were 10-12 p.p.m. during June and July but were not measured in August, when no noticeable turbidity was present. Holton (1952) reported the occurrence

of flash floods in this stream, which caused considerable washing of the stream banks and scouring of the bottom. No such floods occurred during the course of this study. Bottom materials included small gravel in riffle areas, and sand and silt in pools. Areas of sand and silt increased noticeably from April to August. The water source was irrigation runoff and spring seeps. Watercress was the chief submerged aquatic plant. This was confined to the sandy areas in early summer but choked a large portion of the stream by autumn. Overhanging banks were predominant and were lined with willows and sedges. In the fall, sedges formed a canopy over portions of the stream in the upper end of the station. The entire station lay in a small ravine, surrounded by flat farmland.

## Results

A total of 829 trout fry and fingerling stomachs were examined. These came from the following localities: North Meadow Creek - 108 rainbow trout, 120 brown trout; Madison River - 80 rainbow trout, 79 brown trout; South Fork of the Madison River - 88 rainbow trout, 92 brown trout; Duck Creek - 80 rainbow trout, 65 brown trout; Trout Creek - 116 brook trout. Only four stomachs were empty and these were not included in the totals.

### Rainbow Trout

No attempt was made to distinguish between rainbow and cutthroat trout, however cutthroat trout were rare in the collection areas and there is little probability any were taken in the collections.

North Meadow Creek (Table I). The most abundant organisms in the rainbow trout stomachs were the larvae of Tendipedidae. The number of these organisms per stomach ranged from 58 to 90 percent of the total in all collections except on September 22, when it was only 30 percent. They occurred in 95-100 percent of the stomachs in all collections but the one taken on July 24 where they occurred in only 80 percent. Miscellaneous Diptera were next in abundance in all collections except the one procured July 24. The number of these organisms per stomach ranged from 5 to 21 percent of the total. The percentages increased as the season progressed with a consequent increase in size of fish, however the number of stomachs in which they occurred, in each collection followed no apparent pattern. A large number of aphids occurred in the July 24 and September 22 collections. This may be accounted for by rains during and just preceding collecting on those dates which probably washed them into the stream from overhanging vegetation. Other organisms which included over 5 percent of the total number of items per stomach were: Baetidae, Dytiscidae, Hydroptilidae, Tipulidae larvae, and Dixidae larvae.

Madison River (Table II). Lake dwelling Cladocera and Copepoda comprised a major portion of the food in three collections. Copepoda was the predominant food in the July 9 collection, where it comprised 80 percent of the total number of items per stomach and was found in 17 of the 20 fish examined from that collection. It was followed in abundance by Cladocera, with 13 percent (found in 13 fish). In the August 10 collection, Cladocera was the most abundant organism. It constituted 65 percent of the total number of organisms per stomach, followed by Copepoda with 26 percent.

Table I. The food of rainbow trout from North Meadow Creek (1959) expressed as number of items per stomach and percentage occurrence.

| | June 23 | | July 14 | | July 24 | | Aug. 10 | | Sept. 4 | | Sept. 22 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total fish ..... | 11 | | 20 | | 20 | | 20 | | 20 | | 17 | |
| Range in total length (inches). | 1.0-1.1 | | 0.9-1.6 | | 1.1-2.5 | | 1.2-2.4 | | 1.5-3.0 | | 1.9-2.9 | |
| Average length (inches) ..... | 1.0 | | 1.3 | | 1.6 | | 1.7 | | 2.3 | | 2.4 | |
| Item | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Aquatic | | | | | | | | | | | | |
| Nemata ..... | 0.09 | 9 | 0.05 | 5 | 0.20 | 20 | 0.35 | 30 | 0.05 | 5 | 0.18 | 12 |
| Oligochaeta ..... | | | | | | | | | | | 0.12 | 12 |
| Ostracoda ..... | | | | | | | 0.15 | 10 | | | | |
| Copepoda ..... | 0.45 | 9 | 0.05 | 5 | | | | | | | 0.18 | 6 |
| Isopoda ..... | 0.09 | 9 | | | | | | | | | 0.18 | 12 |
| Amphipoda ..... | | | 0.05 | 5 | | | | | 0.05 | 5 | 0.41 | 12 |
| Ephemeroptera | | | | | | | | | | | | |
| Baetidae ..... | 0.82 | 73 | 0.55 | 40 | 0.80 | 55 | 0.40 | 30 | 1.70 | 75 | 0.41 | 29 |
| Ephemerellidae . | | | | | 0.10 | 10 | 0.05 | 5 | 0.20 | 15 | 0.12 | 12 |
| Tricorythidae .. | | | | | | | 0.05 | 5 | 0.65 | 40 | 0.53 | 24 |
| Plecoptera | | | | | | | | | | | | |
| Nemouridae ..... | 0.09 | 9 | | | 0.05 | 5 | 0.10 | 10 | 0.30 | 30 | 0.24 | 18 |
| Coleoptera | | | | | | | | | | | | |
| Dytiscidae ..... | | | | | 0.05 | 5 | | | 0.20 | 10 | 1.71 | 18 |
| Elmidae ..... | | | | | | | 0.15 | 15 | | | | |
| Trichoptera | | | | | | | | | | | | |
| Psychomyiidae .. | | | | | | | | | 0.10 | 10 | | |
| Hydropsychidae . | | | | | | | 0.10 | 10 | 0.05 | 5 | | |
| Hydroptilidae .. | | | | | 0.20 | 20 | 0.45 | 30 | 0.65 | 30 | 1.82 | 65 |
| Limnephilidae .. | | | 0.05 | 5 | 0.10 | 10 | 0.30 | 20 | 0.05 | 5 | 0.53 | 35 |
| Brachycentridae. | | | | | | | | | | | 0.12 | 12 |
| misc. Trichop. . | 0.09 | 9 | 0.05 | 5 | | | | | 0.05 | 5 | 0.06 | 6 |
| Diptera | | | | | | | | | | | | |
| Tipulidae ..... | | | | | 0.05 | 5 | 0.30 | 15 | 0.35 | 30 | 2.53 | 35 |
| Psychodidae .... | | | | | | | 0.05 | 5 | | | 0.06 | 6 |
| Dixidae ..... | | | | | 0.10 | 10 | | | | | 2.12 | 35 |
| Simuliidae ..... | 0.18 | 18 | 0.15 | 15 | 0.65 | 35 | 1.30 | 65 | 0.35 | 25 | 0.24 | 24 |
| Tendipedidae ... | 7.64 | 100 | 21.35 | 100 | 16.35 | 100 | 13.25 | 95 | 17.20 | 95 | 8.71 | 82 |
| Stratiomyidae .. | | | | | | | 0.05 | 5 | 0.05 | 5 | 0.94 | 47 |

Table I (continued).

