



Age and growth of brook trout, *Salvelinus fontinalis*, in Montana
by Robert J Domrose

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

Montana State University

© Copyright by Robert J Domrose (1960)

Abstract:

Age and growth determinations were made for brook trout collected from 13 streams and lakes in
Montana over a 10 year period (1950-1959).

In addition, samples were taken from seven lakes in the Beartooth Mountains during the summer of
1959. Scales were read with the aid of a microprojector, and a direct proportion of scale length to body
length was used in computing the length of fish at each year of life. Brook trout from the Flathead
River drainage produced the greatest growth (9.5 inches) at the third annulus, while fish from the Crow
Creek drainage showed the least (6.9 inches). The average calculated total lengths for all collections at
annuli 1-6 were 3.0, 5.6, 7.9, 10.3, 11.4 and 14.2 inches respectively. Growth rates for these fish were
somewhat greater than those reported for Michigan and New York.

AGE AND GROWTH OF BROOK TROUT, SALVELINUS FONTINALIS,

IN MONTANA

by

ROBERT J. DOMROSE

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

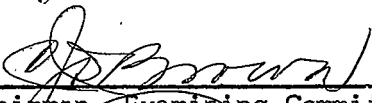
at

Montana State College

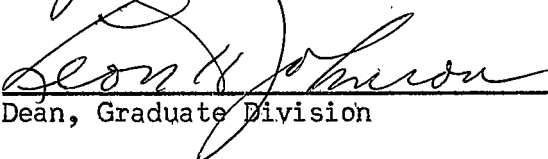
Approved:



Head, Major Department



Chairman, Examining Committee



Dean, Graduate Division

Bozeman, Montana
June, 1960

2 - 1287
1960

TABLE OF CONTENTS

	Page
Abstract	4
Introduction	5
Methods	6
Beartooth Mountain lakes	8
Area description	8
Age and growth	9
Condition factor	15
Other Montana lakes and streams	16
Area description	16
Age and growth	19
Discussion	28
Summary	29
Literature cited	31

ABSTRACT

Age and growth determinations were made for brook trout collected from 13 streams and lakes in Montana over a 10 year period (1950-1959). In addition, samples were taken from seven lakes in the Beartooth Mountains during the summer of 1959. Scales were read with the aid of a microprojector, and a direct proportion of scale length to body length was used in computing the length of fish at each year of life. Brook trout from the Flathead River drainage produced the greatest growth (9.5 inches) at the third annulus, while fish from the Crow Creek drainage showed the least (6.9 inches). The average calculated total lengths for all collections at annuli 1-6 were 3.0, 5.6, 7.9, 10.3, 14.4, and 14.2 inches respectively. Growth rates for these fish were somewhat greater than those reported for Michigan and New York.

INTRODUCTION

The brook trout (Salvelinus fontinalis) was introduced into Montana as early as 1894. The initial plants were made in Glenwood Lake near Jefferson City and in Buffalo and Travis Creeks near Helena (U. S. Fish Commission Report, 1894). In 1889 and 1890 further introductions were made in the Yellowstone and Madison Rivers in Yellowstone Park. Henshall (1906) reported the stocking of brook trout in many lakes and streams throughout the state. The introduction of brook trout and rainbow trout (Salmo gairdneri) about 1900 into the Centennial Valley (Nelson, 1954) is believed responsible for the decline of native cutthroat trout (Salmo clarki) and American grayling (Thymallus signifer). The replacement of cutthroat trout in the lower parts of its original range by exotic trout is reported by Hanzel (1959). The brook trout has been able to survive and reproduce so successfully that it now inhabits most river drainages in Montana.

The age and growth of brook trout in Montana have been studied for the Gallatin River drainage (Purkett, 1951 and Holton, 1953) and Prickley Pear Creek (Bishop, 1955). In western mountain regions the growth rate for this species is reported for Utah (Hazzard, 1935), Canada (Rawson, 1940), and California (Reimers, 1958). Other important age and growth studies for this species have been made for New York (Hazzard, 1932) and Michigan (Shetter and Leonard, 1943; Cooper, 1953).

The present study was conducted to determine the age and growth of brook trout from various locations in Montana. Data include collections

from 13 streams and 8 lakes by state fisheries personnel of the Montana Fish and Game Department over a 10 year period (1950-1959). In addition, the writer studied scales of this species from seven lakes in the Beartooth Mountains during the summer of 1959 (Figure 1).

