Winter observations on trout and bottom organisms in Bridger Creek, southwestern Montana
by Sidney M Logan

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
Montana State University


Abstract:
The effects of temperature, ice and fluctuating water levels on numbers of bottom organisms and also on the abundance and movement of rainbow trout were investigated in a 900 foot section of Bridget Creek in Southwestern Montana from October 21, 1959 to September 12, 1960» A total of 96 bottom samples and 27 drift samples was studied. The most abundant group of organisms was Limnephilidae, Surface ice cover appeared to have no effects on the abundance of bottom organisms except for the loss of a small number found frozen in the ice at the water's edge of the stream.

High stream flows during the spring reduced the number of bottom organisms in situ and increased the number taken in drift samples. Floating surface ice did not appear to increase the number of organisms collected in drift samples.

The number of marked trout (153) decreased 83 percent over a 10 month period in the study section. Sixty-one percent of the trout within the study section did not travel more than 150 feet from the original place of capture. More trout moved downstream than upstream during each month of study. Trout were observed to move as far as 2 miles upstream from the study section and 55 miles downstream in the Missouri River. During the spring, summer and autumn, trout were mainly found in pools while in winter many were collected in riffle areas under surface ice.

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## Introduction

Very few winter fishery investigations have been conducted on trout streams. This fact was recognized by Hubbs and Trautman (1935) and Hazzard (1941). The first comprehensive study of winter conditions on trout and trout foods was made by Maciolek and Needham (1952). Anchor ice and its effects on bottom organisms was investigated by Brown, Clothier and Alvord (1953), O'Donnell and Churchill (1954), Benson (1955) and Reimers (1957).

The present study was initiated to determine the effects of temperature, ice, and fluctuating water levels on the number of bottom organisms, and also on the abundance and movement of trout. This investigation was conducted in Bridger Creek, which is a tributary of the East Gallatin River in Southwestern Montana. The first observations were made October 21, 1959 and continued almost daily through June 5, 1960, after which biweekly observations were made through September 12, 1960.

## Acknowledgments

Grateful acknowledgment is due Dr. C. J. D. Brown who suggested the study and assisted in the preparation of the manuscript. Dr. R. C. Froeschner verified the identification of aquatic insects. Mr. John Heaton helped with the field work. Members of the Montana Fish and Game Department and several Fish and Wildlife students assisted in the shocking operations. The Montana Fish and Game Department furnished equipment and the U. S. Fish and Wildlife Service provided the use of facilities at the Bozeman Hatchery. The Montana State College Agricultural Experiment Station contributed some financial aid.

## Methods

Air and water temperatures were secured to the nearest 1° F. with maximum-minimum thermometers. Readings were made between 6:30 and 8:30 A.M. daily from October through May except for 11 days and biweekly from June through September. Stream flows were determined with a velocity headrod and turbidities with a Hellige turbidimeter. Determination of alkalinity, dissolved solids, pH and dissolved oxygen followed standard methods (Welch, 1948). Trout were marked by tagging and clipping and were collected with a D.C. electric shocker. Stream bottom organisms were taken with a Surber square-foot sampler and drift organisms with a screen 3 feet wide (20 mesh per inch).

## Description of Area

A section of Bridger Creek was selected for study because it was accessible at all seasons and was closed to fishing. This section was located on property of the U. S. Fish and Wildlife Service Fish Cultural Station, 5 miles northeast of Bozeman at an elevation of approximately 4800 feet mean sea level. The water in Bridger Creek, which is a tributary of the East Gallatin River, originates from runoff and springs on the slopes of the Bridger Mountains. Three small warm water springs with a total flow of less than one-half gallon per minute are the only tributaries in the study section.

The climate of the area is characterized by severe winters with frequent and prolonged periods of subfreezing temperatures and heavy snowfall. The mean monthly air temperature was 24.2° F. and the average monthly snow-

fall was 14.4 inches during the winter of study (November through March).