| Item | June 23 | | July 14 | | July 24 | | Aug. 10 | | Sept. 4 | | Sept. 22 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Diptera cont. | | | | | | | | | | | | |
| Musidae ..... | 0.09 | 9 | | | 0.70 | 50 | 0.05 | 5 | 0.20 | 15 | 0.29 | 18 |
| misc. Diptera .. | 1.00 | 100 | 1.15 | 45 | 4.15 | 90 | 3.90 | 85 | 6.20 | 100 | 4.00 | 59 |
| Acari ..... | 0.09 | 9 | 0.30 | 15 | 0.10 | 10 | 0.65 | 15 | 0.85 | 10 | | |
| plant material .. | | | | | | 5 | | | | 10 | | |
| unidentified ... | 0.09 | 9 | | | | | 0.05 | 5 | | | 0.12 | 12 |
| Terrestrial | | | | | | | | | | | | |
| Thysanoptera | | | | | | | | | | | | |
| Thripidae ..... | 0.18 | 9 | | | | | | | | | | |
| Homoptera | | | | | | | | | | | | |
| Aphididae ..... | | | | | 4.25 | 65 | 0.45 | 15 | 0.45 | 30 | 3.06 | 65 |
| Cicadellidae ... | | | | | 0.10 | 10 | | | | | | |
| Lepidoptera | | | | | | | | | | | | |
| Micropterygidae. | | | | | 0.10 | 10 | | | | | | |
| Hymenoptera | | | | | | | | | | | | |
| Formicidae ..... | 0.09 | 9 | | | | | 0.05 | 5 | | | 0.06 | 6 |
| Total | 10.99 | | 23.75 | | 28.05 | | 22.20 | | 29.70 | | 28.74 | |

Table II. The food of rainbow trout from the Madison River (1959) expressed as number of items per stomach and percentage occurrence.

| | July 9 | | July 25 | | Aug. 10 | | Aug. 24 | |
|---|---|---|---|---|---|---|---|---|
| Total fish ..... | 20 | | 20 | | 20 | | 20 | |
| Range in total length (inches). | 0.8-1.3 | | 0.9-1.9 | | 1.2-2.2 | | 1.8-2.7 | |
| Average length (inches) ..... | 1.0 | | 1.1 | | 1.5 | | 2.2 | |
| Item | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Aquatic | | | | | | | | |
| Cladocera ..... | 2.35 | 65 | | | 59.45 | 95 | | |
| Copepoda ..... | 15.15 | 85 | 5.80 | 40 | 23.65 | 95 | | |
| Ephemeroptera | | | | | | | | |
| Baetidae ..... | | | | | 1.05 | 5 | 49.10 | 100 |
| Plecoptera | | | | | | | | |
| Nemouridae ..... | | | | | | | 0.25 | 20 |
| Trichoptera | | | | | | | | |
| Hydropsychidae . | | | | | | | 0.70 | 45 |
| Hydroptilidae .. | | | | | 0.10 | 10 | 1.05 | 60 |
| Limnephilidae .. | | | | | | | 0.20 | 10 |
| Glossosomatidae. | | | | | | | 0.10 | 10 |
| Diptera | | | | | | | | |
| Simuliidae ..... | | | 0.05 | 5 | | | 5.45 | 85 |
| Tendipedidae ... | 0.75 | 35 | 4.95 | 95 | 2.15 | 80 | 7.55 | 100 |
| misc. Diptera .. | 0.55 | 40 | 5.85 | 100 | 4.20 | 80 | 1.35 | 40 |
| Acari ..... | | | 0.10 | 10 | | | | |
| unidentified .... | | | 0.10 | 10 | | | 0.05 | 5 |
| Terrestrial | | | | | | | | |
| Homoptera | | | | | | | | |
| Cicadellidae ... | | | | | 0.05 | 5 | 0.45 | 15 |
| Total | 18.80 | | 16.85 | | 90.65 | | 66.25 | |

Both organisms occurred in 95 percent of the stomachs from that collection. Copepoda was second in abundance in the July 25 collection, being present in 40 percent of the stomachs. The presence of these plankters was not surprising since the collecting station was only a short distance downstream from Hebgen Reservoir. They undoubtedly inhabited the reservoir and passed over the spillway at Hebgen Dam. They were completely absent from the August 24 collection following the earthquake, which was procured 10 miles downstream from the collecting station, just below a landslide which dammed the river. Except for these plankters, Tendipedidae larvae and miscellaneous Diptera were the predominant food organisms in all except the collection taken on August 24. Miscellaneous Diptera exceeded Tendipedidae larvae in abundance on July 25 and August 10. Baetidae was the predominant food organism in the fish taken on August 24. This family occurred in all fish, and the number of organisms per stomach comprised 74 percent of the total. In this collection Tendipedidae larvae included 11 percent and also occurred in all fish. It was followed in abundance by: Simuliidae larvae, miscellaneous Diptera and Hydroptilidae, respectively.

South Fork of the Madison River (Table III). Tendipedidae larvae occurred in a larger percentage of the stomachs than did other organisms in all collections from this station and were also the most abundant organisms in the stomachs except for the collection taken on July 25, where Cladocera comprised 50 percent of the total number of organisms per stomach. Cladocera occurred in only 6 of the 20 stomachs from that collection and one of these contained 188 of these organisms. Cladocera con-

Table III. The food of rainbow trout from South Fork of the Madison River (1959) expressed as number of items per stomach and percentage occurrence.

| | June 23 | | July 11 | | July 25 | | Aug. 10 | | Sept. 1 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total fish ..... | 8 | | 20 | | 20 | | 20 | | 20 | |
| Range in total length (inches). | 0.9-1.2 | | 0.9-1.3 | | 0.9-1.6 | | 0.9-2.5 | | 1.3-2.3 | |
| Average length (inches ..... | 1.0 | | 1.1 | | 1.2 | | 1.4 | | 1.8 | |
| | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Aquatic | | | | | | | | | | |
| Hirudinia ..... | | | | | | | 0.15 | 15 | | |
| Cladocera ..... | | | 2.50 | 15 | 10.35 | 30 | 0.15 | 15 | 0.25 | 15 |
| Ostracoda ..... | | | | | 0.45 | 5 | | | | |
| Copepoda ..... | | | | | 0.10 | 10 | | | | |
| Amphipoda ..... | | | | | 0.20 | 10 | | | 0.05 | 5 |
| Ephemeroptera | | | | | | | | | | |
| Heptageniidae .. | | | | | | | | | 0.10 | 5 |
| Siphlonuridae .. | | | 0.05 | 5 | 0.15 | 5 | | | 0.05 | 5 |
| Baetidae ..... | 0.75 | 63 | 0.30 | 15 | 1.00 | 40 | 1.40 | 60 | 1.30 | 65 |
| Ephemerellidae . | 0.25 | 13 | 0.05 | 5 | 0.15 | 15 | 0.05 | 5 | | |
| Plecoptera | | | | | | | | | | |
| Nemouridae ..... | | | 0.05 | 5 | | | | | 0.05 | 5 |
| Trichoptera | | | | | | | | | | |
| Hydroptilidae .. | | | | | | | | | 1.10 | 40 |
| Limnephilidae .. | | | | | | | | | 1.05 | 60 |
| Brachycentridae. | | | | | | | 0.05 | 5 | 0.05 | 5 |
| misc. Trichop. . | | | 0.10 | 10 | | | | | | |
| Diptera | | | | | | | | | | |
| Simuliidae ..... | 0.13 | 13 | | | 0.10 | 10 | 0.05 | 5 | | |
| Tendipedidae ... | 19.63 | 100 | 18.70 | 95 | 4.50 | 70 | 23.70 | 90 | 9.80 | 95 |
| misc. Diptera .. | 0.25 | 25 | 2.60 | 75 | 3.55 | 50 | 0.85 | 40 | 0.40 | 30 |
| Acari ..... | 0.13 | 13 | | | | | | | 0.95 | 20 |
| Gastropoda ..... | | | | | 0.15 | 5 | | | | |
| Terrestrial | | | | | | | | | | |
| Homoptera | | | | | | | | | | |
| Aphididae ..... | | | | | | | 0.10 | 5 | 0.15 | 15 |
| Total | 21.14 | | 24.35 | | 20.70 | | 26.50 | | 15.30 | |

