

A STOMACH ANALYSIS INVESTIGATION OF THE DIET OF BROWN AND RAINBOW TROUT TAKEN FROM AUGUSTA CREEK, KALAMAZOO COUNTY, MICHIGAN

> Thesis for the Degree of M. S. MICHIGAN STATE UNIVERSITY Robert L. Soles 1958

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W. K. KELLOGG BIOLOGICAL STATION · •

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## KALAMAZOO COUNTY, MICHIGAN

By

Robert L. Soles

## AN ABSTRACT

Submitted to the College of Science and Arts of Michigan State University of Agriculture and Applied Science in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Department of Entomology

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W. K. KELLOGG BIOLOGICAL STATION

#### ABSTRACT

A stomach analysis investigation was carried out on the alimentary tracts of 214 rainbow trout and 105 brown trout. The alimentary tracts were obtained from trout taken from the 1.8 miles of Augusta Creek which flows through the Kellogg Forest property of Michigan State University, Kalamazoo County, Michigan. The fish were selected at random from the creels of fishermen during the 1956 and 1957 fishing seasons.

The specimens which were removed were identified and enumerated. Volumetric determinations were made of the stomach contents by a water displacement method.

The results of this investigation may be summarized as follows: There was a greater volume of food in the stomachs of fish caught early in the season. Except for the brown trout (7 to 9 inches long) planted in 1956 and taken in 1956, the trout did not feed on plant material to any extent. Insects were less important in the diet of trout larger than 10 inches in length. Surprisingly few adults of aquatic insects were found in the stomachs.

There was a general reduction in the numbers of aquatic insects found in the stomachs during the late summer months of trout of comparable age and size. The reduction in aquatic insects was accompanied by an increase in the numbers of terrestrial insects. An exception was the group of 92 rainbow trout (7 to 9 inches long) planted in 1957 and caught in 1957. In similar trout caught over the entire season, the greatest numbers of aquatic insects were found in the stomachs of fish taken in June. An exception was the group of 83 rainbow trout (7 to 9 inches long) planted in 1956 and taken the same season.

The most prevalent orders of aquatic insects represented in the stomachs were Trichoptera, Ephemeroptera, Hemiptera, and Diptera. Among the terrestrial insects, the order Homoptera was the most universally represented group. The same species of trout, of comparable age and size, and taken at the same time of year, in two succeeding years, were found to feed on different groups of aquatic insects. Brown and rainbow trout, of the same size and age, were found to feed heavily on the larvae of aquatic Diptera in the month of May, 1956. The larvae of aquatic Diptera were of negligible importance to the diet in May, 1957. The data indicated an apparent tendency for brown trout to depend upon Trichoptera larvae more than the naiads of Ephemeroptera. In the rainbow trout, the trend was reversed. Insects appeared to be an important part of the diet of brown and rainbow trout.

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#### INTRODUCTION

The fact that insects form an important part of the diet of brown trout (<u>Salmo trutta fario</u> L.) and rainbow trout (<u>Salmo giardneri</u> Rich.) has been recognized for thirty years. The relative importance of insects in the diet of trout has been found to vary with the species, size, and age of the trout, the time of year, and the ecological habitat.

This investigation consisted of the analysis of the alimentary tracts of 214 rainbow trout and 105 brown trout. The alimentary tracts for the investigation were obtained from trout taken from the 1.8 miles of Augusta Creek located on the Kellogg Forest property of Michigan State University in Kalamazoo County, Michigan. A stream alteration study was begun on this section of the stream in 1934 and has been continued to the present time. From 1934 through 1957, except for the war years (1941-1944), complete fishing data have been recorded from the section of stream within the Kellogg Forest. In 1946, an annual trout stocking and creel census was added. Trout stomach analysis and intermittent studies of the bottom fauna were initiated by Dr. Walter F. Morofsky and have been continued through the 1957 fishing season. During the 1955, 1956 and 1957 fishing seasons, the collection of trout stomachs for analysis was particularly intense, and the stomachs which were analysed in this study were collected in the latter two seasons.

The taxonomic categories obtained from the stomachs were identified as far as possible and the numbers of each group were recorded. The volume of the stomach contents was also determined by a water displacement method.

The object of the study was to determine the importance of insects in the diet of brown and rainbow trout in the Kellogg Forest section of Augusta Creek and to determine, if possible, the seasonal fluctuation of the numbers of insects in the trout diet.

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#### LITERATURE REVIEW

The study of the fish diet by the analysis of stomach contents has been utilized by numerous workers with nearly all species of fish. Trout have been studied more extensively than any other group. It is unfortunate that these studies lack continuity. It is difficult to draw definite conclusions from the data of many of these studies. They lack representative sampling, there is disagreement in the definition of terrestrial insects, as well as a wide variation in the ecological habitat and geographical location of the fish studied. In general, there is an absence of data concerning the volume of the stomach contents.

Investigators have speculated as to whether or not there is a tendency among trout to discriminate among possible food organisms and practice some degree of selection. According to Neill (1938), "The trout feed on the whole range of animals present in whatever type of habitat it finds itself, to an extent dependent on their degree of accessibility and the extent of their representation in the fauna." On the other hand, Allan (1938) stated that "Percentages which the important food animals make up of the food are probably very much greater than are their percentages in the fauna at the same time, i.e., the fish are performing definite selection in their food." Idyll (1941), in his studies of the rainbow, cutthroat and brown trouts of the Cowichan River, agreed with the latter view.

Studies of Rainbow Trout Salmo gairdneri Rich.

Insects have been reported to be of prime importance in the dist of rainbow trout. According to Metzelaar (1928) and Coleman (1929),

insects made up nearly the entire diet of small trout. As the fish grew larger, the insect portion of their diet became smaller and less important, with Crustaceae and small fish composing a large porportion of the diet (Metzelaar, 1928).

Surber (1936), Rayner (1937), and Idyll (1941) indicated that aquatic insects were of greater importance in the trout diet during the spring and early summer. Surber (1936), Rayner (1937), and Idyll (1941) found that terrestrial insects assumed great importance to the trout during the late summer and fall months. It is obvious, however, from the data of other investigators (Idyll, 1941; Maciolek and Needham, 1951) that insects were an important part of the trout diet throughout the year.

Among the aquatic insects, caddisfly larvae, mayfly nymphs, midge larvae and blackfly larvae were often eaten in great numbers (Clemens, 1928; Coleman, 1929; Maciolek and Needham, 1951).

Investigators differ in their reports regarding the percentage of the trout diet made up of aquatic insects. The percentages of immature insects in the diet varied from a low of 28.3% (Metselaar, 1928) to a high of 84.23% (Dimick and Mote, 1934). The percentages of terrestrial insects varied also, from 11.3% (Dimick and Mote, 1934) and 12.8% (Metselaar, 1928) to 31.88% (Morofsky, 1940).

In some habitats, algae were an important component of the rainbow diet, as four workers have pointed out (Metzelaar, 1928; Surber, 1936; Lord, 1934; Needham, 1938). Metzelaar (1928) stated that 15% of the rainbow diet was composed of vegetation, largely filamentous algae.

The importance of insects in the rainbow diet seems to be independent of the geographical location. Results of investigations carried out in Oregon, Vermont, Washington and New York were in general agreement, (Dimick and Mote, 1934; Lord, 1934; Doudoroff, 1935; Needham, 1938).

Studies on Brown Trout Salmo trutta fario L.

Insects have been reported to be of prime importance in the diet of brown trout, but, as do the rainbow, the larger brown trout were found by Frost (1939) to depend more upon Crustaceae and fish as they increase in size. In some localities, molluscs have been found to be a sizeable component of the diet, especially during the winter (Allan, 1938).

Allan (1938) found that aquatic insects assumed their greatest importance from the early spring to mid-summer, while terrestrial insects were most important from late spring to early fall.

Among the aquatic insects, caddisfly larvae, mayfly nymphs, midge larvae, and Diptera in general appeared to be eaten in the greatest numbers, (Allan, 1938; Frost, 1939; Morofsky, 1940; Idyll, 1941). According to Morofsky (1940), aquatic insects composed 63.17% of the diet, while terrestrial insects made up 29.5% of the diet.

Investigators in the United States (New York - Clemens, 1928; Needham, 1938; Michigan - Morofsky, 1940); Canada (Idyll, 1941), and the British Isles (Allan, 1938; Frost, 1939) agreed that insects played an important role in the feeding of brown trout.

#### METHODS AND MATERIALS

The trout stomachs for this investigation were obtained from trout caught in Augusta Creek, Kalamazoo County, Michigan.

Augusta Creek originates in several small lakes in Barry County and empties into the Kalamazoo River at Augusta, Michigan. The average flow of water at the Kellogg Forest is 61 cubic feet per second. The flow is fairly stable and since 1947, when observations were begun, it has never been lower than 33 cubic feet per second, even during periods of extended drought. The average gradient is about 62 feet per mile of stream. The stream bottom is predominantly gravel. In 1934, a stream alteration study was begun on a section of Augusta Creek. In 1946, an annual trout stocking and creel census study was added. The primary purpose of that study was to determine the results of stocking legal size trout in this heavily fished southern Michigan stream (Lemmien et al, 1957).