The writer wishes to express sincere thanks to Dr. C. J. D. Brown for guidance in this study and in the preparation of the manuscript. Thanks are also extended to John Heaton for checking scale readings and to Vern Waples, John Peters, and Perry Nelson for their assistance in the field work. The writer is indebted to state fisheries biologists who collected scale samples from various places in Montana. Financial support was provided by the Montana Fish and Game Department under Federal Aid Project F-20 R-4.

METHODS

Fish samples were taken by one or more of the following methods: experimental gill nets, fine mesh gill nets, fish toxicants, electric shocking, seining, and angling. Total lengths were measured to the nearest 0.1 inch and weights to the nearest 0.01 pound. Sex was determined only for mature fish captured from the Beartooth Mountain lakes. Scale samples were taken from the side of each fish anterior to the dorsal fin and above the lateral line, with the exception of specimens from the Beartooth Mountain lakes and Culver Pond. Scales from the latter were taken from the area immediately below the lateral line and just anterior to the anal fin.

Scales were prepared for study by making plastic impressions or gum

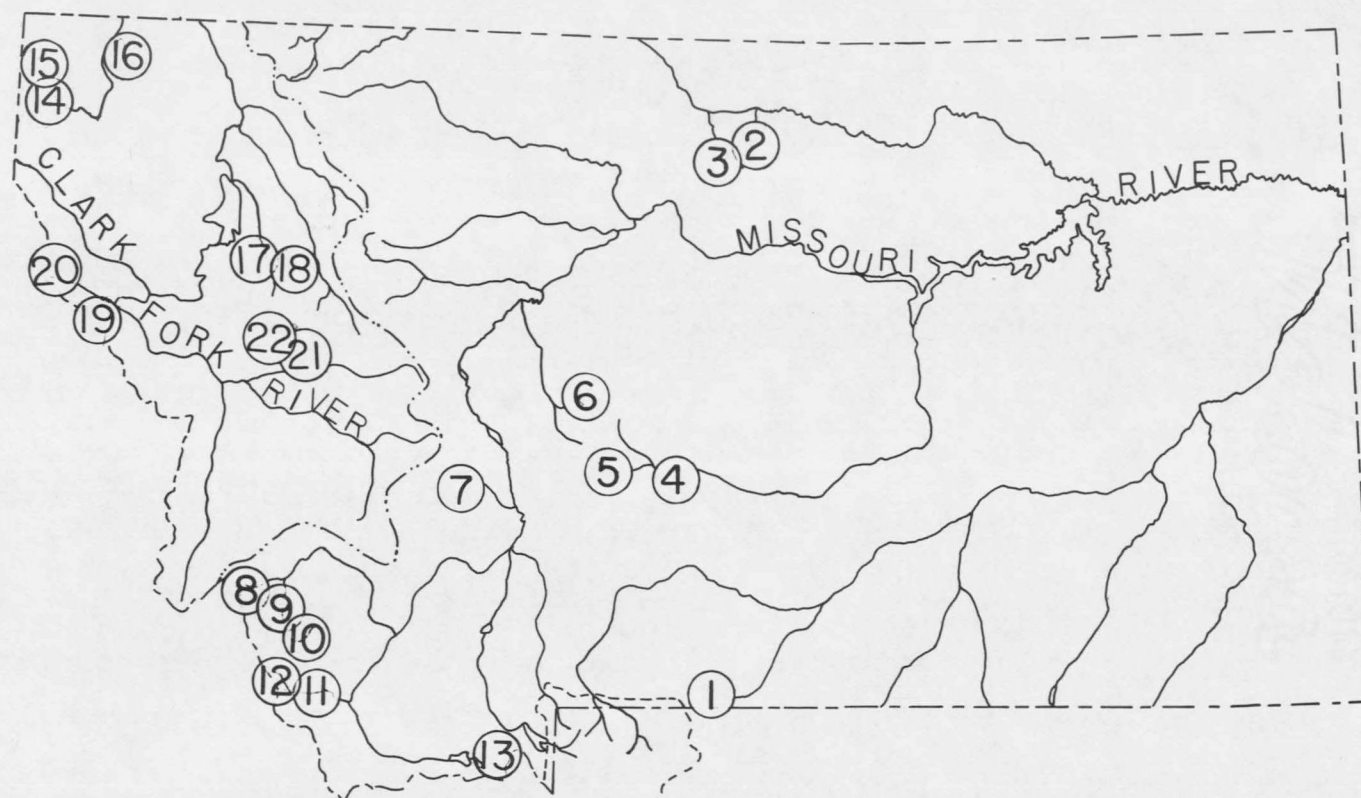


Figure 1. Locations of brook trout collections in Montana.