stituted 10 percent of the total number of organisms per stomach on July 11, but occurred in only three of the 20 stomachs from that collection. Miscellaneous Diptera were of minor abundance except in the July 11 and July 25 collections when they made up 11 percent and 17 percent respectively of the total number of organisms per stomach. They occurred in 75 percent and 50 percent of the stomachs, respectively. Baetidae was present in all collections, and its numbers per stomach ranged from 1 to 9 percent of the total. It occurred in 15-65 percent of the stomachs. Hydroptilidae and Limnephilidae were present only in the collection taken on September 1, where each comprised 7 percent of the total number of organisms per stomach. Hydroptilidae occurred in 8 of the 20 stomachs from that collection, and Limnophilidae in 12.

Duck Creek (Table IV). Tendipedidae larvae were the most abundant food organisms in the July 9 and July 25 collections. They were present in all collections, with the number per stomach ranging from 19 to 63 percent of the total. These percentages decreased as the season progressed. Miscellaneous Diptera were predominant in the August 11 and September 1 collections. They were present in all collections and their numbers per stomach ranged from 26 to 55 percent of the total. Baetidae occurred in all collections with a range of 3-13 percent of the total and occurred in 30-45 percent of the stomachs. A variety of terrestrial insects occurred in all collections, but were never very abundant. Limnephilidae occurred in eight of the 20 stomachs from September 1 and constituted 9 percent of the total number of items per stomach in that collection, but was not as abundant in the other collections from this stream.

Table IV. The food of rainbow trout from Duck Creek (1959) expressed as number of items per stomach and percentage occurrence.

| | July 9 | | July 25 | | Aug. 11 | | Sept. 1 | |
|---|---|---|---|---|---|---|---|---|
| Total fish ..... | 20 | | 20 | | 20 | | 20 | |
| Range in total length (inches). | 0.8-1.2 | | 0.9-1.3 | | 0.8-1.9 | | 1.5-2.7 | |
| Average length (inches ..... | 1.0 | | 1.0 | | 1.3 | | 2.0 | |
| Item | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Aquatic | | | | | | | | |
| Cladocera ..... | | | 0.05 | 5 | 0.10 | 10 | 0.05 | 5 |
| Ostracoda ..... | | | 0.15 | 10 | | | | |
| Copepoda ..... | | | 0.40 | 20 | 0.20 | 5 | | |
| Ephemeroptera | | | | | | | | |
| Baetidae ..... | 0.55 | 30 | 1.05 | 45 | 0.80 | 35 | 1.55 | 45 |
| Leptophlebiidae. | | | | | | | 0.20 | 15 |
| Ephemerellidae . | | | | | 0.05 | 5 | 0.15 | 15 |
| Hemiptera | | | | | | | | |
| Corixidae ..... | | | | | | | 0.15 | 15 |
| Coleoptera | | | | | | | | |
| Dytiscidae ..... | | | 0.05 | 5 | | | 0.10 | 10 |
| Trichoptera | | | | | | | | |
| Hydroptilidae .. | | | | | | | 0.30 | 25 |
| Limnephilidae .. | | | | | 0.20 | 20 | 1.15 | 40 |
| misc. Trichop. . | 0.35 | 15 | 0.20 | 5 | 0.05 | 5 | 0.15 | 10 |
| Diptera | | | | | | | | |
| Tipulidae ..... | | | | | 0.20 | 10 | | |
| Simuliidae ..... | | | 0.05 | 5 | 0.10 | 5 | 0.10 | 10 |
| Tendipedidae ... | 12.65 | 95 | 5.60 | 65 | 6.60 | 85 | 2.25 | 75 |
| Musidae ..... | | | | | 0.05 | 5 | 0.10 | 5 |
| misc. Diptera .. | 6.00 | 80 | 2.90 | 65 | 11.45 | 100 | 5.00 | 75 |
| fish eggs ..... | | | 0.55 | 5 | | | | |
| plant material .. | | | | 5 | | | | 5 |
| unidentified .... | | | 0.10 | 10 | | | 0.05 | 5 |

Table IV, continued.

| Item | July 9 | | July 25 | | Aug. 11 | | Sept. 1 | |
|---|---|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Terrestrial | | | | | | | | |
| Collembola | | | | | | | | |
| Entomobryidae .. | 0.05 | 5 | 0.05 | 5 | 0.10 | 5 | | |
| Thysanoptera | | | | | | | | |
| Thripidae ..... | 0.25 | 15 | 0.10 | 10 | 0.10 | 10 | 0.05 | 5 |
| Homoptera | | | | | | | | |
| Aphididae ..... | 0.05 | 5 | 0.05 | 5 | 0.70 | 30 | 0.20 | 10 |
| Cicadellidae ... | 0.10 | 10 | 0.05 | 5 | 0.05 | 5 | 0.50 | 25 |
| Hymenoptera | | | | | | | | |
| Platygasteridae. | | | | | 0.10 | 10 | 0.10 | 5 |
| Total | 20.00 | | 11.35 | | 20.85 | | 12.15 | |

## Brown Trout

North Meadow Creek (Table V). Tendipedidae larvae were the predominant food organisms in small brown trout stomachs from all collections from this station, where their numbers per stomach ranged from 41 to 87 percent of the total. Percentages were smaller as the season progressed. These larvae occurred in 95-100 percent of the fish except in the September 22 collection, where they occurred in only 80 percent. Miscellaneous Diptera were second in abundance in most collections and the number per stomach ranged from 5 to 21 percent of the total. The percentage increased as the season progressed, but decreased to 11 percent on September 22. They occurred in 45-95 percent of the fish, but their occurrence followed no apparent pattern. Aphids occurred in large numbers in the July 24 and September 22 collections, as they did in the rainbow trout from this stream. These collections were taken during and just after rains. Hydroptilidae was abundant in all collections but those procured on June 23 and July 14. It constituted 5-19 percent of the total number of items in all collections but the latter two mentioned. Baetidae was present in all collections with 2-8 percent of the total.