The trout were taken from the 1.8 miles of stream on the Kellogg Forest property of Michigan State University. Trout were selected at random from the creels of fishermen at the Kellogg Forest station. Each fish was cut open and the alimentary tract was removed and placed in preservative. The species of trout, size, year planted, and the date caught were recorded and the record was placed in a bottle with the stomach. The term stomach used throughout the text refers to the trout alimentary tract from the esophagus to the anus.

The preserved trout stomachs were transported to Michigan State University where the stomachs were removed from the preservative and were cut open their entire length with a pair of sharp scissors. The

contents were then scraped out with a pair of forceps into a petri dish containing a small amount of 50% ethyl alcohol. The internal lining and folds of the alimentary tract were then examined under 20 power magnification of a binocular microscope for possible food material lodged there.

The material was examined under 60 power magnification. The identifiable material was sorted into a second petri dish, while the remaining material was divided into animal, plant, and general debris. The recognizable material was classified as specifically as possible with limits imposed by the author's taxonomic training.

The volumetric measurements were determined by displacement according to the following procedure: 15 ml. centrifuge tubes calibrated to 0.1 ml. were filled to the 10 ml. mark and placed in a test tube rack. The classified material was removed from the petri dish with forceps and dabbed on paper toweling to remove the excess alcohol. The material was then placed in a centrifuge tube and the rise in the level of the water in the tube as indicated by the bottom of the meniscus was taken to be the volume of the material. Volumes smaller than 0.05 ml. could not be estimated and were recorded as "trace" (Trc.) on the data sheets. The volumetric methods were similar to those used by Ball (1948).

Figure 1 is an example of the data form for a single stomach. Data from trout of the same species, size and age and collected on the same day were combined. The numbers in parenthesis above each month in the tables and graphs refer to the number of stomachs taken that month.

Throughout the text of this thesis, the trout stomachs are from fish 7 to 9 inches in length unless otherwise specified.

# Figure 1

# AN EXAMPLE OF A STOMACH ANALYSIS DATA FORM

# HISTORY

Stomach No. 23	<u>ц</u>
Species of Fish	Brown, 1957, 9"
Where Taken	
How Captured	
Date Taken	April 28, 1957
Type of Bait	
Time of Day	
Preservative	
Name of Sampler	

# STOMACH CONTENT

Name	Number	Volume
Annelida	3 parts	1.4
Crustaceae		
Amphipoda	l (in part)	0.5
Trichoptera	l larva (rather digested)	0.1
Limnephilidae	l larva (rather poor)	0.1
Hydropsychidae Hydropsyche	l larva	0.05
Diptera		
Tipulidae	l larva	0.2
	· · · · · · · · · · · · · · · · · · ·	
Animal Debris		1.7

TOTALS

4.05

REMARKS

#### PRESENTATION AND DISCUSSION OF DATA

#### 1. Rainbow Trout.

A. Rainbow trout, planted in 1955, taken in 1956 - Table I. The numbers of fish which fall into this classification were limited. There were only 16 fish collected in late April and early May.

The stomach analysis indicated that the annelids were the most important single food item in the diet, with the crustaceans also being well represented.

The most important aquatic insects were members of the families Tipulidae and Tendipedidae of the order Diptera and the family Limnephilidae of the order Trichoptera. It was the larval stage of these taxonomic groups that were eaten.

<u>B. Rainbow trout, planted in 1956, taken in 1956 - Table II.</u> Trout stomachs of this group were collected over nearly the entire fishing season in 1956 and a total of 83 stomachs were collected. The monthly distribution of stomachs was unequal, ranging from 38 in May to only 2 between July 14 and August 25. This distribution results in certain difficulties in interpreting the data, nevertheless, certain general trends may be seen.

Aquatic Diptera were important to the trout diet, especially in May, when larvae of the family Tendipedidae and other Diptera were found to be abundant in the trout stomachs. Both the time of year and the groups of insects present were in agreement with the studies of other workers (Rayner, 1937; Idyll, 1941).

Other groups of aquatic insects such as the Ephemeroptera and Trichoptera, were generally important throughout the season. Needham (1934), Idyll (1941), and Maciolek and Needham (1951) found that aquatic insects play a major role in the trout diet throughout the year.

There was an increase in the numbers of terrestrial insects eaten by the rainbow trout in July and August as compared with the spring months. This is in agreement with the data of Surber (1936), Rayner (1937), and Idyll (1941).

The annelids and animal debris were large components of the diet, particularly in the spring months, while the crustaceans occupied a role of a lesser, but relatively steady portion of the diet all season.

<u>C. Rainbow trout, planted in 1956, taken in 1957 - Tables III</u> and IV. Eight stomachs of rainbow trout planted in 1956 were collected in May and June of 1957, while 9 stomachs of rainbow trout (9 to 13 inches long), were collected April 27 and 28.

In the stomachs of rainbow trout planted in 1956, Ephemeroptera naiads were found to be important, while the stomachs of rainbow trout (9 to 13 inches long), planted in 1956, indicated that the annelids formed the main portion of the diet. The larger fish were collected earlier in the spring than the small fish, and it should be noted that the larvae of Tipulidae were of some importance to the larger fish.

D. Rainbow trout, planted in 1957, taken in 1957 - Tables V and VI. Six stomachs were collected late in the season from rainbow trout planted in 1957 which were over 9 inches long. There were 92 stomachs taken from rainbow trout planted in 1957, with 89 of them being obtained from May through August. As far as could be determined, the data do not indicate any striking change in the diet of the larger trout as compared with the smaller ones.

The data indicated the importance of both aquatic and terrestrial insects in trout feeding. The most important insects in the trout diet as indicated by total numbers eaten were Ephemeroptera naiads, Hemiptera nymphs and Trichoptera larvae in descending order. The mayfly naiads were prevalent in the stomachs throughout the season. The family Corixidae was the prevalent group of the Hemiptera, but while the corixids were eaten in the greatest numbers in June, the greatest variety of Hemiptera were taken in July. The genera Hydropsyche (Hydropsychidae), Helicopsyche (Helicopsychidae) and Brachycentrus (Brachycentridae) formed the greater part of the Trichoptera larvae. Trichoptera larvae were taken in greatest numbers in July. The remaining aquatic insects recorded from the stomachs made up a relatively minor part of the trout diet. A number of investigators concur with the importance of Trichoptera and Ephemeroptera, but found certain groups of Diptera (Tendipedidae and Simuliidae) to be more important than Hemiptera, a group they found to be of relatively little importance (Clemens, 1928; Coleman, 1929; Needham, 1934; Dimick and Mote, 1934; Rayner, 1937; Morofsky, 1940; Idyll, 1941; Maciolek and Needham, 1951).

Among the terrestrial insects, specimens of Coleoptera and Homoptera made up a moderately large portion of the diet, with the most important families being the Curculionidae and Cercopidae. The beetles occured in the stomachs in greatest abundance in June, while the spittle bugs were eaten in greatest numbers in July.

Other groups of animals which were apparently important to the trout are the crustaceans, especially crayfish (Decapoda), the annelids, the watermites (Hydracarina) and snails (Gastropoda). The annelids appeared to be more important in May, June and July, with decreasing importance in the diet as the summer progressed. The crustaceans were not well represented in the samples taken in May but became increasingly important in June, July and August. The watermites were found in greatest abundance in June, while the gastropods were most prevalent in July. So far as volume was concerned, the animal debris portion of the stomach contents was the largest item.

II. A Comparison of Rainbow Trout of the Same Age.

A. Rainbow trout caught the year following stocking. All of the fish which fit this classification were taken during the spring months, so their feeding could be compared. Larvae of the families Tendipedidae and Tipulidae of the order Diptera and Trichoptera larvae of the family Limnephilidae were important in the diet of rainbow trout, planted in 1955, taken in 1956. The annelids formed the largest portion of the diet, both numerically and volumetrically, while the crustaceans were also taken to some extent.

In contrast, the diet of rainbow trout, planted in 1956, taken in 1957, showed that the Ephemeroptera naiads were the dominant group among the insects, while the orders Diptera and Trichoptera were of minor importance. The annelids and crustaceans were not present in large numbers.

The rainbow trout (9 to 13 inches long), planted in 1956, taken in 1957 were found to have a diet somewhat similar to the rainbow trout (7 to 9 inches long), planted in 1955, taken in 1956. The annelids represented the predominant group of animals in the diet and the larvae of Tipulidae of the order Diptera were the most numerous group of insects Present. <u>B. Rainbow trout caught the same year they were stocked.</u> Rainbow trout, planted in 1956, caught in 1956, apparently depended on the naiads of Ephemeroptera and the larvae of Trichoptera for a moderate portion of their diet all season. In May, the larvae of several families of Diptera, especially the family Tendipedidae were important. Terrestrial insects were taken during July and August. The annelids formed the second largest portion of the diet in numbers and volume. Crustaceans formed a moderate but steady portion of the food throughout the season. Volumetrically, the animal debris portion of the diet was the greatest.

