



Parasite incidence in relation to size and condition of trout from two Montana lakes  
by Alfred C Fox

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree  
of Master of Science in Fish and Wildlife Management at Montana State College  
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**Abstract:**

Rainbow trout (*Salmo gairdneri*) were taken from Cliff Lake and brown trout (*Salmo trutta*) and rainbow trout were collected from Meadow Lake, southwestern Montana during the summer of 1959. Parasites were predominant in the digestive tracts of rainbow trout from Cliff Lake. Meta-cercarial cysts, located in the musculature, were most common in rainbow and brown trout from Meadow Lake. Trout, from both lakes, were observed to have greater numbers of parasites accompanying increased length. The metacercaria of *Bolbophorus confusus* is reported for the first time from North America. It was found to be common in the rainbow and brown trout from Meadow Lake. Cysts were generally distributed over the body of the fish but they occurred in greater numbers anteriorly and dorsally. The fewest cysts were found in the posterior portions near the caudal fin. No important effects of parasite incidence on condition of trout was determined.

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FROM TWO MONTANA LAKES

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ALFRED C. FOX

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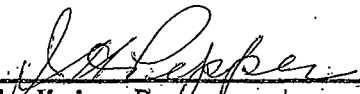
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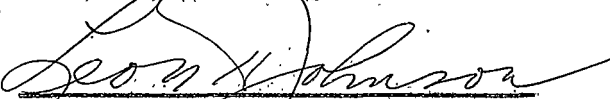
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Abstract

Rainbow trout (Salmo gairdneri) were taken from Cliff Lake and brown trout (Salmo trutta) and rainbow trout were collected from Meadow Lake, southwestern Montana during the summer of 1959. Parasites were predominant in the digestive tracts of rainbow trout from Cliff Lake. Metacercarial cysts, located in the musculature, were most common in rainbow and brown trout from Meadow Lake. Trout, from both lakes, were observed to have greater numbers of parasites accompanying increased length. The metacercaria of Bolbophorus confusus is reported for the first time from North America. It was found to be common in the rainbow and brown trout from Meadow Lake. Cysts were generally distributed over the body of the fish, but they occurred in greater numbers anteriorally and dorsally. The fewest cysts were found in the posterior portions near the caudal fin. No important effects of parasite incidence on condition of trout was determined.

### Introduction

Although numerous investigations have been made on parasite infestations in fish, very few concern the effects of parasites on the growth rate and condition of cold water fish. A comprehensive study by Woodbury (1940) revealed no apparent deleterious effects of parasites on the condition of yellow perch (Perca flavescens) in Walsh Lake, Michigan. Conversely, Hubbs (1927), Cross (1934, 1935), Richardson (1936), Langlois (1937), Hunter and Hunter (1938), and Hoffman (1956) found harmful effects of parasites on the condition of fish hosts.

The present investigation concerns the effects of parasites on the growth rate and condition of rainbow trout (Salmo gairdneri) and brown trout (Salmo trutta). The objectives of the study were twofold: to obtain information on distribution of parasites within the body of the fish, and to determine parasite incidence in relation to growth rate and condition.

Fish were collected from Cliff Lake and Meadow Lake in southwestern Montana. These areas were selected because of known parasite infestation of trout. Cliff Lake is located about 40 miles southeast of Ennis, Montana. It lies at an elevation of 6313 feet (mean sea level) and is surrounded by high cliffs. It has an area of 620 acres and a shoreline of about 13 miles. The maximum depth is 125 feet and most of the lake has a depth in excess of 40 feet. Meadow Lake, an impoundment on the Madison River, is located about five miles north of Ennis, Montana. The lake has a maximum surface area of 1945 acres and lies at an elevation of 4840 feet. The maximum depth is 38 feet, but most of the lake is less than 15 feet in

depth.