Missouri River drainage:

1. Beartooth Mountain lakes
2. Clear Creek
3. Beaver Creek
4. Big Elk Creek
5. Allabaugh Creek
6. Sheep Creek
7. Upper and Lower Tizer lakes

Clark Fork River drainage

8. Trail Creek
9. Big Hole River, Section 1
10. Big Hole River, Section 2
11. Reservoir Lake
12. Bloody Dick Creek
13. Culver Pond
14. O'Brien Creek
15. Kilbrennan Lake
16. Pinkham Creek
17. Lost Lake
18. Moore Lake
19. Silver Lake
20. Smith Creek
21. Placid Lake
22. Placid Creek

arabic-glycerin mounts. Water mounts were made on some samples where plastic impressions were unsatisfactory.

Annuli were determined with the aid of a microprojector, and measurements were made along the anterior radius of the scale from the center of the focus to the outer edge. Assuming a straight line relationship of scale length to body length, the length of fish at each year of life was computed by use of a nomograph. Some difficulty was encountered in distinguishing the first annulus mark, and wherever serious difficulty occurred, scale samples were discarded.

A coefficient of condition (C) was calculated for each fish from the Beartooth Mountain lakes using the formula:

$$C = \frac{W \times 10^5}{L^3}$$

where W equals weight in pounds, and L equals total length in inches.

Beartooth Mountain Lakes

Area Description — The seven Beartooth Mountain lakes studied (Table 1) are located in south-central Montana in the Cooke City-Red Lodge region. They lie at elevations from 8,000 to 10,500 feet above sea level and vary in size from 15 to 160 acres and in depth from 30 to 200 feet. Most are fed by small streams averaging 3 to 4 feet in width. Melting snow supplies water for these streams, which are believed to dry up during the winter. Lake bottom materials in shallow areas consist of rubble and boulders except for alluvial deposits near the inlets. The shoreline varies from steep escarpments to gently sloping meadows. Surface tempera-

Table 1. Some physical and chemical characteristics of Beartooth Mountain lakes.

Lake	Elevation (feet)	Approximate size (acres)	Approximate maximum depth (feet)	Methyl orange alkalinity (p.p.m.)
Crow	9,064	20	40	-
Glacier	9,702	160	50	15
Kersey	8,070	100	200	15
Round	9,280	20	30	28
Russell	8,800	40	50	-
Ship	10,480	15	-	15
Timberline	9,660	15	50	18

tures varied between 42° and 62° F. (July 9 - September 10). Vegetation surrounding these lakes is either sub-alpine forest (Engleman spruce, Picea engelmanni; lodgepole pine, Pinus contorta; whitebark pine, Pinus albicaulis; alpine fir, Abies lasiocarpa; and limber pine, Pinus flexilis) or alpine tundra formation (alpine meadow and barren rock) (Figures 2, 3).

Methyl orange alkalinity was low, ranging from 15 to 28 p.p.m.

Although no attempt was made to secure quantitative food samples, observation showed that Diptera, Ephemeroptera, Trichoptera, and Plecoptera were common. In addition to brook trout, cutthroat trout were found in Glacier and Round Lakes, and northern chub, Hybopsis plumbea, was taken from Kersey Lake.

Age and Growth — It is believed that the young of certain brook trout in the Beartooth Mountain lakes fail to form scales the first year and

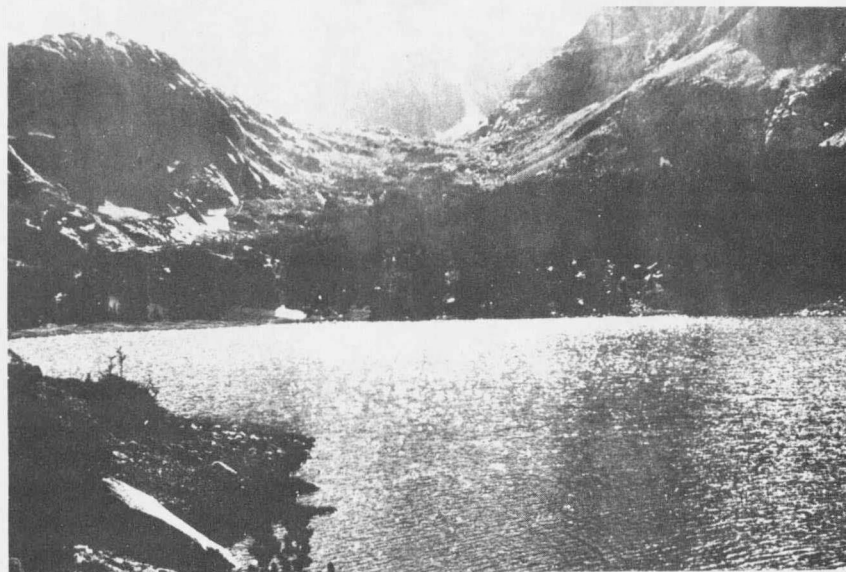


Figure 2. Sub-alpine forest, Timberline Lake (elevation 9,660 feet).