The diet of rainbow trout, planted in 1957, taken in 1957, was found to be somewhat similar to that of rainbow trout of comparable size and age of the previous year, but there were also marked differences. The diet was similar in that Ephemeroptera naiads and Trichoptera larwae were taken all season. Animal debris was the largest item of the diet volumetrically and the crustaceans were eaten in moderate numbers. The stomach analyses indicated the following differences from the diet of comparable rainbow trout of the previous year. The aquatic Diptera were of negligible importance and were replaced by members of the families Corixidae and Gerridae of the order Hemiptera. The terrestrial insects were important in the same months as the aquatic insects and were not prevalent in the summer months. The annelids were not as important as other groups of animals. There was an average of 15.9 watermites (Hydracarina) per trout stomach taken in June. Snails (Gastropoda) were eaten during July.

Stomach analyses of the six rainbow trout (7 to 10 inches in length), planted in 1957, which were collected late in August of 1957 indicated that the diet of these trout compared favorably with the diet

of the rainbow trout (7 to 9 inches long), planted in 1957, taken in 1957.

### III. Brown Trout.

A. Brown trout, planted in 1956, taken in 1956 - Table VII. Seventy-one stomachs of brown trout, planted in 1956, were collected during the 1956 fishing season. It is unfortunate that a disproportionately large number of these stomachs were collected in May, leaving a small number of stomachs to represent the remaining months of the season. From July 14 to September 5, for example, only 5 stomachs were collected.

The order Diptera was the most important group of the aquatic insects, in both numbers and volume and both the larvae and adults were eaten in large numbers. The most prevalent families of Diptera which were taken by the fish as larvae were Tendipedidae and Tipulidae, while those taken as adults were the Empididae and Tendipedidae. The tipulid larvae were found in fish sampled in the spring months, especially in May, and the tendipedid larvae were also the most important in May. The adult tendipedids were found mostly in fish taken in June, while the Empididae adults were most prevalent in fish stomachs in May.

The family Gerridae of the order Hemiptera ranked second in abundance. The Gerridae were well represented in April, May and July, and were at least present in June and August. The order Hemiptera has not been reported to be important by other investigators.

The order Trichoptera was moderately important in the brown trout diet, especially in May but there were no families present in great numbers. The importance of Diptera and Trichoptera to the diet of brown trout has been shown by Allan (1938), Frost (1939), Morofsky (1940) and Idyll (1941). The mayfly naiads were reported to be important to brown trout by the preceding workers, but were not important to the fish in this study.

Terrestrial insects were present in increasing numbers toward the end of the summer with the order Homoptera being the most prevalent group. The increased importance of terrestrial insects in the summer months agrees with the findings of Allan (1938).

The annelids and crustaceans formed a sizeable portion of the trout diet throughout the season, with the former group representing both the greatest number and greatest volume of animals consumed by the trout. A large volume of animal debris and a surprising amount of plant material were other major elements in the diet.

<u>B.</u> Brown trout, planted in 1957, taken in 1957 - Table VIII. Only 13 fish which fall into this category were collected. They were taken from April to August. The Trichoptera larvae were the most important aquatic insect group fed upon by the fish. The Trichoptera were important throughout the season, and the genus <u>Helicopsyche</u> of the family Helicopsychidae was the most prevalent group found.

The family Gerridae ranked second in total numbers eaten and also represented the largest volume among the aquatic insects. The Gerridae were taken by fish only in July and August.

One is not surprised at the importance of the Trichoptera larvae to the fish since other studies have indicated this trend (Allan, 1938; Frost, 1939; Morofsky, 1940; Idyll, 1941), but the lack of importance of Diptera and Ephemeroptera conflicts with the results of previous workers.

The terrestrial insects were of relatively little importance with the exception of the family Formicidae (Hymenoptera) which were

found in moderate numbers in fish caught during August.

The crustaceans were represented nearly every month, but not in large numbers. Volumetrically, animal debris makes up a major portion of the stomach contents.

<u>C. Native brown trout taken in 1956 - Table IX.</u> Since there were but five fish which fit into this category, all collected in May, the data presented in the table is of limited value. The diet of these fish did not show any notable deviation from that of planted brown trout of comparable size.

D. Native brown trout taken in 1957 - Tables X, XI and XII. There were three different size classes of native brown trout collected in 1957. There were 11 stomachs from 7 to 9 inch fish, 4 stomachs from 11 to 15 inch fish and 1 stomach from a 17 inch fish.

The diet of the 7 to 9 inch fish was not notably different from the stocked brown and rainbow trout of comparable size. The Diptera and Trichoptera were the most prevalent orders of insects found.

The 11 to 15 inch fish were found to rely on the Trichoptera larvae, but the crustaceans made up the largest component of the diet volumetrically.

The 17 inch fish indicated a definite swing toward crustaceans as the most important element in the diet of large fish. Frost (1939) reported that brown trout rely more upon crustaceans and fish in their diet as they increase in size.

IV. A Comparison of Brown Trout of the Same Age.

All of the stomachs from planted brown trout collected were from trout which were caught the same year they were planted. Brown trout, planted in 1956, taken in 1956, were found to feed extensively in the spring on both the larvae and adults of the family Tendipedidae, the larvae of the family Tipulidae and the adults of the family Empididae of the order Diptera. The orders Hemiptera and Trichoptera made up the remaining important groups of immature aquatic insects. Terrestrial insects were important in the summer months. The annelids were the animal group which were present in the greatest numbers and volume. Crustaceans were present in the stomachs in moderate numbers and the plant debris present indicated that these fish fed on plant materials. Animal debris also formed a sizeable portion of the stomach contents.

Brown trout, planted in 1957, taken in 1957, were found to depend upon Trichoptera larvae and the nymphs of Hemiptera, as did similar trout of the previous year. Diptera larvae and adults were of negligible importance. Terrestrial insects were important in August. The annelids, an important group the year before, were of little consequence to the diet, while the crustaceans were quite important. The volume of plant debris was small, as compared to that found in similar trout the year before. The animal debris portion of the diet was the largest item volumetrically.

V. A Comparison of the Average Number of Aquatic Insects and Terrestrial Insects Per Stomach in Each Month of the Fishing Season in 1956 and

1957 in Brown and Rainbow Trout of Comparable Age and Size.

These data are summarized in figures 2 through 5. There was a general reduction in the numbers of aquatic insects found in the stomachs of fish taken in the late summer months. This was accompanied by an increase in the numbers of terrestrial insects. The 92 rainbow trout, planted in 1957 and caught in 1957, were an exception. There was a reduction in the numbers of all insects in the late summer months.

VI. A Comparison of the Average Number of Trichoptera and Diptera Larvae and Ephemeroptera Naiads Per Stomach in Each Month of the Fishing

Season in 1956 and 1957 in Brown and Rainbow Trout of

## Comparable Size and Age.

These data are summarized in figures 6 through 9. There was a tendency for brown trout to feed more upon the larvae of Trichoptera than on Ephemeroptera naiads. Rainbow trout exhibited an opposite tendency. A definite statement regarding this matter cannot be made since there was a wide variation in the number of stomachs collected. It is interesting to note that both species of fish were found to feed rather heavily on the larvae of aquatic Diptera in May of 1956, while the larvae of Diptera were of little importance to comparable fish in May in 1957.





Fig. 3. A Comparison of the Numbers of Aquatic and Terrestrial Insects Found in the Stomachs of 13 Brown Trout 7 - 9 Inches Long,











5-


### Figure 10

### 1956 Fishing Results Augusta Creek, Kellogg Forest

### Plantings:

Brown trout	1000	
Rainbow trout	1250	
Total planted		2250

Eight weekly plantings of legal sized trout were made from April 24, 1956 to June 13, 1956. Each week 125 brown trout and 125 rainbow trout were spot planted. One additional plant of 250 rainbows was made on August 22, 1956.

### Trout caught:

### Rainbows

1956 Stocking 1955 Stocking Total Rainbows	818 54	872	
Browns			
1956 Stocking	479		
Native or 1951 Stocking	48		
Total Browns Total trout taken		_527_	1399

### Figure 11

### 1957 Fishing Results Augusta Creek, Kellogg Forest

Plantings:

Rainbow trout	2000	
Brown trout	125	
Total planted		21.25

s,

Eight plantings of 250 trout each were made from April 19 to July 2. One additional planting of 125 rainbows was made on August 13. The first planting on April 19 consisted of 125 rainbows and 125 browns. These were the only brown trout stocked this year.

### Trout caught:

Rainbows

1957 Stocking 1956 Stocking Total rainbows	1318 <u>83</u>	1401	
Browns			
1957 Stocking	31		
1956 Stocking	25		
Other browns	35		
Total browns		91	
Total trout taken			1492

### **RESULTS AND CONCLUSIONS**

The results of this investigation may be summarized as follows:

1. There was a greater volume of food in stomachs of fish caught early in the season.

2. Except for the brown trout, planted in 1956 and taken in 1956, the trout did not feed on plant material to any extent.