The study section of Bridger Creek was 900 feet in length with a mean width of 17 feet and an average depth of 15 inches. The mean flow during the year of study was 35.7 cubic feet per second and water velocities were as great as 3.8 feet per second. There are numerous riffles and few deep pools in the study section and the bottom is composed of sand, gravel and rubble. The predominant plants bordering the stream included dense growths of willow, chokecherry and rose with occasional douglas-fir and aspen. These plants provided abundant natural cover in most of the study section. Annual water temperatures ranged from 32 to 65° F. Turbidity ranged from 3 to 18 p.p.m. during low water (July-February) and from 45 to 96 p.p.m. during high water (March-June).

During the study period chemical analysis showed the following ranges: total dissolved solids 205 - 244 p.p.m.; pH 7.6 - 8.2; methyl purple alkalinity 175 - 202 p.p.m. and dissolved oxygen 9.1 - 11.9 p.p.m.

Aquatic vegetation was limited to small patches of watercress and cattails in the spring areas. Rainbow trout (Salmo gairdneri) were common and was the most numerous game fish. A small number of cutthroat trout (Salmo clarki), brown trout (Salmo trutta) and brook trout (Salvelinus fontinalis) were also present. The mottled sculpin (Cottus bairdi) was abundant and the white sucker (Catostomus commersoni) was present in small numbers.

## Ice Conditions

Observations were made on ice formation and distribution in the study section and also in a portion of the stream 100 yards upstream. Ob-

servations outside the study section provided a comparison of ice conditions in the two areas. This was deemed desirable because a small quantity of relatively warm water from 3 small springs entered the study section.

Surface (sheet) ice, anchor ice and frazil ice are the 3 types known to occur in northern streams. Only surface and anchor ice was found in this study. Surface ice was most common and formed first at the water's edge where stream velocities were lowest. From this initial formation it grew outward toward the center of the stream. Surface ice often began as patches on emergent bottom materials or shelves at the water's edge and completely bridged the stream in certain areas. This ice reoccurred as many as 5 times in the same places. Brown, Clothier and Alvord (1953) reported similar conditions in the West Gallatin River, Montana. The thickest surface ice found in the study section was 2.5 inches while in the area upstream it reached 4.5 inches. This maximum occurred in both places on March 1, 1960. Some differences in ice cover between the study section and the area upstream may be seen in Figure 1. Anchor ice did not form in the study section although it was present in the area above. This type of ice has been described by Barnes (1906), Maciolek and Needham (1952), Brown, Clothier and Alvord (1953), O'Donnell and Churchill (1954) and Benson (1955).

Figure 1. Differences in ice cover between the study section (upper photograph) and the area upstream (lower photograph) in Bridger Creek on March 1, 1960.

## Bottom Organisms

A total of 96 bottom samples was collected during the period of study. Six were taken biweekly from the study section during November through April and monthly during October, May, July and August. Three of these were from unit 7, and 3 from unit 20 (Figure 2). Each series of 3 samples was collected at distances of 1, 4 and 7 feet respectively, from the water's edge.

The kinds and abundance of bottom organisms are shown in Table 1. Limnephilidae were the most abundant, constituting 54.3 percent of the total, followed by Hydropsychidae, 15.5 percent; Tenipedidae, 5.6 percent; Rhagionidae, 5.5 percent; and Ephemerellidae, 4.5 percent. Abundance of bottom organisms by months is presented in Table 2. Trichoptera was the most abundant in all months of the study and ranged from 50.5 to 85.6 percent of the samples. Diptera was second with 4.5 to 25.1 percent. The total of all organisms was highest in November when there were 285.0 per square foot and lowest in May with 104.3.

The average monthly water temperatures ranged from 33.5 to 35.0° F. (November through March). During this period bottom organisms were abundant, averaging 243.1 per square foot. Long periods of low water temperatures had no apparent effects on the abundance of bottom organisms (Figure 3). Surface ice covered some of the study section from November through March except for short periods when temperatures rose above freezing. Surface ice broke off under the weight of new snow