Rainbow trout were collected in Cliff Lake from early June through September 1959. Both rainbow and brown trout were secured in Meadow Lake from early August through September. Fish collections were made by 125-foot experimental gill nets (mesh 0.75 - 1.5 inches). Total lengths to the nearest 0.1 inch and weights to the nearest 0.01 pound were obtained for all fish taken. Specimens were iced and transported to the laboratory where they were frozen for future examination.

#### Host Examination

The fish were thawed only to the point where the viscera could easily be removed. All fins were then removed flush with the body and the head was cut off as shown in figure 1. This method of decapitation severed the

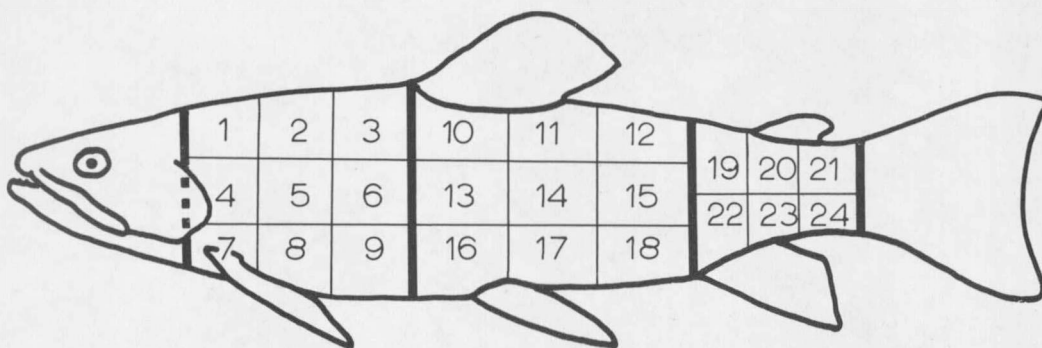


Fig. 1. Diagram of fish showing "portions" (heavy vertical lines) and "sections" (numbered areas) used in mapping distribution of parasites.

esophagus at a point immediately anterior to the base of the pectoral fins.

A mid-ventral incision permitted removal of the viscera. The body cavity and visceral organs were examined for parasites. The digestive tract was opened and its content thoroughly flushed into a container. The content of the tract was carefully decanted until most extraneous material had been removed. That remaining was microscopically examined and all parasites were removed and preserved. An examination of the digestive tract was then made to locate any encysted parasites.

The partially thawed body of the fish was cut into two parts along the median saggital line. Each part was then cut into three portions (Fig. 1). These portions were weighed to the nearest 0.01 gm. and then subdivided into sections (Fig. 1). The flesh in each section was teased apart, under a microscope, to locate encysted parasites. When a parasite was found its approximate position, in the section, was recorded (Fig. 2).

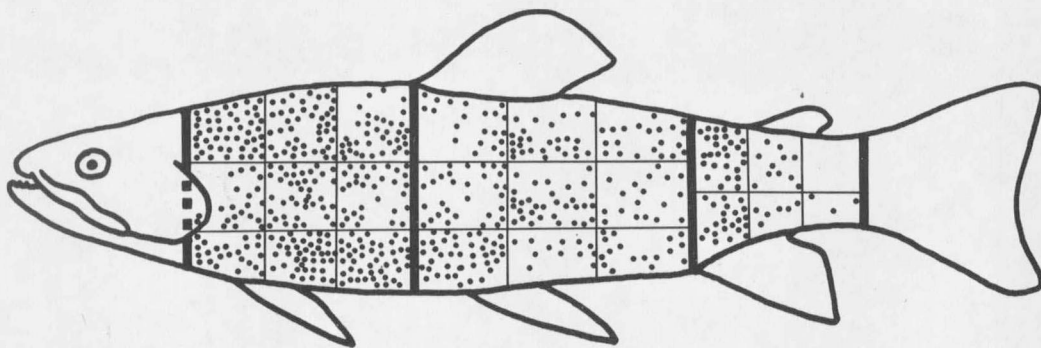


Fig. 2. Distribution of metacercariae on left side of brown trout from Meadow Lake. Each dot represents one metacercarial cyst.