Insects were less important in the diet of trout larger than
 10 inches in length.

4. Surprisingly few adults of aquatic insects were found in the stomachs.

5. In similar trout represented over the entire season, there was a general reduction in aquatic insects during the late summer months. The reduction in aquatic insects was accompanied by an increase in the numbers of terrestrial insects. An exception was the group of 92 rainbow trout, planted in 1957 and caught in 1957.

6. In similar trout caught over the entire season, the greatest numbers of aquatic insects were found in the stomachs of fish taken in June. An exception was the group of 83 rainbow trout, planted in 1956 and taken the same season.

7. The most prevalent orders of aquatic insects represented in the stomachs were Trichoptera, Ephemeroptera, Hemiptera, and Diptera.

8. Among the terrestrial insects, the order Homoptera was the most universally represented group.

9. The same species of trout, of comparable size and age, and taken at the same time of year, in succeeding years, were found to depend on different groups of aquatic insects.

Both the brown and rainbow trout, of the same size and age, were found to feed rather heavily on the larvae of aquatic Diptera in the month of May, 1956. The larvae of aquatic Diptera were of negligible importance to the diet of comparable fish in May of 1957.

10. The data indicated an apparent tendency for brown trout to depend upon Trichoptera larvae more than on the naiads of Ephemeroptera. In the rainbow trout, the trend was reversed. A definite statement regarding this difference in feeding habits of the two species of fish cannot be made, however, since there were wide variations in the number of stomachs collected.

11. The stomach analysis data indicated that insects were an important part of the diet of brown and rainbow trout, particularly in 7 to 9 inch fish.

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TABLE	

## STOMACH CONTENTS OF 16 RAINBOW TROUT # PLANTED IN 1955, TAKEN APRIL 28 - MAI 5, 1956

	Apri	(6) 1 28	(10 May	С ул	Tota	a l
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.
AQUATIC INSECTS Ephemeroptera - naiads Ephemeridae	ч	0•25	~	0.3	e	0.55
<b>Plecoptera - naia</b> ds Perlidae	ч	1.0	;	:	Ч	1.0
Odonata - nadads Anisoptera	-	0•2	1	;	н	0.2
Hemiptera Belostomstidae Gerridae	н I ,	• • • • • • •	lm	 0•6	ЧМ	0.0 .0
Trichoptera - larvae Limnephilidae Rhyacophilidae Kydropsychidae	Ø 0 0	9•3 0•7	2 1 1 2	4.55 0.1 	ዿ፞፝፞፞፞ቚዾ	13.85 1.0 0.7
<ul> <li>pupae</li> <li>Pamíly Indeterminable</li> </ul>	1	•	0	0•2	~ ~	0.2
- case Family Indeterminable	:	;	Ч	1.7	Ч	1.7

\* 7 - 9" Long

(contrib.)	
TABLE I	

-30

	Apr11 28	May 5	Tot	als
Taxonomic Category	No. Vol.	No. Vol.	No.	Vol.
Dintera - larvae				
Tipulidae	3 1.9	13 2.9	16	4.8
Tendipedidae	4 0 <b>.45</b>	10 0.65	7	1.1
Simulidae	3 0.4	1 0.1	7	0•5
<b>Culicidae</b>	1.0.1	9 5 9	Ч	0.1
Strationyiidae	8	1 0.2	Ч	0•2
- pupae	•			•
Tendipedidae	1 0.3	•	-1	0•3
TERRESTRIAL INSECTS				
Orthopters				
Acrididae *	:	1 1.0	<b>H</b>	1•0
ANNELIDA	6°THI 26	6 17.05	103	158.95
Amphipode	15 6 <b>.</b> 1	5 1.55	8	7.65
ISOPODA	:	2 0•3	8	0•3
DIPLOPODA	:	2 0.5	8	0•5
GASTROPODA	1 0.3	:	Ч	6•3
NEMA TODA	:	l4 0•5	7	0•5
FISH BOGS	:	3.5	•	3•5

(CONT'D.	
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TABLE	

	Apri	1 28	W	<b>1y</b> 5	To	tals
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.
EOG CLUSTER	-	0.5	:	ŧ	-	0.5
DEBRIS (ANIMAL)	ł	6•9	ł	11-11		11.3
oebris (plant)	:	9.7	;	4•05	:	13.75
JEBRIS (GENERAL)	:	0.3	ł	9.45	:	9.75

					TABL	II T								
		MIA	STOMAC NTED I	TH CONT IN 1956	TAKE	F 83 R	AINBOW L - SE	PTEMBE	R 1956					
	(6) April	ч	(38) May		(18 Jun		(8) July	(11-1	July Aug.	25-1-1-	Aug. Sept.	28-	Tota	16
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.
AQUATIC INSECTS Bphemeroptera - naiads														
Eph <b>eme</b> ridae Heptageniidae	~	0•lt 	۳ч	0•2 Tre	н I	0°5	1 -	1. 1.	;;	::	: :	: :	<b>19 Q</b>	0 8 1 1 2 1
Baetidae Family Indeterminable		1.0	<b>រ</b> ភ្ន		1 m	Frc.	<b></b>	2. 2. 2. 2.	: :	11	•	0.1	20 ه	0.1
- adults Family Indeterminable	ł	ł	1	i	ł	:	;	:	:	:	Ъ	1.0	Ч	0.1
<b>Plecoptera - naiads Family Indeterminable</b>	t B	l B	ł	ł	•	0.55	ł	1	ł	1	ł	ł	e	0•55
Hemiptera Gerridae Gerris Belostomatidae	Im	1.5	<b>м</b>	0•25	;;		: :	::	::	::	::	11	ŊM	0•25 1•5
Trichoptera - larvae Hydropsychidae Hydropsychidae Limnephilidae	104	0.5	vin	176. 0.1	-		• • •	:::			:::	:::	৵৸৸	Tre. 0.5
Limephilias Limephilus	ł	1	Ч	0•4	Ч	0•5	1	1	1	:	ł	:	2	0•9

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\*7 - 9" Long

	Ap	Ţ	ž	Ň	Ju	9	July	11-1	July Aug.	- <del>1</del> %	Aug. Sept	и 1 2 3 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Tot	<b>1</b> 8
Taxonomic Category	No.	Vol.	No.	Vol.	No.	•lol	No.	Vol.	No.	Vol.	No.	Vol.	Ko.	Vol.
Trichoptera - Larvae (Cont'd.)														
Leptoceridae	ł	;	Ч	21	ł	;	ł	ł	ł	ł	1	ł	Ч	Trc.
Boraeidae	;	ł	l đ	;	Ч	0.1	I	;	1	1	ł	ł	Ч	0.1
Rhyacophilidae	ł	•	:	ł	ł	ł	1	21	ł	ł	ł	:	Ч	Tre.
bracnycen truae Brachycen trus	ł	ļ	:	ł	;	ł	2	0.1	ł	ł	-	0.05	m	0.15
Fandly Indeterminable	ł	•	Ś	0.1	1	I	ł	ł	ł	ł	:	•	ŝ	1.0
-pupae Philopotamidae	:	ł	Ч	Ž	ł	ł	:	1	:	ł	ł	ł	Ч	Jre.
- adults Family Indeterminable	ł	8	;	ł	;	1	ł	1	Т	0•2		ł	Ч	0•2
Coleoptera - adulta Haliplidae <u>Haliplus</u>	ł	1	় শ	0•1	ł	ł	ł	ł	ł	1	t	ł	4	. 1.0
- larvae Elmidae	:	1	ч	<b>.</b> 24	-1	0.1	ł	ł	1	;	1	ł.	8	0.1
Diptera - larvae														
Stratiom <b>yi</b> dae	1	ł	<b>-</b> 1 '	e L	1	:	1	1	1	1	I	1	Ч,	Tro.
Tipulidae	ł	1	9	4-15	:	ł	ł	ł	ł	ł	ł	:	9	4.15
Tendipedidae	;	ł	्र	0.25	;	ł	:	ł	ł	ł	Ч	ġ,	ጽ	0.25
- pupao Simuliidae Simulium	ł	;	8	je j	ł	ł	1	ł	ł	I	ł	;	8	Ĕ
Tendipedidae	18	0•3	22 5	0.05	2	lle.	ł	ł	ł	ł	ł	ł	<b>L</b> J	0.35
Family Indeterminable	:	<b>.</b>	Ч	Tre	ł	ł	ł	1	:	1	1	ł	• <b></b> 1	Tre

TABLE II (CONT'D.)