Madison River (Table VI). The food of small brown trout was similar to that of rainbow trout, at this station below Hebgen Dam. Planktonic Cladocera and Copepoda were present in all collections except the one procured on August 24. Cladocera was the most predominant food organism in the stomachs of fry and fingerlings taken July 9 and August 10. It made up 67 and 77 percent of the total number of organisms per stomach, respectively. Copepoda occurred in large numbers in the June 23 and July 9

Table V. The food of brown trout from North Meadow Creek (1959) expressed as number of items per stomach and percentage occurrence.

| | June 23 | | July 14 | | July 24 | | Aug. 10 | | Sept. 4 | | Sept. 22 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total fish ..... | 20 | | 20 | | 20 | | 20 | | 20 | | 20 | |
| Range in total length (inches). | 1.1-2.9 | | 1.1-2.5 | | 1.6-2.6 | | 2.1-3.1 | | 2.0-3.7 | | 2.4-4.1 | |
| Average length (inches) ..... | 1.5 | | 1.7 | | 2.1 | | 2.4 | | 3.1 | | 3.0 | |
| Item | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Aquatic | | | | | | | | | | | | |
| Nemata ..... | | | | | 0.30 | 30 | 0.05 | 5 | 0.05 | 5 | | |
| Oligochaeta ..... | | | | | | | | | | | 0.10 | 10 |
| Ostracoda ..... | 0.25 | 10 | | | | | | | 0.10 | 10 | | |
| Isopoda ..... | | | | | 0.05 | 5 | 0.15 | 10 | | | 0.10 | 10 |
| Amphipoda ..... | 0.05 | 5 | | | | | | | 0.05 | 5 | 0.05 | 5 |
| Ephemeroptera | | | | | | | | | | | | |
| Heptageniidae .. | 0.25 | 20 | | | | | | | | | | |
| Siphlonuridae .. | 0.20 | 15 | | | | | | | | | | |
| Baetidae ..... | 0.85 | 60 | 0.50 | 40 | 0.95 | 40 | 0.50 | 30 | 3.00 | 85 | 1.15 | 60 |
| Ephemerellidae . | 0.55 | 20 | | | 0.20 | 10 | | | 0.15 | 15 | | |
| Tricorythidae .. | | | | | | | | | 0.10 | 10 | 0.75 | 45 |
| Plecoptera | | | | | | | | | | | | |
| Nemouridae ..... | 0.20 | 15 | 0.05 | 5 | 0.10 | 10 | 0.25 | 15 | 0.20 | 20 | 0.15 | 15 |
| Coleoptera | | | | | | | | | | | | |
| Hydrophilidae .. | | | | | 0.05 | 5 | | | | | 0.15 | 15 |
| Elmidae ..... | | | 0.05 | 5 | | | 0.05 | 5 | | | | |
| Curculionidae .. | | | | | 0.15 | 10 | 0.05 | 5 | | | | |
| Trichoptera | | | | | | | | | | | | |
| Psychomiidae ... | | | | | | | 0.05 | 5 | 0.10 | 10 | | |
| Hydropsychidae . | | | | | | | 0.40 | 15 | 0.30 | 30 | 0.20 | 20 |
| Hydroptilidae .. | 0.10 | 10 | 0.75 | 20 | 1.60 | 50 | 4.15 | 65 | 1.95 | 30 | 1.75 | 75 |
| Limnephilidae .. | | | 0.25 | 20 | 0.10 | 10 | 0.35 | 30 | 0.35 | 25 | 0.45 | 25 |
| Brachycentridae. | | | | | | | | | | | 0.15 | 5 |
| misc. Trichop. . | | | | | 0.15 | 15 | 0.45 | 30 | 0.50 | 45 | 0.10 | 10 |
| Diptera | | | | | | | | | | | | |
| Tipulidae ..... | 0.10 | 10 | 0.10 | 10 | 0.15 | 15 | 0.50 | 30 | 0.70 | 35 | 0.30 | 20 |
| Psychodidae .... | | | | | | | | | | | 0.50 | 15 |
| Dixidae ..... | | | | | 0.20 | 10 | | | 0.20 | 15 | 0.30 | 15 |

Table V (continued).

| Item | June 23 | | July 14 | | July 24 | | Aug. 10 | | Sept. 4 | | Sept. 22 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Diptera cont. .. | | | | | | | | | | | | |
| Simuliidae .... | 0.05 | 5 | 0.30 | 15 | 0.25 | 15 | 1.05 | 55 | 1.70 | 60 | 0.05 | 5 |
| Tendipedidae .. | 11.90 | 95 | 32.25 | 100 | 16.40 | 100 | 10.55 | 100 | 18.10 | 100 | 8.10 | 80 |
| Heleidae ..... | 0.25 | 15 | | | | | | | | | 0.15 | 15 |
| Stratiomyidae . | | | | | | | | | | | 0.15 | 10 |
| Musidae ..... | 0.15 | 15 | | | 0.15 | 5 | 0.05 | 5 | 0.20 | 15 | 0.10 | 10 |
| misc. Diptera . | 0.95 | 45 | 2.35 | 55 | 3.65 | 95 | 2.85 | 60 | 7.65 | 80 | 2.20 | 60 |
| Acari ..... | 0.50 | 20 | 0.30 | 10 | 0.35 | 15 | 0.25 | 10 | 0.70 | 15 | 0.35 | 20 |
| Gastropoda ..... | | | | | | | 0.10 | 5 | | | 0.10 | 5 |
| fish eggs ..... | 0.30 | 10 | | | | | | | | | | |
| plant material . | | | | 5 | | 5 | | 5 | | 10 | | |
| unidentified ... | | | | | | | | | | | 0.10 | 10 |
| Terrestrial | | | | | | | | | | | | |
| Homoptera | | | | | | | | | | | | |
| Aphididae ..... | 0.05 | 5 | 0.25 | 10 | 4.60 | 60 | 0.30 | 20 | 0.20 | 20 | 2.20 | 50 |
| Cicadellidae .. | 0.05 | 5 | 0.05 | 5 | | | 0.15 | 10 | 0.05 | 5 | | |
| Hymenoptera | | | | | | | | | | | | |
| Formicidae .... | | | | | 1.10 | 10 | 0.05 | 5 | 0.05 | 5 | | |
| Total | 16.75 | | 37.20 | | 30.50 | | 22.30 | | 36.40 | | 19.70 | |

Table VI. The food of brown trout in the Madison River (1959) expressed as number of items per stomach and percentage occurrence.