Figure 3. Alpine tundra formation, Ship Lake (elevation 10,480 feet).

therefore have no annulus. Brown and Bailey (1952) reported that a considerable number of cutthroat trout from Yellowstone Lake passed the first winter without scales. Robertson (1947) found the same condition to exist for cutthroat trout taken from Upper and Lower No Name Lakes, Wyoming. Curtis (1934) indicated that 50 to 75 percent of golden trout, Salmo aguabonita, from Cottonwood Lakes, California, failed to develop scales during their first growing season. In the present study 40 percent of the brook trout scales from Round Lake and 16 percent from Timberline Lake were judged to lack the first annulus (Figure 4). These fish had 8 to 12 circuli, while the usual number before the first annulus ranged from 4 to 7 (Figure 5). In addition, the scales of these fish differ from others in that they have a larger focus, and the first 3 or 4 circuli are wider apart.

The average calculated total lengths of brook trout for the seven Beartooth Mountain lakes (Yellowstone drainage) are shown in Table 2 and Figure 6. Round Lake produced brook trout with the greatest average calculated total length at the fourth annulus (12.0 inches), while Timberline Lake had fish with the least average calculated total length (7.9 inches). The average calculated total lengths for the seven lakes at annuli 1-4 were: 2.7, 5.5, 7.8, and 9.6 inches respectively. These fish had a maximum of four annuli, with the exception of Glacier Lake where the maximum was six. Greatest growth increments occurred during the second year of life and decreased gradually through the third and fourth. Since no significant difference in growth rate of males and females was found, data for both sexes were combined.



Figure 4. Scale of a 5.2 inch brook trout from Round Lake believed to lack a first annulus mark.



Figure 5. Scale of a 6.2 inch brook trout from Round Lake with a definite first annulus mark.

The actual total length of brook trout from these lakes ranged from 2.1 to 17.4 inches, and weight varied between 0.01 and 2.29 pounds. Based on the catch from experimental gill nets only (Table 3), Glacier Lake showed the largest average size of fish (11.3 inches; 0.74 pounds) and Timberline Lake the poorest average size (7.9 inches; 0.17 pounds). Timberline Lake produced the greatest average catch (41.0) per 12-hour night set and Round Lake the least (13.7). The average weight of brook trout was lowest in lakes where the largest number of brook trout was caught per 12-hour set (Figure 7).

Table 2. The average calculated total length (inches) of brook trout from the Beartooth Mountain lakes. (Numbers of specimens in parentheses.)

Locality	Year of life					
	I	II	III	IV	V	VI
Crow Lake	2.7 (116)	5.5 (110)	7.8 (107)	9.2 (28)	-	-
Glacier Lake	3.2 (57)	5.9 (46)	8.1 (40)	10.1 (32)	11.9 (4)	14.2 (1)
Kersey Lake	2.8 (121)	5.2 (101)	7.2 (65)	8.6 (19)	-	-
Round Lake	2.7 (60)	6.7 (38)	9.8 (12)	12.0 (8)	-	-
Russell Lake	2.3 (133)	5.2 (101)	7.7 (60)	10.2 (6)	-	-
Ship Lake	3.1 (92)	5.3 (86)	7.3 (65)	9.2 (26)	-	-
Timberline Lake	2.0 (76)	4.5 (61)	6.5 (53)	7.9 (11)	-	-
Grand averages	2.5 (655)	5.3 (548)	7.6 (410)	9.4 (130)	11.9 (5)	14.2 (1)

Table 3. Summary of brook trout catch taken by experimental gill nets from Beartooth Mountain lakes.