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	Ap	LT-1	Ŭ.	ţ,	Jur	g	July	<b>H-I</b>	July Aug.	-11- 28	Aug. Sept	л. В Д	Tota	1s
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.
<pre>Hptera (Cont'd.)     - adults     Simuliidae     Tendipedidae     Family Indeterminable</pre>	111	111	- ° -	17re - 0 - 05 17re -	111		~	2 4	111				more More	176. 176.
Unidentifiable larvae	:	ł	8	Tre.	ł	ł	ł	ł	ł	;	ł	:	2	Tre.
TERRESTRIAL INSECTS Iomoptera Cercopidae Membracidae	I	Tre.	: :	: :	l 1	1 1	20 10	0 <b>.1</b>	<b>~</b> –	0°5 0.9	11	::	٥ س	0•6 0•1
lemiptera Pentatomidae	1	Ì	:	ł	Ч	0•2	ł	ł	ł	ł	;	ł	ч	0•2
leuroptera - larvae Chrysopidae	• –	1•0	ł	ł	ł	ł	:	8	ł	ł	ł	;	ч	0.1
rthoptera Acrididãe	ł	ł	ł	ł	1	ł	ł	1	ч	0•7	ł	ł	ч	0•7
oleoptera Chrysomelidae Staphylinidae Coccinellidae Curculionidae				9 ₽ ₽			-~- ¦		~ <b>!</b>  ч	0.2			2015	0.2 1rc. 0.1

TABLE II (CONT'D.)

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				TABL	) II S	CONT'D	•							
	Ap	Ĺ	Ŵ	Þ.	Jur	8	July	<b>11-1</b>	July Aug.	27 27	Aug. Sept	مرکع	Tot	ų s
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.
Coleoptera (Cont'd.) Elateridae Family Indeterminable	: :	::	: :	11	14		::	11	н I	0.25	11	11		0.25 0.1
Lepidoptera - larvae Family Indeterminable	ł	ł	2	ġ	:	ł	ł	ł	:	ł	н	j.	m	Tre.
Diptera Drosophilidae Family Indeterminable	: :	::	1 m	Tro.	- I	0.1	::	•	::	11	::	::	ЧМ	0.1 Trc
Hymenoptera Formicidae Chrysididae	::	: :		Tre. Tre.	~ 1	91 1	- I	Tro.	- I	1.0	::	::	мч	0.1 Trc.
CRUSTACEAE Decapoda Amphipoda Cladocera	- ~ <b>i</b>	0.3	41 15 15	1.0 2.2 Tre	~~	1.7 Tre.	w	6.0		:::	мч <b> </b>	1.1 1.0 	15 19	5.1 2.6 1re
ANNELLDA	12	39.1	01	30•35	Ч	2.6	Ч	0•3		0•8	ч	ł	56	73.15
NEWA TODA	m	Tre	m	- Let	1	ł	6	Trc.	:	ł	Ч	-ST	ព	Tre.
DIPLOPODA	:	ł	2	ġ	ł	ł	ł	ł	ł	:	ł	ł	~	Trc.
HYDRACARINA	ł	ł	m	Tre.	:	ł	2	Tre.	:	1	ł	;	м	17 <b>6</b> .

TABLE II (CONT'D.)

zb

Vol. 1.55 9•95 0.1 6•0 1.0 8**.**5 76.4 1.1 Totals No. 1 ł : m 3 コ Vol. 1.6 2•0 Aug. 28 Sept. 5 1 1 ł I No. 1 1 ł 1 1 1 1 Vol. 0•0 0.1 2•5 July 114-Aug. 25 0.7 ; ł 1 No. ł ţ 1 1 1 Ч A Vol. Tre. July 1-11 0.8 0•2 6.7 1 No. 1 1 1 1 1 Ч Vol. 0.15 3.45 ח•יות 1.7 ł ł ł 1 June No. 1 1 ł 1 I 1 ł 9 **Vol.** 8-11 1.1 6•0 **6.**0 0.1 1 ; ł May No. 1 1 1 ł 1 Ħ Vol. . 24 0.4 **6**•0 0.0 3.5 1.0 ł ł April No. ł 1 ; ł ł ł m -Taxonomic Category DEBRIS (CENERAL) DEBRIS (ANIMAL) DEBRIS (PLANT) GASTROPODA FISH BOGS ARACENTDA MOLLUSCA SODE

TABLE III

STOMACH CONTENTS OF 8 RAINBOW TROUT \* PLANTED IN 1956, TAKEN MAY 24 - JUNE 11, 1957

	() May	) - 24	) June	5) • 11	To ta	Je
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.
AQUATIC INSECTS Ephemeroptera - naiads Family Indeterminable	ч	Тгс.	16	0.85	17	0.85
Trichoptera - Larvae Hydropsychidae Hydropsyche Helicopsychidae <u>Helicopsyche</u>	1 :	::	44	Tre. 0.05		Tre. 0.05
Family Indeterminable	;	ł	Ļ	Tre.	1	Tre.
Diptera - larvae Tendipedidae	ł	ŧ	ħ	Tre.	-7	Tre.
TERRESTRIAL INSECTS Coleoptera - adults Carabidae Curculionidae	: :	11	4 °	Tre. 0.05	H 00	Tre. 0.05
Diptera - adults Family Indeterminable	ł	ł	Ч	Tre.	Ч	Trc.
Hymenoptera - adults Formicidae	-	-	ч	Tre.	Ч	Trc.

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<sup>\* 7 - 9&</sup>quot; Long

TABLE III (CONT'D.)

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7.4 7

	May	टो	Jun	e 11	Tota	l e
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.
ANNELIDA	4	0.4		0•6	v	1.0
CRUSTACEAE Amphipoda	ч	0.05	:	:	Ч	0-05
ARACHNIDA	ł	ł	Ч	Tre.	ч	Tre.
HTDRACARINA	•	;	Ч	Tre	Ч	Tree
DEBRIS (ANIMAL)	1	2.1	ł	5•1	:	7.2
DEBRIS (PLANT)	ł	:	:	0.1	ł	0.1
DEBRIS (GENERAL)	ł	Tre.	ł	Trc.	ł	Trc.

42

.

	() Tot	) als		To	tals
Taxonomic Category	No.	Vol.	Taxonomic Category	No.	Vol.
AQUATIC INSECTS Plecoptera - adults Pteronarcidae <u>Pteronarcys</u>	Ч	1.1	TERRESTRIAL INSECTS Coleoptera - adults Curculionidae		fre.
Odonata - naiads Gomphidae <u>Gomphus</u> Agrionidae <u>Agrion</u> Family Indeterminable	ЧМЧ	0.0 0.55 0.05	Hymenoptera - adults Apidae Bombus Formicidae Andrenidae	<b>ч</b> оч	1.2 0.05 0.1
Hemiptera Gerridae <u>Gerris</u>	T	0•05	Order Indeterminable - adults ANNELIDA	1 127	Tre. 47.6
Trichoptera - larvae Helicopsychidae <u>Helicopsyche</u> Limnephilidae Family Indeterminable	4 <i>~</i> ~	Tre. 1.55 0.15	CRUSTACEAE Amphipode DEBRIS (ANIMAL)	~	0•6 28 <b>•1</b>
Diptera - larvae Tipulidae Tendipedidae	ъщ	10.7 Tre.	DEBRIS (PLANT) DEBRIS (GENERAL)	: :	3•2 1•05

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TABLE IV

STOMACH CONTENTS OF 9 RAINBOW TROUT PLANTED IN 1956, 9 - 13" LONG, TAKEN APRIL 27 - 28, 1957

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t	-	

# STOMACH CONTENTS OF 6 RAINBOW TROUT PLANTED IN 1957, 7 - 10" LONG, TAKEN AUG. 22 - AUG. 31, 1957

	Tot	6) al s		Tot	als
Taxonomic Category	No.	Vol.	Taxonomic Category	No.	Vol.
AQUATIC INSECTS Ephemeroptera - naiads Family Indeterminable	&	2.05	TERRESTRIAL INSECTS Homoptera Cercopidae	ъ	0.3
Odonata - naiads Family Indeterminable	Ч	0-05	Coleoptera - adults Family Indeterminable	Ч	Tre.
Hemiptera Corizidae	7	Tro.	Hymenoptera - adults Formicidae Family Indeterminable	мч	0.1 Tre.
Megaloptera - larvae Corydalidae <u>Corydalus</u>	Ч	0.7	ANNELTDA	m	1.95
Trichoptera - larvae Hydropsychidae Hydropsyche	8	0•05	CRUSTACEAE Decepoda Cladocere	<b>10</b>	0.45 Tre.
Family Indeterminable	ч	Tre.	GASTROPODA	8	0•3
Coleoptera - adults Dytiscidae	2	Tre.	ARACHNIDA DEBRIS (ANIMAL)	- I	Tre. 9.6
Diptera - larvae Tendipedidae	Ч	Tre.	DEBRIS (PLANT) DEBRIS (GENERAL)	: :	0.55 Tre.