| | June 23 | | July 9 | | July 25 | | Aug. 10 | | Aug. 24 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total fish ..... | 20 | | 20 | | 12 | | 12 | | 15 | |
| Range in total length (inches) . | 0.9-1.2 | | 1.3-2.4 | | 1.4-2.3 | | 1.5-2.7 | | 2.5-3.7 | |
| Average length (inches) ..... | 1.0 | | 1.7 | | 1.9 | | 2.2 | | 3.1 | |
| Item | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Aquatic | | | | | | | | | | |
| Cladocera ..... | 0.45 | 20 | 31.70 | 85 | 0.08 | 8 | 54.00 | 100 | | |
| Copepoda ..... | 3.70 | 35 | 12.25 | 40 | 0.25 | 17 | 1.25 | 50 | | |
| Ephemeroptera | | | | | | | | | | |
| Heptageniidae ... | | | | | 0.17 | 17 | | | | |
| Baetidae ..... | | | 0.05 | 5 | 0.25 | 17 | 5.75 | 83 | 33.80 | 100 |
| misc. Ephem. .... | | | 0.15 | 10 | 0.33 | 8 | | | | |
| Hemiptera | | | | | | | | | | |
| Corixidae ..... | | | 0.05 | 5 | 0.08 | 8 | | | | |
| Trichoptera | | | | | | | | | | |
| Hydropsychidae .. | | | | | | | | | 1.67 | 67 |
| Hydroptilidae ... | | | | | | | | | 1.27 | 53 |
| Limnephilidae ... | | | | | | | | | 0.67 | 27 |
| Diptera | | | | | | | | | | |
| Simuliidae ..... | | | | | | | 0.33 | 25 | 4.53 | 80 |
| Tendipedidae .... | 2.30 | 60 | 0.85 | 35 | 7.08 | 100 | 4.17 | 83 | 5.80 | 87 |
| misc. Diptera ... | 8.25 | 75 | 1.80 | 30 | 24.08 | 100 | 3.66 | 40 | 1.60 | 33 |
| Gastropoda ..... | | | | | | | 0.33 | 17 | 0.20 | 7 |
| unidentified ..... | | | | | | | 0.17 | 17 | 0.20 | 20 |
| Terrestrial | | | | | | | | | | |
| Homoptera | | | | | | | | | | |
| Aphididae ..... | | | 0.20 | 5 | | | 0.08 | 8 | | |
| Cicadellidae .... | | | 0.05 | 5 | | | | | 0.13 | 7 |
| Hymenoptera | | | | | | | | | | |
| Formicidae ..... | | | | | | | | | 0.20 | 13 |
| misc. Hymenop. .. | | | | | | | | | 0.13 | 13 |
| Total | 14.90 | | 47.10 | | 32.32 | | 69.74 | | 50.20 | |

collections, comprising 25 and 26 percent of the total, respectively, however it was found in only a few fish. As in the case of rainbow trout, both Cladocera and Copepoda were absent from the August 24 collection, which was procured downstream from a landslide that dammed the river. Miscellaneous Diptera were the most predominant food items in the June 23 and July 25 collections and were next to Cladocera and Copepoda in abundance in the July 9 collection. The numbers of miscellaneous Diptera per stomach ranged from 38 to 75 percent of the total in the latter three collections, and were followed in abundance by Tendipedidae larvae with 2-22 percent of the total in the same collections. In the August 10 collection, Tendipedidae larvae were next in abundance to Cladocera, when they constituted 6 percent of the total number of organisms per stomach, followed by miscellaneous Diptera with 5 percent. Baetidae was the most predominant food in the August 24 collection. It was present in all the stomachs in that collection and the number of these organisms per stomach constituted 67 percent of the total. Baetidae was followed in abundance by Tendipedidae, Simulidae, Hydropsychidae, miscellaneous Diptera, and Hydroptilidae respectively in that collection.

South Fork of the Madison River (Table VII). Tendipedidae larvae were the most predominant food organisms in the July 11 and September 1 collections. They appeared in all collections from this location. The numbers of these items per stomach decreased from 59 percent of the total on June 23 to 13 percent on August 10, and increased to 42 percent on September 1. They occurred in 58-95 percent of the stomachs. Baetidae was present in all collections from this station and its numbers per

Table VII. The food of brown trout in the South Fork of the Madison River (1959) expressed as number of items per stomach and percentage occurrence.

| | June 23 | | July 11 | | July 25 | | Aug. 10 | | Sept. 1 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total fish ..... | 20 | | 20 | | 20 | | 12 | | 20 | |
| Range in total length (inches). | 1.1-2.1 | | 1.2-2.5 | | 1.5-2.7 | | 1.8-2.8 | | 1.7-3.6 | |
| Average length (inches) ..... | 1.5 | | 1.8 | | 2.0 | | 2.3 | | 2.6 | |
| Item | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Aquatic | | | | | | | | | | |
| Hirudinia ..... | | | | | 0.30 | 10 | | | 0.05 | 5 |
| Cladocera ..... | | | | | 1.10 | 25 | 9.08 | 25 | 0.45 | 25 |
| Ostracoda ..... | 0.10 | 10 | 0.25 | 5 | 0.05 | 5 | | | 0.05 | 5 |
| Copepoda ..... | 0.10 | 5 | 0.05 | 5 | 0.15 | 15 | 0.08 | 8 | | |
| Amphipoda ..... | 0.05 | 5 | | | 0.20 | 15 | 0.17 | 17 | 0.70 | 35 |
| Ephemeroptera | | | | | | | | | | |
| Siphlonuridae .. | 0.25 | 15 | 0.45 | 25 | 0.35 | 30 | 0.25 | 17 | 0.05 | 5 |
| Baetidae ..... | 3.05 | 95 | 1.30 | 40 | 2.65 | 65 | 1.08 | 50 | 1.35 | 65 |
| Leptophlebiidae. | 0.10 | 10 | | | | | | | | |
| Ephemerellidae . | 0.75 | 50 | 1.05 | 30 | 0.70 | 25 | 0.25 | 17 | 0.15 | 15 |
| Plecoptera | | | | | | | | | | |
| Nemouridae ..... | 0.45 | 5 | | | 0.05 | 5 | | | 0.25 | 20 |
| Coleoptera | | | | | | | | | | |
| Haliplidae ..... | | | 0.05 | 5 | 0.05 | 5 | 0.25 | 17 | | |
| Dytiscidae ..... | | | 0.10 | 10 | 0.05 | 5 | | | 0.05 | 5 |
| Trichoptera | | | | | | | | | | |
| Glossosomatidae. | | | | | | | 0.08 | 8 | 0.10 | 5 |
| Hydroptilidae .. | | | | | | | | | 1.40 | 35 |
| Limnephilidae .. | 0.05 | 5 | 0.05 | 5 | 0.10 | 5 | 0.08 | 8 | 1.85 | 60 |
| misc. Trichop. . | | | 0.05 | 5 | | | 0.08 | 8 | | |
| Diptera | | | | | | | | | | |
| Tipulidae ..... | | | | | | | | | 0.20 | 15 |
| Simuliidae ..... | 0.20 | 15 | | | | | 0.08 | 8 | | |
| Tendipedidae ... | 7.50 | 95 | 3.50 | 75 | 1.20 | 60 | 1.83 | 58 | 5.50 | 70 |
| Heleidae ..... | 0.05 | 5 | 0.05 | 5 | 0.10 | 10 | | | | |
| misc. Diptera .. | 0.05 | 5 | 0.85 | 45 | 0.50 | 20 | 0.17 | 17 | 0.40 | 30 |
| Acari ..... | | | | | | | | | 0.40 | 25 |