Lake	Number of fish	Number of 12 hour net sets	Catch per set	Average weight (pounds)	Average total length (inches)
Crow	82	5	16.4	0.35	10.3
Glacier	47	3	15.7	0.74	11.3
Kersey	182	6	30.3	0.22	8.3
Round	41	3	13.7	0.42	7.9
Russell	75	3	25.0	0.27	8.7
Ship	88	3	29.3	0.26	9.2
Timberline	82	2	41.0	0.17	7.9

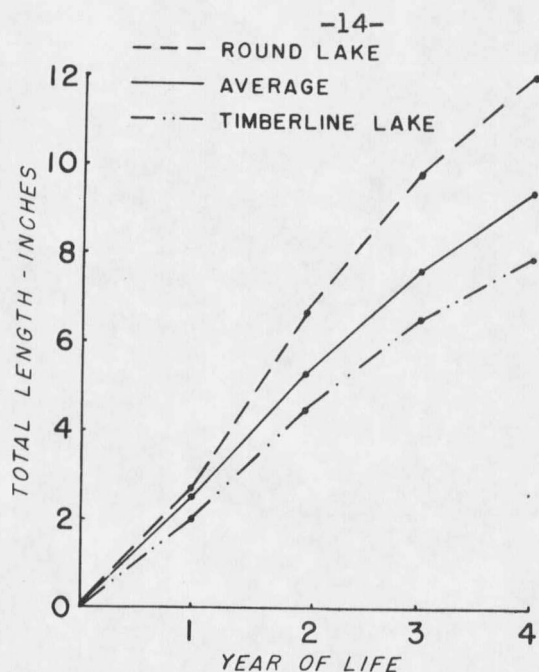


Figure 6. The average calculated total length of brook trout from the Beartooth Mountain lakes showing the maximum (Round Lake), average (for seven lakes) and minimum (Timberline Lake) growth rates at annuli 1-4.

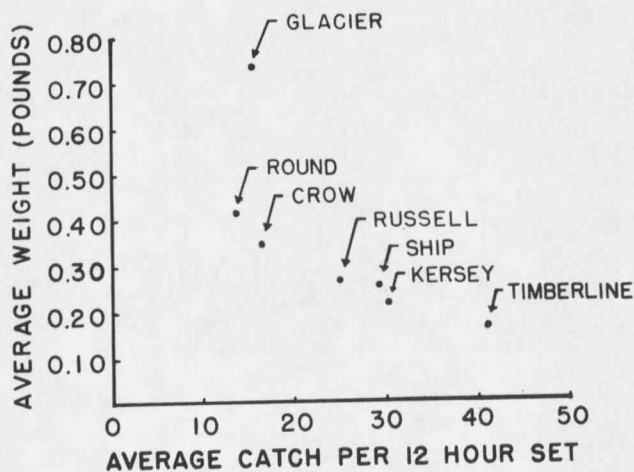


Figure 7. The average weight of brook trout compared to the average number of brook trout caught per 12-hour night set in seven Beartooth Mountain lakes.

Five fish were caught in Bald Knob (not included in Table 2 and Figure 4). These ranged from 15.5 to 17.7 inches total length and weighed between 2.0 and 2.8 pounds. All had a maximum of five annuli, and no other age group was found, except 27 young of the year which were taken in the outlet of the lake. It is believed that the poor spawning conditions which exist in the lake prevent over-population and account for the larger fish.

Using the fourth annulus as a basis, a comparison was made between the average calculated total lengths of brook trout from the Beartooth Mountain lakes with other lakes in the western mountain region. Hazzard (1935) showed that brook trout from Fish Lake (elevation 8,800 feet) Utah were 12.9 inches at this annulus, while Rawson (1940) reported 11.2 and 11.7 inches respectively for Maligne and Beaver Lakes elevation 5,500 feet) Alberta, Canada. In both instances, the average calculated total lengths exceeded those of the Beartooth Mountain lakes. Reimers (1958) showed that the size of brook trout from Bunny Lake (elevation 10,900 feet) California was considerably less at the fourth annulus (5.9 inches) than those of the Beartooth lakes.

Condition factors — Coefficients of condition of brook trout for the Beartooth Mountain lakes were made only for fish exceeding 6 inches (total length). Smaller fish were not weighed because adequate equipment was not available. The average coefficient of condition (C) for the seven lakes ranged from 32.0 (Ship Lake) to 45.5 (Glacier Lake). Average coefficients of condition were then determined for each lake by four-inch size groups.

With the exception of Glacier and Kersey Lakes, a progressive decline in condition was noted as the fish increased in size (Table 4). Shetter and Leonard (1943) reported the opposite where the larger brook trout had better condition than the smaller trout in Hunt Creek, Michigan.

Table 4. Average condition factors (C) of brook trout from Beartooth Mountain lakes.