	Πď	<b>ANTED</b>	DMACH IN 195	CONTEN	TS OF EN APR	92 RAI	NBOW T EPTEMB	ROUT *	57					
	(o) Apr	<b>~</b> <sup>t‡</sup>	) Me	(5) 17	Jun		(28 Jul	() K	( 20 Augu	) Ist	() Sep	t.	Tota	8
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.
AQUATIC INSECTS Ephemeroptera - naiads Ephemeridae	No		r1 r	0.15	-	0• 25		0.25	6	0.95	:	ł	<i>م</i> د	1.6 25
Family Indeterminable			3°	1.3	<b>-</b> 4	1.4	3.1	<b>1.</b> 2		0.05	t- 1	0.25	<b>7</b>	t-2
Family Indeterminable	Stoma	chs	;	1	м	0.25	1	: :	11	0.8	;	ł	22	1.05
Odonata - naiads Gomphidae Gomphus Family Indeterminable				0 <b>.1</b> 0.1	14	1.0	łń	0.25	: :	: :	::	: :	ЧЛ	0 <b>.1</b> 0.45
Hemiptera Gerridae Gerridae <u>Gerris</u>	Colle	cted		<b>; ;</b>	~	1.0	113	0.15 1.15	1 –	1.0	~	0.2	2 L L	0.25 1.45
Corixidae Hebridae <u>Hebrus</u>	In		а I	0•02 	<del>ور</del> ا	0.35	79 78	0.2 Tre	1 =	0•02	11	: :	72	0.65 Tre.
Trichoptera - larvae Brachycentridae <u>Brachycentrus</u>		:	Ч	1.0	;	ł	4	Trc.	۵	0.25	2	0.05	15	<b>1</b> •0
Hellcopsychidae Helicopsyche	Jdv	7	ł	ł	;	1	2	0.25	ł	ł	0	Trc.	12	0• X

\* 7 - 9" Long

TABLE VI

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	Apr	=	Ma	8	Jur	9	Ju	y	Augr	ıst	Sep	t.	Tot	al s
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.
Trichoptera - larvae (Cont'd.)														
Hydropsychidae Hydropsyche	2		2	<b>t</b> •0	4	Tre.	19	0•3	2	Tre.	ł	1	32	<b>٦-0</b>
nyuropsycniaae Chaunatopsyche	ON		Ч	0•05	ł	ł	ł	;	1	ł	ł	ł	Ч	0. 9
Limnephilidae Rhwacombilidae			1	:	ł	ł	~ ~	0-05	Ч	0.15	:	i	~ ~	0•2
Limnephilidae	Stomac	hs	I	•	I	;	-	Trc.	ł	ł	ł	1	-1	170.
Neophylax Rhyacophilidae			1	ł	1	ł	н	ાર	:	ł	ł	ł	Ч	Trc.
Glossosoma			ł	ł	ł	ł	Ч	Trc.	1	ł	ł	ł	н	Trc.
Hydropsychidae	Collec	ted	ł	ł	1	1	~	Trc.	!	I	1	ł	2	с. Ц
Family Indeterminable			m	0•3	~	Trc.	~	0.05	ł	:	;	ł	2	0.35
Limnephilidae	1 		;	ł	ł	ł	ł	ł	-	0•2	1	;	-	0•2
Limnephilidae Family Indeterminable	11-1		10	 0.15	12	0.15	β	0.1	_	0.05	::		L7 3	0.1 0.4
<b>Goleoptera - adults</b> Dytiscidae Laccophilus	Apri	н	1	ł	ч	0.05	Ч	Trc.	1	ł	1	:	~	0.05
Dytiscidae Bidessus				Tre.	ч.	21	ł	ł	;	;	1	1	। ର	J.C.
Haliplidae Peltodytes			1	ł	ഹ	<i>8</i> •	!	:	1	ł	1	ł	м	े. १
Halipildae Haliplus			1,	, ; ;	Ν,	<b>1•</b> 0	1	1	ł	1	:	ł	2	0.1
Viiry someridae			זר	<b>2</b> 2 2 2 2 2 2 2 0 2 0 2 0 0	- 1	<b>T•</b> 0	1	:	1	:		1	~ _	0.15
			1	4 = >		}		]	]	ł	ł	:		1.0

TABLE VI (CONT'D.)

TABLE VI (CONT'D.)

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	Apri	1	Ma	A	Jun	8	ງແມ	А	Augu	st	Sept	•	Tot	a la
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.
Diptera - larvae Tipulidae Tendipedidae Psychodidae			요~ 1	3.7 Tre.	ч2ч 12ч	9 9 9 9 9 9 9 9	∾	Frc.		:::	111	:::	цуч	Jrc. Tre.
- pupae Tendipedidae Simuliidae <u>Simulium</u> Heleidae	No		100	<b>Tre.</b> 0.05	~   –	Tre.					111		ч°г	Tre. 0.05 Tre.
- adults Tendipedidae Heleidae Empididae	Stomach	8		;;;			~~~	Trc. Trc.	~	0•05 ••			0 1 1 0	176. 0.05
TERRESTRIAL INSECTS Homoptera Fulgoridae Cercopidae Cicadellidae Aphididae Membracidae	Collect In	ted	_				1 2 8 8 9 1	0.25 0.1 1rc.	0	10111 8	~	3::::	~~IF~~	00.1 176.1 176.1
Hemiptera Pentatomidae Miridae	April		14	Trc.	::	::	- <b>-</b>	0.1 Trc.	н I	1.0 	::	::	20 0	0.2 Tre

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	Apr.	-	Ma	A	ղա	16	Jul	y	Augu	lst	Sept	٩	Tot	als
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.
Coleoptera - adulta														
Current tont dae			6		1, 2	עע	ſ		ſ				เ	l t c
Combidae Combidae			-	1.>	÷.		<u>,</u>		4	5.0	•	;	24	5.0
Valautuae			t B	1	-1 1	-21	-1	<b>C</b> <b>O</b> <b>O</b>	•	ł	1	ł	N	0.05
H18terigae			ļ	ł	-1	0.05	:	1	ł	1	ł	:	Ч	0 2 2
Languriidae			1	ł	Ч	Tro.	1	ł	;	;	;	ļ	-	, er
Elateridae	No		ł	ł	:	;	2	0.1	:	!	-	0.1	~	0.0
<b>Coccinelidae</b>			1	ł	1	1		The second	-		•		) C	
Staphylinidae			1	t	;	;	, 1	; ;	• -			<b>;</b> ;	<b>،</b> ۱	
Family Indeterminable			ł	1	-	0-05	-	الروم	. 1				40	
	Stom	ach s			I		1			1		1	J	5
)rthoptera														
<b>PhaneropterInae</b>			1	;	:	ł	ł	;	ч	0•25	•	ł	Ч	0.25
Hoters	Coller	tad												
Muscidae		500	ļ	ļ	!	ł	l	۰ ا	-		ļ	1	F	•
Family Indeterminable			"	Trc.	9	0.05	~	j. L	4				4 °	
•			١		,		•				ļ	1	4	
[ymenoptera	In													
Formicidae			2	0 8	ጽ	0.25	م	0.15	7	0.1	;	1	ĩ	0.55
Vespidae			ł	ł	1	ł	ł	ł	2	0.35	ł	:	2	5.0
Family Indeterminable			Ч	Tre.	Ч	Tre.	!	;			1	;	2	
	Linga	A											I	
Jepidoptera - Larvae Family Indaterminahla			~		c		c	и С					ı	
			4	5	V	<b>C0</b> •0	V	50.0	:	:	:	:	л	0.15
order Indeterminable			T	Tre.	m	Trc.	1	ł	;	ł	1	;	7	lfe.

TABLE VI (CONT'D.)

	Id <b>y</b>	뒤	Me	δ	Jur	9	Ju	У	Augu	st	Sept	•	£	tals
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.
CRUSTACEAE														
Decapoda Amphilpoda			<b>~</b> 0	5.t 0.15	<b>م</b>	2•25 0•05	a I	4.45	ㅋㅋ	2• 25 0•1	- 1	<b>1</b> -0	႙ၟႜၜ	11.75 0.3
ANNELIDA	No		2	6.05	m	4.1	6	4.5	Ч	0.75	1	:	8	15.4
GASTROPODA			9	0•2	13	0-45	٩ra	1.75	9	0 <b>•</b> 6	:	-	651	3•0
HTDRACARINA	Stoma	chs	Ч	Tre.	255	0•8	<b>0</b> 1	0.1	ł	ł	ł	:	80	0•9
ISOPODA .			ł	ł	ł	ł	ł	:	Ч	Tre.	ł	<b>1</b> -	Ч	St
WUOJOIJII	e [[o]	ctad	1	8	ł	ł	Ч	<b>.</b>	:	;	1	ł	Ч	Tre.
ARACHNIDA		5	:	ł	Ч	0.1	Ч	0.05	1	1	ł	ł	2	0.15
NEWATODA	ţ		ł		ч	Tro.	1	1	1	ł	:	;	Ч	Tre.
EGGS (CRUSTACEAN)	3		ł	ł	~	မို	ł	ł	;	;	:	ł	2	Trc.
DEBRIS (ANTHAL)			1	24 <b>. 1</b>	:	15.05	ł	20.75	ł	17.75	ł	2.75	1	80.1
DEBRIS (PLANT)	T T T T	4	1	1.45	1	0.65	:	4.85	ł	1.75	ł	•35	ł	9•05
DEBRIS (GENERAL)			:	0.75	;	0.15	ł	2.0	ł	Tre.	:	0.15	ł	1.75