Table VII (continued).

| Item | June 23 | | July 11 | | July 25 | | Aug. 10 | | Sept. 1 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Aquatic, cont. | | | | | | | | | | |
| Teleostei | | | | | | | | | | |
| Cottidae ..... | | | 0.05 | 5 | 0.10 | 10 | | | 0.05 | 5 |
| unidentified ..... | | | | | | | | | 0.20 | 15 |
| Terrestrial | | | | | | | | | | |
| Homoptera | | | | | | | | | | |
| Cicadellidae .... | | | | | | | 0.17 | 17 | | |
| Total | 12.70 | | 7.80 | | 7.65 | | 13.65 | | 13.20 | |

stomach ranged from 8 to 35 percent of the total. It was the most predominant food in the July 25 collection. This item occurred in 40-95 percent of the stomachs from this station. Cladocera was the most predominant food in the August 10 collection, where it constituted 66 percent of the total number of items per stomach. It was also present in the July 25 collection with 14 percent. It occurred in only five of the 20 stomachs on each of these two dates. Other organisms constituting over 10 percent of the total number of items per stomach on one or more dates were: Ephemerellidae, Hydroptilidae, and Limnephilidae.

Duck Creek (Table VIII). Stomachs from collections taken on June 23, July 9, and September 1 contained predominantly Tendipedidae larvae. The numbers per stomach constituted from 30 to 59 percent of the total. Miscellaneous Diptera were present in all collections and were the most predominant food items in the July 25 collection. Their numbers per stomach ranged from 6 to 36 percent of the total and they occurred in 31-70 percent of the stomachs. Cladocera constituted 22 percent of the total number of items per stomach on July 25, but occurred in only one of the nine fish in that collection. Baetidae was present in all collections and the number per stomach ranged from 10 to 32 percent of the total. It occurred in 38-70 percent of the stomachs.

The only instance where small trout stomachs contained a relatively large number of fish was the July 9 collection from Duck Creek. Seven of the 20 brown trout stomachs in this collection contained small sculpins (Cottus bairdi), which were approximately 8 millimeters in length.

Table VIII. The food of brown trout in Duck Creek (1959) expressed as number of items per stomach and percentage occurrence.

| | June 23 | | July 9 | | July 25 | | Sept. 1 | |
|---|---|---|---|---|---|---|---|---|
| Total fish ..... | 20 | | 20 | | 9 | | 16 | |
| Range in total length (inches). | 1.1-2.0 | | 1.2-2.2 | | 1.6-2.2 | | 2.1-3.3 | |
| Average length (inches) ..... | 1.5 | | 1.6 | | 1.9 | | 2.8 | |
| Item | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Aquatic | | | | | | | | |
| Oligochaeta ..... | | | 0.05 | 5 | | | 0.06 | 6 |
| Cladocera ..... | | | 0.05 | 5 | 1.33 | 11 | | |
| Ostracoda ..... | | | 0.30 | 15 | 0.33 | 11 | | |
| Copepoda ..... | 0.40 | 10 | 0.30 | 20 | | | | |
| Amphipoda ..... | | | 0.05 | 5 | 0.11 | 11 | | |
| Ephemeroptera | | | | | | | | |
| Siphlonuridae .. | 0.10 | 10 | 0.30 | 20 | | | | |
| Baetidae ..... | 2.90 | 70 | 3.75 | 70 | 0.78 | 56 | 0.75 | 38 |
| Ephemerellidae . | 0.35 | 20 | | | 0.11 | 11 | | |
| Plecoptera | | | | | | | | |
| Nemouridae ..... | | | 0.05 | 5 | | | 0.06 | 6 |
| Hemiptera | | | | | | | | |
| Corixidae ..... | | | | | | | 1.56 | 69 |
| Coleoptera | | | | | | | | |
| Haliplidae ..... | | | 0.05 | 5 | 0.56 | 22 | | |
| Dytiscidae ..... | 0.10 | 5 | | | | | 0.38 | 25 |
| Trichoptera | | | | | | | | |
| Hydroptilidae .. | | | | | | | 0.88 | 31 |
| Limephilidae ... | | | 0.05 | 5 | | | 0.81 | 44 |
| misc. Trichop. . | 0.05 | 5 | 0.60 | 10 | | | 0.06 | 6 |
| Diptera | | | | | | | | |
| Tendipedidae ... | 6.70 | 85 | 3.80 | 80 | 0.22 | 22 | 2.19 | 50 |
| misc. Diptera .. | 0.80 | 40 | 1.50 | 70 | 2.22 | 66 | 0.44 | 31 |
| Teleostei | | | | | | | | |
| Cottidae ..... | | | 0.70 | 35 | 0.11 | 11 | 0.06 | 6 |
| Terrestrial | | | | | | | | |
| Homoptera | | | | | | | | |
| Aphididae ..... | | | 0.10 | 5 | 0.33 | 22 | | |
| Total | 11.40 | | 11.65 | | 6.10 | | 7.25 | |

## Brook Trout

Trout Creek (Table IX). Tendipedidae larvae were abundant food items in all brook trout collections and were the most predominant organisms in stomachs from the June 4, July 21 and August 18 collections. The number of organisms per stomach ranged from 20 to 48 percent of the total and these organisms occurred in 70-95 percent of the stomachs in all collections. Baetidae was also abundant and was the most predominant food in the June 30 and August 15 collections. The number of these organisms per stomach ranged from 11 to 45 percent of the total and this item occurred in 75-100 percent of the stomachs. Copepoda was the most abundant food organism taken in the April 22 collection, where it included 39 percent of the total number of items per stomach. Cladocera constituted 18 percent in this collection. Hydroptilidae occurred in all collections except those taken on April 22 and June 4, and ranged from 2 to 6 percent of the total number of organisms per stomach in the various collections. The percentage increased as the season progressed. Simuliidae occurred in these same collections and constituted 2-10 percent of the total number of organisms per stomach. The percentage of this item also increased as the season progrssed. Aphididae was abundant in the collections taken on August 5 and August 18 but no reason for their presence was evident.

## Discussion

Although foods from the different streams varied considerably, Tendipedidae larvae were abundant in all rainbow trout collections and made up 40 percent of the total number of organisms per stomach. The remaining 60

Table IX. The food of small brook trout in Trout Creek (1959) expressed as number of items per stomach and percentage occurrence.