Lake	Average (C) for 4-inch length intervals						Average (C) for each lake
	Number	6.0-9.9	Number	10.0-13.9	Number	14.0-17.9	
Glacier	8	40.8	36	45.9	4	50.4	45.5
Crow	64	34.7	56	33.6	-	-	34.2
Kersey	99	33.2	17	33.3	2	45.7	33.4
Round	27	39.8	35	37.4	1	35.0	38.4
Russell	97	37.6	17	36.9	1	38.2	37.2
Ship	86	34.3	33	27.3	-	-	32.0
Timberline	80	32.8	1	27.0	-	-	32.7

Other Montana Lakes and Streams

Area description — The lakes and streams from which brook trout scale samples were taken are located on both sides of the Continental Divide and include the Clark Fork River of the Columbia River drainage and the Missouri River. The primary tributaries of these two rivers originate in the mountains at elevations from 5,000 to 8,000 feet. They descend through steep canyons to cultivated valleys and range land below. Most of the scale samples were taken from fish which inhabit

secondary and tertiary tributaries of these drainages.

The lakes and streams where brook trout collections were made are treated by drainages beginning at the mouth and going towards the source (Figure 1). Descriptions of the sample locations follow:

Two creeks were sampled within the Milk River drainage. Clear Creek (Figure 1; No. 2) is a tributary to the central part of the Milk River. Samples were restricted to a 5-mile portion located in the upper part of the stream approximately 25 miles southeast of Havre. Beaver Creek (Figure 1; No. 3) is also a tributary of the central part of the Milk River, and samples were confined to a 2-mile portion in the upper reaches of this creek. This area is located about 20 miles south of Havre.

Two creeks were also sampled within the Musselshell River drainage. Big Elk Creek (Figure 1; No. 4) is a tributary to the upper portion of the Musselshell River. Samples were from a 10-mile section of this stream located 8 miles south of Two Dot. Allabaugh Creek (Figure 1; No. 5) drains into the South Fork of the Musselshell River, and samples were secured from a 10-mile section of this stream located 1 mile west of Lempep.

Only one stream was sampled in the Smith River drainage. This was Sheep Creek (Figure 1; No. 6) which drains into the central portion of the Smith River. Samples were taken from a 10-mile section of stream, approximately 20 miles southeast of the King's Hill Ranger Station.

Two lakes were sampled from the Crow Creek drainage. These are Upper and Lower Tizer Lakes (Figure 1; No. 7), located about 32 miles northwest of Toston, at the headwaters of Crow Creek.

Three streams and two lakes were sampled within the Jefferson River drainage. Trail Creek (Figure 1; No. 8) is a tertiary tributary which drains into the Big Hole River. Scale collections were taken from a place on the lower part of this creek near the site of the Big Hole Battlefield National Monument. Two areas were sampled on the Big Hole River. The lower area, Section 1 (Figure 1; No. 9), was sampled 3 miles south of Jackson. The other area, Section 2 (Figure 1; No. 10), was sampled at a place upstream from Section 1 in the vicinity of Skinner Meadows. Bloody Dick Creek (Figure 1; No. 11) is a tertiary tributary of the Jefferson River which flows into the upper part of Horse Prairie Creek, which in turn is a tributary to the Beaverhead River. Brook trout were taken at a location in the upper part of this creek 4 miles south of Skinner Meadows. Reservoir Lake (Figure 1; No. 12) drains into Bloody Dick Creek 4 miles south of Skinner Meadows. Culver Pond (Figure 1; No. 13) is on one of the small tributaries to Elk Springs Creek and Upper Red Rock Lake on the eastern border of the Red Rock Migratory Bird Refuge.

Two creeks and one lake were sampled within the Kootenai River drainage. O'Brien Creek (Figure 1; No. 14) is tributary to the central part of the Kootenai River. A sample was secured from one place on the lower portion of this stream, which is located 3 miles west of Troy. Kilbrennan Lake (Figure 1; No. 15) drains into the upper part of O'Brien Creek 10 miles east of Leopia. Pinkham Creek (Figure 1; No. 16) which is also tributary to the middle portion of the Kootenai River was sampled 17 miles southeast of Rexford.

Two lakes were sampled within the Saint Regis River drainage. Moore

Lake (Figure 1; No. 17) is located at the headwaters of the South Fork of the Saint Joe Creek 12 miles southwest of Saint Regis. Silver Lake (Figure 1; No. 18) drains into Silver Creek, tributary to the Saint Regis River, 6 miles southwest of Saltese.

One lake and one stream were sampled from the Flathead River drainage. Smith Creek (Figure 1; No. 19) is tributary to Condon Creek which in turn empties into the Swan River. Brook trout were taken from a location 5 miles upstream from the Condon Ranger Station. Lost Lake (Figure 1; No. 20) is located 5 miles east of the Condon Ranger Station and drains into Little Salmon Creek, which is tributary to the South Fork of the Flathead River.