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TABLE	

STOMACH CONTENTS OF 71 BROWN TROUT \* PLANTED IN 1956, TAKEN APRIL - SEPTEMBER, 1956

	) Api	(S) 111	C.M.	42) 8y	Jur 1		) July	() 1-11	(3) July Aug.	-ग- 52	(2) Aug. Sept.	25 27	Tota	ls
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.
AQUATIC INSECTS Ephemeroptera - naiads Ephemeridae Heptageniidae Family Indeterminable	:::	°	alm	0.3 1	111	111	:::	: : :	~	Tro.		:::	<b>N</b> N N	0.6 Tre 0.1
Plecoptera - naiads Perlidae Pteronarcidae Family Indeterminable	114		<b>нн</b>	0.5	: : :	:::	;;;;	:::	111		: : :	:::		0•2 0•5 0•1
Odonata - naiads Gomphidae Anisoptera - adults Agrionidae <u>Agrion</u> Coenagrionidae	:: ::		H0	0.6	9E	 2•2 0•4			:: ::			:: ::	<b>Ч</b>	0.6 0.1 0.1
Hemiptera Gerridae <u>Gerris</u> Gerridae Notonectidae Corixidae Naucoridae	0	88 1	12112	1.15 1.1 0.1		•         •	=	13111	ᆔᆝᆡᆔᇞ		-	11311	36 <b>- 5</b>	10.1 10.1 10.1 10.1 10.1 10.1 10.1 10.1

\*7 - 9" Long

	<b>A</b> p	ril	W	A.	վա	90	July	<b>11-1</b>	July Aug.	ង្ខ័	Aug. Sept	žv	Tote	ls
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.
Hemiptera (Cont'd.) Belostomatidae Notonectidae <u>Natonecta</u>	<b>;</b>			0•3 0•05	; ;	: :		11	;;	::	11	::		0•3 0•05
Trichoptera - larvae Rhyacophilidae Limnephilidae Psychomyiidae Helicopsychidae			๛៷๛๚	0.45 0.65 0.05 0.05	m	1.0							~~~~~	0.45 1.05 0.2 0.05
Brachycentridae Brachycentrus	;	t T	Ч	0.1	ł	1	ч	0.1	ł	;	ł	ł	8	0.2
Hydropsychidae Hydropsyche Family Indeterminable	: :	: :	9	0.05	- 1	Tre.	11	::	::	: ;	1 ~	Tre.	<b>H</b> Ø	<b>Trc.</b> 0.05
- acuits Family Indeterminable	;	;	۲ ک	0•2	:	1	н	Tre.	;	ł	ł	1	6	0.2
Coleoptera - larvae Chrysomelidae Haliplidae <u>Haliplus</u> Chrysomelid <u>ae Donacia</u>			-		нн I	0.2 Tre.			:::	: : :		:::		0.2 Tre. Tre.
Psephenidae Psephenus	ł	ł	;	1	<b>F</b> 6	٥•4	ł	:	;	1	ł	:	16	0•l
Diptera - larvae Tendipedidae Tipulidae	мч	0.15 0.1	3t 3t	1.55 15.95	m	[.0	14		: :	;;	::	: :	<u>አ</u> ຮ	1.8 16.15

TABLE VII (CONT'D.)

	<b>A</b> p	111	M	Ŋ.	Jw	90	July	<b>11-1</b>	July Aug.	- 1%	Aug. Sept	Мул	Tota	g e
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	¥0.	Vol.	No.	Vol.
<pre>iptera - larvae (Cont'd.) Tabanidae Simuliidae</pre>	::	::	~	1.0	::	::	: :	::	1 1		14	 Trc •	ч 2	0.1 Tre
- pupae Tendipedidae	2	0.1	Ч	Trc.	1	1	ł	ł	ł	1 8	ł	1	n	1.0
- adults Empididae Simuliidae Tendipedidae Culicidae			53	0.5 1 1 1	<sub>2</sub>	  			_				27 47 7	1.rc. 1.rc. 1.rc.
TERRESTRIAL INSECTS Iomoptera Cicadellidae Membracidae Cercopidae Family Indeterminable				; ; ;	~~!!	Trc.	<b>1</b> @ <b>1</b>	Tre. 0.1			оно <b>!</b>	Trc. Trc.	Üedi	Tre. 1.re. 1.re.
l <del>em</del> íptera Mirid <b>ae</b>	ł	1	1	;	ł	;	ł	ł	ч	Tre.	ł	ł	ч	Tre.
coleoptera Coccinelidae Cerambycidae Chrysomelidae Curculionidae		: : : :	_	0.05	10 E	Trc.	~~!!	54 54 1					20101	176. 176. 0.05

TABLE VII (CONT'D.)

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	<b>A</b> p	ri1	W	Ly	Лц	8	յայ	11-1	July Aug.	4×	Aug. Sept	<sup>1</sup> <sup>1</sup> <sup>1</sup> <sup>1</sup>	Tota	ដំន
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.
Coleoptera (Cont'd.) Erotylidae Family Indeterminable		<b>1.</b> 0	::	::	ابر ا	91   E	::	::				1.0	~~~	0.0
Lepidoptera - larvae Pyralidae Family Indeterminable	;;	::	11	11	: :	::	;;	11	;;	::	50 50	0.2 0.1	~ ~ ~	0 <b>.</b> 2 0 <b>.1</b>
Diptera Family Indeterminable	ł	!	~	Tre.	Ч	Trc.	Ъ	0.2	Ч	Tre.	:	ł	Ś	0.2
Hymenoptera Formicidae Chalcidoidea Family Indeterminable		511		Tre.		:::		Trc.	_	Å	- <b>   </b>		<b>NTT</b>	0.1 Tre.
CRUSTACEAE Decapoda Ostracoda Amphipoda		0.2	<i>х</i>   <i>х</i>	14.95  0.4	<b>мн  </b>	9.3 Tre-	• • •			:::	~	9.11	<u></u> щ <i>ч</i> л	27.05 Tre. 0.4
DIPLOPODA	ł	1	8	0.15	1	1	ł	1	ł	ł	ł	ł	8	0.15
ISOPODA	1	1	7	0•1	ł	ł	ł	ł	ł	ł	ŗ	ł	ユ	0.1
ANNELLDA	18	29.8	न <b>'</b>	28.95 2.	\$ \$	п.5	l	ł	-	0•2	ł	•	8	70.45
	1	1	-	1•0	Q	<b>M</b> •0	ł	1	ч	Tre.	•	ł	8	0•4

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TABE VII (CONT'D.)

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TABLE VII (CONT'D.)

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35.95 Vol. 31.25 Trc. **1.**0 2•2 0•2 1.9 0.7 Totals No. ł 1 ឌ 2 -Vol. Aug. 25-Sept. 5 Trc. 1.7 ł -No. 1 1 1 1 Vol. July 14-Aug. 25 0.1 1.5 1 ; i 1 ł ł No. 1 ł 1 1 I 1 ស Vol. July 1-11 2•0 1 1 1 1 1 ; No. ł 1 1 1 1 | Vol. j. 8° 2 **6.**0 1.8 ł 1 1 1 June No. ; 1 I l 1 1 M 22.55 Vol. Trc. 0.2 2.2 28.3 1.6 ł ł May No. 1 1 ł 2 Vol. 1.15 2.4 0.7 1 1 1 ł April 1 No. : 1 1 ł 1 1 Taxonomic Category EGGS (CRUSTACEAN) DEBRIS (GENERAL) DEBRIS (ANIMAL) DEBRIS (PLANT) HYDRACARINA FISH BOGS EGGS FISH

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STOMACH CONTENTS OF 13 BROWN TROUT \* PLANTED IN 1957, TAKEN APRIL - SEPTEMBER, 1957

	(1) Apri	- 4	(6) May		(1) June		(2 Jul	с <b>к</b>	() Augu	) st	(0) Sept.	Tot	als
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No. Vol.	No.	Vol.
AQUATIC INSECTS Ephemeroptera - naiads													İ
Family Indeterminable	;	ł	ł	:	у	0.15	ł	1	ł	ł	2	м	0.15
Family Indeterminable	ł	i	1	ł	;	1	ţ	ł	ч	0•25	<b>D</b>	Ч	0•25
Hemiptera Gerridae	ł	;	i	:	ł	-	5	1•05	ñ	0.3	Stomachs	15	1.35
Odonata - adults Agrionidae <u>Agrion</u> Family Indeterminable	::	::	: :	<b>I I</b>	: :	: ;	~	1.2	_			~~	1.2 0.15
Trichoptera - larvae									t		Collected	4	
Brachycentridae Brachycentrus Haliconswhide	ł	;	ł	1	ł	;	ţ	i	Ч	0.05	In	Ч	0*05
Helicopsyche Helicopsyche	:	ţ	6	٥-4	ч	Trc.	1	;	32	0.7	1	142	1.1
Limephilidae		0 <b>•0</b> 5 0 <b>•1</b>	0		ЧЧ	Tre. 0.05	::		;;	::	Sept.	E 0	0•05 0•25
Glossosome	1	ł	8	;	~	Tre.	ł	ł	:	ł		2	Tre.