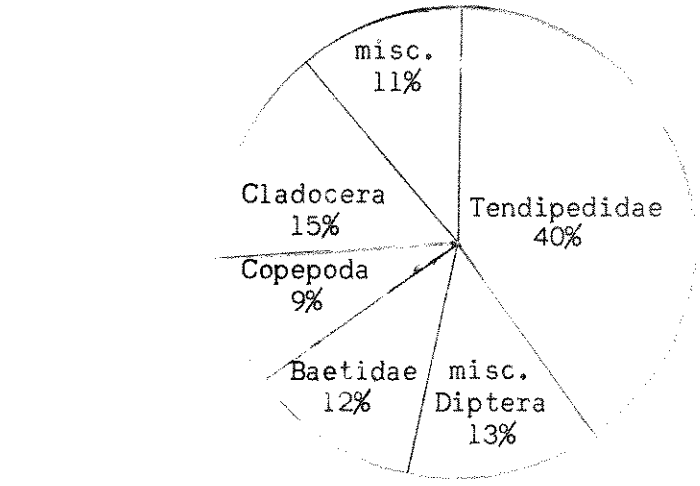
| | Apr. 22 | | June 4 | | June 30 | | July 21 | | Aug. 5 | | Aug. 18 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total fish ..... | 16 | | 20 | | 20 | | 20 | | 20 | | 20 | |
| Range in total length (inches). | 0.9-1.4 | | 1.1-2.1 | | 1.3-2.4 | | 2.2-3.3 | | 2.6-3.7 | | 3.0-4.0 | |
| Average length (inches) ..... | 1.1 | | 1.7 | | 1.9 | | 2.7 | | 3.1 | | 3.5 | |
| Item | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Aquatic | | | | | | | | | | | | |
| Nemata ..... | 0.25 | 1 | | | 0.10 | 5 | 0.10 | 10 | 0.05 | 5 | 0.40 | 25 |
| Hirudinia ..... | | | | | | | | | | | 0.15 | 10 |
| Cladocera ..... | 2.69 | 31 | | | | | | | | | | |
| Ostracoda ..... | 0.13 | 13 | | | | | | | 0.05 | 5 | | |
| Copepoda ..... | 5.69 | 56 | 0.15 | 10 | | | | | | | | |
| Ephemeroptera | | | | | | | | | | | | |
| Heptageniidae .. | | | | | 0.15 | 15 | | | 0.25 | 25 | 0.10 | 10 |
| Baetidae ..... | 1.69 | 75 | 1.75 | 80 | 2.40 | 75 | 4.25 | 85 | 7.95 | 100 | 9.20 | 100 |
| Plecoptera | | | | | | | | | | | | |
| Nemouridae ..... | 0.06 | 6 | 0.05 | 5 | 0.05 | 5 | | | 0.80 | 40 | 0.30 | 20 |
| Coleoptera | | | | | | | | | | | | |
| Haliplidae ..... | | | | | | | | | 0.05 | 5 | 0.10 | 10 |
| Dytiscidae ..... | | | | | | | | | | | 0.10 | 10 |
| Hydrophylidae .. | | | | | 0.05 | 5 | 0.15 | 15 | 0.25 | 15 | 0.35 | 15 |
| Curculionidae .. | | | | | | | | | | | 0.40 | 20 |
| Trichoptera | | | | | | | | | | | | |
| Hydroptilidae .. | | | | | 0.10 | 5 | 0.75 | 50 | 1.90 | 55 | 2.30 | 75 |
| Limnephilidae .. | | | | | | | | | | | 0.15 | 15 |
| Diptera | | | | | | | | | | | | |
| Tipulidae ..... | | | | | | | 0.35 | 25 | | | | |
| Simulidae ..... | | | | | 0.10 | 10 | 0.70 | 35 | 1.05 | 50 | 3.90 | 45 |
| Tendipedidae ... | 2.88 | 81 | 2.40 | 90 | 1.95 | 70 | 6.40 | 85 | 7.20 | 95 | 11.05 | 95 |
| Heleidae ..... | 1.13 | 44 | 0.15 | 10 | 0.35 | 30 | 0.15 | 15 | 0.35 | 25 | 0.40 | 20 |
| Stratiomyidae .. | | | | | 0.05 | 5 | | | 0.05 | 5 | 0.30 | 25 |
| Rhagionidae .... | | | | | | | | | 0.15 | 10 | 0.10 | 10 |
| Musidae ..... | | | | | | | | | 0.10 | 10 | 0.35 | 25 |
| misc. Diptera .. | 0.19 | 19 | 0.45 | 30 | | | 0.20 | 15 | 0.40 | 15 | 0.15 | 15 |

Table IX (continued).

| Item | Apr. 22 | | June 4 | | June 30 | | July 21 | | Aug. 5 | | Aug. 18 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Acari ..... | 0.06 | 6 | | | | | 0.70 | 30 | 1.90 | 55 | 1.50 | 55 |
| Gastropoda ..... | | | | | | | 0.05 | 5 | 0.35 | 5 | 0.25 | 20 |
| fish ..... | | | | | | | | | | | 0.10 | 10 |
| plant material | | 6 | | 20 | | 5 | | 5 | | 5 | | |
| Terrestrial | | | | | | | | | | | | |
| Orthoptera | | | | | | | | | | | | |
| Locustidae ..... | | | | | | | 0.10 | 10 | | | | |
| Homoptera | | | | | | | | | | | | |
| Aphididae ..... | | | 0.05 | 5 | | | 0.15 | 10 | 3.35 | 75 | 4.70 | 80 |
| Cicadellidae ... | | | | | | | | | 0.05 | 5 | 0.25 | 10 |
| Fulgoridae ..... | | | | | | | | | | | 0.70 | 5 |
| Hymenoptera | | | | | | | | | | | | |
| Formicidae ..... | | | | | | | 0.05 | 5 | 0.15 | 10 | 0.60 | 25 |
| Araneida | | | | | | | | | | | | |
| Thomisidae ..... | | | | | | | 0.05 | 5 | 0.05 | 5 | | |
| Total | 14.77 | | 5.00 | | 5.30 | | 14.15 | | 26.45 | | 37.90 | |

percent was divided about equally among miscellaneous Diptera, Baetidae, Copepoda, Cladocera and miscellaneous food. As the season progressed and fish consequently grew larger, there was a greater variety of organisms in the stomachs. Idyll (1942) studied the food of 15 rainbow trout and 20 cutthroat trout, up to 4 inches in total length, from the Cowichan River System in British Columbia. He found Tendipedidae was the predominant food of both fish, constituting 76 percent and 64 percent of the total number of items per stomach, respectively. He found Plecoptera was second in importance in rainbow trout (12 percent) and Ephemeroptera in cutthroat trout (16 percent). Hazzard and Madsen (1933) determined the food of 48 cutthroat trout (1.0-1.6 inches in total length) from a tributary of Jackson Lake, Wyoming. They reported Tendipedidae larvae to be the predominant food, making up 20 percent of the total number of organisms per stomach, while Copepoda and Diptera pupae and adults were present in large numbers. Acari, Oligochaeta and Ostracoda were also quite numerous. These latter occurred in the rainbow trout of the present study but were of minor importance.