One lake and one stream were also sampled within the Blackfoot River drainage. Placid Lake (Figure 1; No. 21) is located 5 miles south of the Seeley Lake Ranger Station. Placid Creek (Figure 1, No. 22) is a tributary of the upper part of the Blackfoot River, and the samples came from a 6-mile section of stream immediately above Placid Lake.

Age and growth — The average calculated total lengths of brook trout are presented for various lakes and streams described above. Because the scales from a majority of brook trout collected had a maximum of three annuli, comparisons of the average calculated total lengths were made for this annulus, except for the scales of fish from the Musselshell River drainage which only had two annuli. In addition to average calculated total lengths, comparisons were made of growth increments and actual total lengths and weights.

The average calculated total length of brook trout from the Milk

River drainage was 7.6 inches (Table 5; Figure 8). Brook trout from Beaver Creek showed an average calculated total length of 8.0 inches, while that for Clear Creek was 7.3 inches. In both instances, the greatest growth increment occurred during the first year of life. Actual total lengths of these fish ranged from 3.9 to 10.7 inches, and weights varied between 0.02 and 0.45 pounds.

The average calculated total length of brook trout from the Mussel-shell drainage at the second annulus was 5.7 inches (Table 5; Figure 9). Fish from Big Elk Creek were 5.9 inches at this annulus, while trout from Allabaugh Creek were only 5.1 inches. In each case, the growth increment was the greatest during the first year of life. These fish ranged in actual total length from 3.2 to 10.6 inches and varied in weight from 0.02 to 0.46 pounds.

The Smith River drainage is represented by one collection from Sheep Creek, where the average calculated total length was 10.0 inches at the third annulus (Table 5; Figure 10). The greatest growth was exhibited during the third year of life. The range of actual total lengths was from 3.9 to 13.7 inches and the weights varied from 0.03 to 1.16 pounds.

The average calculated total length of brook trout from the Crow Creek drainage was 6.9 inches (Table 5; Figure 11). All of the fish studied came from Upper and Lower Tizer Lakes. The greatest growth increment occurred during the first year. Their actual total lengths ranged from 5.1 to 8.9 inches, and weights varied from 0.04 to 0.25 pounds.

Brook trout collected from the Jefferson River drainage had an av-

Table 5. The average calculated total length (inches) of brook trout from some streams and lakes in Montana. (Numbers of specimens in parentheses.)

Locality	Year of life				
	I	II	III	IV	V
Milk River drainage					
Clear Creek	3.2 (107)	5.7 (44)	7.3 (4)	-	-
Beaver Creek	3.3 (60)	5.7 (29)	8.0 (3)	9.1 (1)	-
Average calculated length	3.3 (167)	5.7 (73)	7.6 (7)	9.1 (1)	-
Musselshell River drainage					
Big Elk Creek	3.4 (77)	5.9 (34)	-	-	-
Allabaugh Creek	2.8 (77)	5.1 (13)	-	-	-
Average calculated length	3.1 (144)	5.7 (47)	-	-	-
Smith River drainage					
Sheep Creek	3.3 (66)	5.6 (25)	10.0 (1)	12.3 (1)	-
Crow Creek drainage					
Upper and Lower Tizer lakes	3.2 (48)	5.3 (24)	6.9 (5)	7.4 (1)	-
Jefferson River drainage					
Trail Creek	2.8 (79)	5.7 (37)	7.8 (14)	9.3 (3)	-
Big Hole River (Section 1)	2.9 (48)	5.4 (25)	7.7 (10)	9.4 (2)	-
Big Hole River (Section 2)	2.2 (58)	4.2 (35)	6.5 (17)	-	-
Reservoir Lake	4.3 (58)	7.2 (41)	8.9 (4)	-	-
Bloody Dick Creek	2.3 (38)	4.3 (27)	5.8 (9)	-	-
Culver Pond	4.7 (89)	10.0 (48)	14.4 (21)	17.4 (9)	20.6 (1)
Average calculated length	3.4 (370)	6.5 (213)	8.8 (75)	14.5 (14)	20.6 (1)

Table 5. Continued.