\*7 - 9" Long

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	Apr	1	May		June	-	July		Augus	t	Sep t.		Tota	ls
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No. V	101.	No.	Vol.
Trichoptera - larvae (Contid.)														
Family Indeterminable	Ч	0.1	ñ	0.1	ч	0•05	Ч	<b>.</b>	ł	ł			6	0.25
- acuits Family Indeterminable	ł	t	1	ł	ч	Trc.	;	· <b>¦</b>	ч	Trc.	ON N		2	Trc.
Diptere - larvae Tipulidae	Ч	0•2	ч	0•2	ч	0•25	1	1	:	:	2		ŝ	0.65
Tendipedidae	ł	:	!	1	2	lic.	;	:	ł	:	•		~	Trc.
- pupse Tendipedidae	1	ł	Ч	Tre.	ł	ł	;	:	:	2 	tomachs		ч	Trc.
- aaurus Eenpididee	1	ł	1	ł	ł	ł	ч	Tre.	ļ	1			Ч	Trc.
TERRESTRIAL INSECTS										5	OTTECTED			
Homoptera Membracidae Cicadellidae Cercopidae			:::		• • •		<b> </b>	Trc.	110	115	In		~~~	51 5 1.0 1.0
Coleoptera - adults Curculionidae Family Indeterminable	;;	;;		: :	ъ I	0.05		::	l H	Tre.	Sept.		мч	0.05 Tre-
Hymenoptera - adults Formicidae Andrenidae	: :	::	-1 <b>-1</b>	0•05 0•1			н I	Trc.	817	1.65 		u	9 ч	1.7

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	Apr	q	May		June		Jul	•	Augus	st	Sept.	To	tal s
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No. Vol	. No.	Vol.
Order Indeterminable	1	:	:	1		:	1	1	2	0.1	N.	5	1.0
CRUSTACEAE Decapoda Amphipoda	Ч	0.5	<b> </b>	0.8		::	н I	2.4	I	2•0 	NO Stomachs	ч	0 • 5 • 5
LINELIDA	m	1.4	ч	0.2	ł		;	ł	ł	ł		t	1.6
LAS TROPODA	1 8	ł	7	0.55	m	0•05	ł	ł	:	ł	<b>Collected</b>	7	<b>0</b> •6
<b>RACHNIDA</b>	;	ł	• •	ł	ł	ł	ł	ľ	Ч	Trc.		ч	Tre
<b>YDRACARINA</b>	ł	ţ	ъ	Trc.	2	Trc.	ł	;	ţ	1	In	ដ	Trc.
EBRIS (ANIMAL)	ł	1.7	ł	5.2	ł	<b>6</b> •0	t i	1.25	ł	1.0	<u>,</u>	1	<b>10.</b> 05
EBRIS (PLANT)	ł	ł	ł	0.1	1	1.1	l t	:	ł	0.35	Sept.	1	1.55
EBRIS (GENERAL)	ł	ł	;	0•5	1	0.15	ł	ł	ł	Trc.		ł	0•65

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### TABLE IX

### STOMACH CONTENTS OF 5 NATIVE HROWN TROUTS TAKEN MAY 12 - 26, 1956

	Tot: (5	() als
Taxonomic Category	No.	Vol.
AQUATIC INSECTS Trichoptera - larvae Brachycentridae <u>Brachycentrus</u> Family Indeterminable	ЧМ	Tre. 0.1
Coleoptera - adults Dytiscidae	Ч	Trc.
CRUSTACEAE Decapoda	2	3.7
ANNELLDA	11	12.0
DIPLOPODA	Ч	Trc.
DEBRIS (ANIMAL)	ł	6.0
DEBRIS (PLANT)	1	0.7
DEBRIS (GENERAL)	ł	1•5

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### STOMACH CONTENTS OF 11 NATIVE BROWN TROUT \* TAKEN APRIL - SEPTEMBER, 1957

	(L) Apri	<b>6</b> 4	(1) May		(1) June		(3) July		(2) Augus	دب	(o) Sept.	Tote	цs
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No. Vol.	No.	Vol.
AQUATIC INSECTS Ephemeroptera - naiads Ephemeridae Family Indeterminable	;;	;;	11	;;	11	::	11	: :	нн	0.25 Tre.	No	нн	0.25 Tre.
<b>Plecoptera - naiads</b> Family Indeterminable	12	0•5	ł	ł	ŧ	ł	ł	ł	ł	ů ¦		12	0•5
Odonata - naiads Family Indeterminable	ł	ł	ł	ł	ļ	ł	Ч	0•2	ł	2 	8 110 BHO	н	0•2
Hemiptera Gerridae <u>Gerris</u>	ㅋ	<b>0•</b> 6	2	1.0	Ч	0.1	ł	1	1	3	llected	2	0.8
Trichoptera - larvae Brachycentridae Brachycentrus Heliconsychidae	ł	1	ł	1	ł	8	ł	ł	ч	Trc.	In	Ч	Trc.
Helicopsyche Limmephilidae Family Indeterminable	LE!	1.1		: : :	:::				~	Trc.	Sept.	てたる	Tre. 1.1 0.05
- aduits Family Indeterminable	8	0•9	ł	;	:	ł	ł	;	:	;		ß	0•9

\* 7 - 9" Long

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	Apı	LF.	May		June	•	July		Augus	t.	Sept.	Ă	tals	
Taxonomic Category	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No. Vo]	. No.	Vol.	
Diptera - larvae Tipulidae	ъ	6•5	ł	1	ч	Tre.	1	ł	:	;		6	6•5	
- adults Epididae	•	ł	ł	;	;	ł	ł	1	32	1.15	CN N	32	1.15	
TERRESTRIAL INSECTS Homoptera Cicadellidae	1	ł	ł	ł	1	ł	Ŷ	0.15	ł			v	0.15	
<b>Coleoptera</b> Curculionidae	;	ł	ł	ł	ł	:	8	0.05	ł	מ 	COMMENTS	~	0*0	
Hymenoptera Formicidae	ł	}	;	۱ ۱	8	1	ы	Tre.	5	Tre. C	ollected	m	Tre.	
CRUSTACEAE Decepoda Amphipoda	44	0•h 0•05	44	0•7 0•05	н <b>I</b>	1.1	44	0.05 0.05	::	: :	In	MF	8.h 0.15	
ANNELLDA	9	17.0	9	2.2	ł	:	ч	0•8	ł	ł	1	47	20•0	
ARA CH NIDA	1	ł	ł	ł	1	ł	Ч	0.1	ł	ł	Selp 2	Ч	0.1	
DEBRIS (ANIMAL)	1	14-7	ł	0•9	;	1.6	ł	0.7	ł	0.7		1	18.6	
DEBRIS (PLANT)	:	0•35	I	0.1	1	;	1	1•05	;	ł		:	1•5	
DEBRIS (GENERAL)	ł	0.1	;	ł	;	ł	ł	Trc.	;	1		ł	0.1	

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TABLE	

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STOMACH CONTENTS OF 4 NATIVE BROWN TROUT 11 - 15" LONG, TAKEN MAY 8 - JULY 22, 1957

	Tot	L) Sals		Ц Ц	tals
Taxonomic Category	No.	Vol.	Taxonomic Category	No.	Vol.
AQUATIC INSECTS Ephemeroptera - naiads Family Indeterminable	н	Tre.	TERRESTRIAL INSECTS Coleoptera - adults Coccinelidae	-	Tre.
Hemiptera Gerridae <u>Gerris</u>	5	0.1	Lepidoptera - larvae Family Indeterminable		. • 0
Trichoptera - larvae Hydropsychidae <u>Hydropsyche</u>	Ч	Tre.	Hymenoptera - adults Formicidae	2	0•2
Helicopsychidae <u>Helicopsyche</u> Family Indeterminable	4-	0.35	CRUSTACEAE Decapode	, M	12.7
Phrygane1dae	4	0•2	Amphipoda	Н	Tre.
Diptera - larvae			ANNELIDA	<b>H</b> 1	0•5 0,0
Tipulidae	Ч	0.4	(ASTRUPULA	ŀ	2.1
			HSL	Ч	<b>2</b> 35
			ROGS	19	1•0
			DEBRIS (ANIMAL)	1	2.3
			DEBRIS (PLANT)	ł	Trc.
			DERIS (GENERAL)	ł	<b>1-0</b>

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## STOMACH CONTENTS OF 1 NATIVE BROWN TROUT 17" LONG, TAKEN JUNE 10, 1956

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	Tota	ls
Taxonomic Category	No.	Vol.
CRUSTACEAE		
Decapoda	6	6.4
DEHRIS (ANIMAL)	1 9	1.8

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## W. K. KELLOGG BIOLOGICAL STATION

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