### Parasite Incidence and Condition of Trout

Cliff Lake Rainbow Trout. The rainbow trout population of Cliff Lake is believed to consist largely of hatchery fish. Stocking records show that 35,000 rainbow trout (4 - 10 in. total length) were planted during the eight month period immediately preceding this study. Fin deformities characteristic of recently introduced hatchery fish were noted for 18 of 69 fish collected. Abundance of hatchery fish was further indicated by the scale samples taken. Difficulty was encountered in locating true annulus marks on most scale samples and it was not possible to age these fish. All parasitized trout taken from Cliff Lake were arranged by length groups and the average number of parasites was obtained for each group (Table 1). Condition of trout was determined by the following:

$$C = \frac{w \cdot 100,000}{l^3}$$

where w = weight and l = length.

Parasites were found in 54 of 69 trout examined. These were confined to the digestive tracts except in two fish which had nematodes (Eustrongylides sp.) encysted in the musculature. The parasites found in the digestive tracts included: nematodes (unidentified), cestodes (Dibothriocephalus sp.), acanthocephalans (Neoechinorhynchus sp.), and trematodes (Crepidostomum farionus). Nematodes occurred in 47 trout and were usually located in the pyloric caecae and intestines. The average number per fish for each collection period was as follows: 7.0 in June; 27.5 in August; 19.3 in September. The greatest number found in any one fish was 238. Cestodes occurred in 44 trout and were found in the same areas as nema-



Table 1. Length and condition of rainbow trout from Cliff Lake, showing the kinds and numbers of parasites.

Total length in inches	Number of fish	Average number of parasites				Average number of parasites per length group	Average C- factor per length group
		Nema- todes	Cestodes	Acantho- cephalans	Trema- todes		
7.0 - 7.9	1	3.0	-	-	1.0	4.0	43.8
8.0 - 8.9	2	6.0	4.5	-	1.5	12.0	39.2
9.0 - 9.9	4	1.7	2.0	1.7	0.7	6.2	38.1
10.0 - 10.9	13	3.3	5.1	5.2	4.1	17.7	32.9
11.0 - 11.9	12	5.7	6.4	6.1	2.9	21.2	31.5
12.0 - 12.9	8	9.0	12.4	2.1	1.7	25.2	31.0
13.0 - 13.9	7	34.4	5.3	21.1	3.1	64.1	34.6
14.0 - 14.9	6	48.7	5.2	3.8	-	57.6	35.3
15.0 - 15.9	-	-	-	-	-	-	-
16.0 - 16.9	1	238.0	1.0	4.0	2.0	245.0	38.6

todes. The average number per fish for each collection period was as follows: 8.0 in June; 4.5 in August; 5.9 in September. The greatest number found in any one fish was 20. Acanthocephalans occurred in 34 trout and were usually located in the stomach and intestines. The average number per fish for each collection period was as follows: 17.1 in June; 3.2 in August; 2.1 in September. The greatest number found in any one fish was 116. Trematodes occurred in 31 trout and were found in the same areas as acanthocephalans. The average number per fish for each collection period was as follows: 3.4 in June; 2.0 in August; 2.2 in September. The greatest number found in any one fish was 19.

The average C-factor of the 15 non-parasitized trout was higher (37.7) than that of the 54 parasitized trout (33.7). The difference in C-factor is appreciable and may be due to either parasite infestation or the presence of newly planted fish. Twelve of the non-parasitized trout had fin deformities and corresponded in size to fish of recent hatchery plants. Hatchery trout were known to have a higher C-factor than wild fish.

In general the longer the trout the greater the number of individual parasites and kinds of parasites it contained (Table 1). This could have resulted from a longer exposure time since body length is generally determined by age. No individual parasite group (nematodes, cestodes, acanthocephalans, trematodes) or combination of groups appeared to influence length or condition more than any other group or combination. It was noted, however, that fish with no more than two kinds of parasites had

