Tendipedidae larvae contributed 32 percent of the total number of organisms per stomach in brown trout (Figure 1) with miscellaneous Diptera, Baetidae, and miscellaneous foods each with about equal amounts. The number of Cladocera per stomach in brown trout included 21 percent of the total, while Copepoda included only 4 percent. Idyll (1942) examined stomachs of 35 brown trout, up to 4 inches in total length and found that Tendipedidae constituted about 70 percent of the total number of organisms per stomach, followed by Ephemeroptera with 15 percent. Clemens (1928)

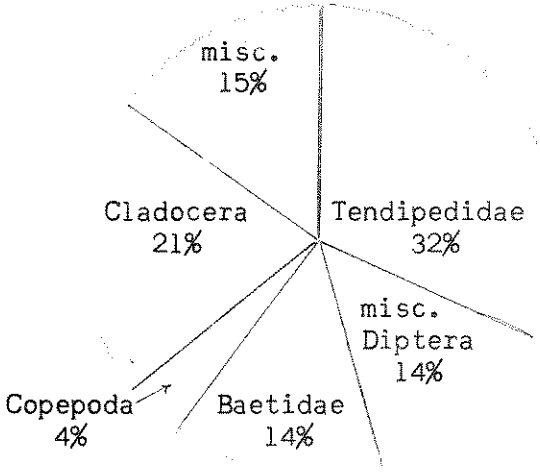



Rainbow Trout

Total fish - 356

Average length - 1.5 inches

Average number of organisms per stomach - 27

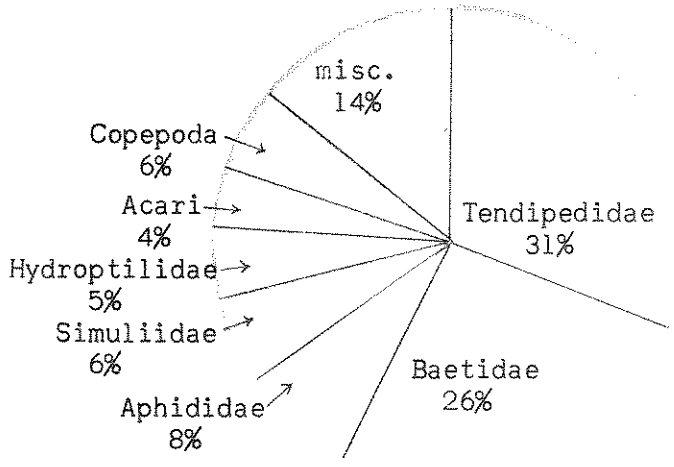



Brown Trout

Total fish - 356

Average length - 2.1 inches

Average number of organisms per stomach - 23




Brook Trout

Total fish - 116

Average length - 2.3 inches

Average number of organisms per stomach - 17

Figure 1. Percentages of the total number of items found in the stomachs of rainbow trout, brown trout and brook trout fry and fingerlings.

studied the food of seven brown trout (2-3 inches in total length) from Oneida County, New York and found the predominant foods were Trichoptera and Ephemeroptera.

Although numerous differences occurred between the foods of rainbow trout and brown trout, only four were very noticeable. Considering all collections, Cladocera was less abundant in rainbow trout than in brown trout, while Copepoda was less abundant in the latter. In several collections from Duck Creek and the South Fork of the Madison River, Baetidae was more predominant in brown trout than in rainbow trout, while Tendipedidae larvae were more predominant in the latter. Changes in diet composition throughout the season were generally quite similar in both species of fish.

Although the most abundant food in small brook trout was Tendipedidae larvae, Baetidae was nearly as predominant. Together, these constituted over half the total number of organisms per stomach. Most of the other food was comprised of: Aphididae, Simuliidae larvae, Hydroptilidae, Acari and Copepoda. Clemens (1928) found that Tendipedidae (larvae and pupae) were the predominant food organisms, followed by Ephemeroptera, in 155 brook trout up to 4 inches in length. Ricker (1930) analysed 41 brook trout (0.8-4.0 inches in total length) stomachs from Ontario, in which Tendipedidae made up 39 percent of the total volume of organisms per stomach. He found Cladocera, Copepoda and Ostracoda to be quite important for fish 0.8-1.0 inches long. Results from Trout Creek (Table IX) agree with this.

The foods of small brook trout were somewhat different from those of

rainbow trout and brown trout. Baetidae comprised a much larger portion of the food in stomachs of brook trout than in the other two species. Cladocera and miscellaneous Diptera were less abundant in brook trout, while Aphididae, Simuliidae larvae, Hydroptilidae and Acari were more abundant. These differences might be explained by the lower elevation of the stream and difference in habitat where brook trout were collected.

As the season progressed, and small trout grew larger, their stomachs contained a greater variety of organisms. Larger trout, no doubt are able to capture and swallow bigger organisms and they range over more of the stream, where a greater variety of organisms are found.

## Summary

1. Samples of rainbow trout, brown trout and brook trout fry and fingerlings were obtained for stomach analysis from five southwestern Montana streams.

2. Collections were secured at about two-week intervals, from about the time trout began to feed until they reached a length of approximately four inches. Samples were procured from April 22 to September 22.

3. Where numbers permitted, 20 fish of each species, from each stream for each date were randomly selected for stomach analysis.

4. A total of 356 rainbow trout, 356 brown trout and 116 brook trout were examined.

5. The most abundant organisms in the stomachs of rainbow trout fry and fingerlings were the larvae of Tendipedidae, which made up 40 percent of the total number of organisms per stomach in this fish.

6. Miscellaneous Diptera, Baetidae, Copepoda, Cladocera and miscellaneous food were about equally abundant in rainbow trout stomachs and comprised the remaining 60 percent of the diet.

7. Tendipedidae larvae constituted 32 percent of the total number of organisms per stomach in small brown trout, and was the predominent food.

8. Miscellaneous Diptera, Baetidae, and miscellaneous foods comprised about equal portions of brown trout diet. Cladocera exceeded Copepoda in abundance in these stomachs.

9. Considering all collections, Cladocera was less abundant in stomachs of rainbow trout than in brown trout, while Copepoda was more abundant. Baetidae was more predominant and Tendipedidae larvae were less predominant in stomachs of brown trout than in rainbow trout in several collections.

10. Changes in diet composition throughout the season were similar in rainbow trout and in brown trout.

11. Aphids were abundant in the stomachs of rainbow trout and brown trout collected in North Meadow Creek during and after rains.

12. Cladocera and Copepoda were abundant in rainbow trout and brown trout stomachs collected from the Madison River station, a short distance downstream from Hebgen Reservoir.

13. Tendipedidae larvae were the most abundant food items in brook trout stomachs, however Baetidae comprised nearly as many organisms per stomach.

14. Cladocera and miscellaneous Diptera were less abundant in brook trout than in the other two species, while Aphididae, Simuliidae

larvae, Hydroptilidae and Acari were more abundant.

15. As the season progressed and fish became larger, there was a greater variety of organisms in the stomachs of all three species of fish.

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