Locality	Year of life				
	I	II	III	IV	V
Kootenai River drainage					
O'Brien Creek	3.0 (261)	5.3 (93)	7.5 (4)	-	-
Kilbrennan Lake	3.5 (45)	6.0 (36)	9.1 (17)	-	-
Pinkham Creek	2.5 (42)	4.2 (22)	6.0 (5)	-	-
Average calculated length	3.0 (348)	5.3 (151)	8.2 (26)	-	-
Flathead River drainage					
Smith Creek	3.7 (54)	6.8 (51)	9.5 (20)	-	-
Lost Lake	4.2 (48)	6.9 (17)	8.9 (1)	-	-
Average calculated length	3.9 (102)	6.8 (68)	9.5 (21)	-	-
Saint Regis River drainage					
Moore Lake	3.8 (46)	7.3 (29)	10.1 (3)	-	-
Silver Lake	2.4 (52)	5.5 (52)	7.7 (22)	-	-
Average calculated length	3.1 (98)	6.2 (81)	7.9 (25)	-	-
Blackfoot River drainage					
Placid Lake	2.9 (32)	5.2 (32)	7.2 (23)	8.8 (4)	10.2 (1)
Placid Creek	2.8 (293)	5.0 (174)	8.8 (34)	11.4 (10)	16.0 (4)
Average calculated length	2.8 (325)	5.0 (206)	8.1 (57)	10.7 (14)	14.8 (5)
Grand average calculated length	3.2 (1668)	5.8 (888)	8.4 (217)	13.6 (28)	16.9 (5)

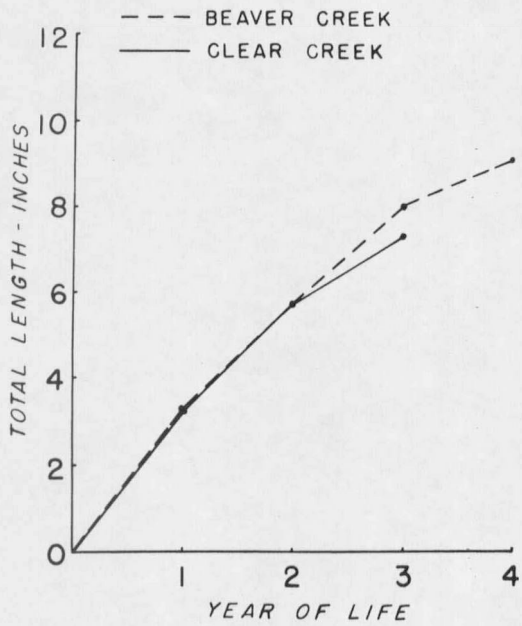


Figure 8. Milk River drainage.

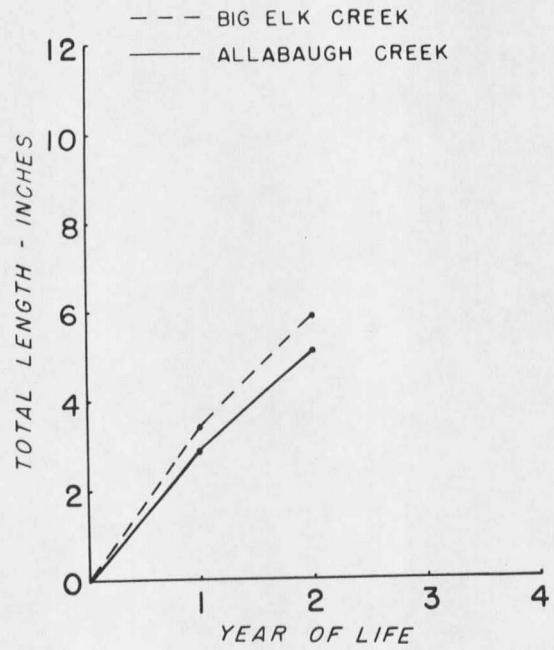


Figure 9. Musselshell River drainage.

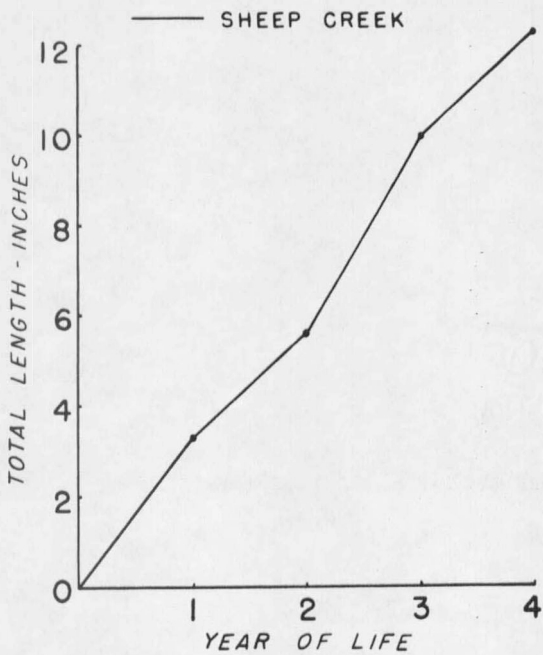


Figure 10. Smith River drainage.

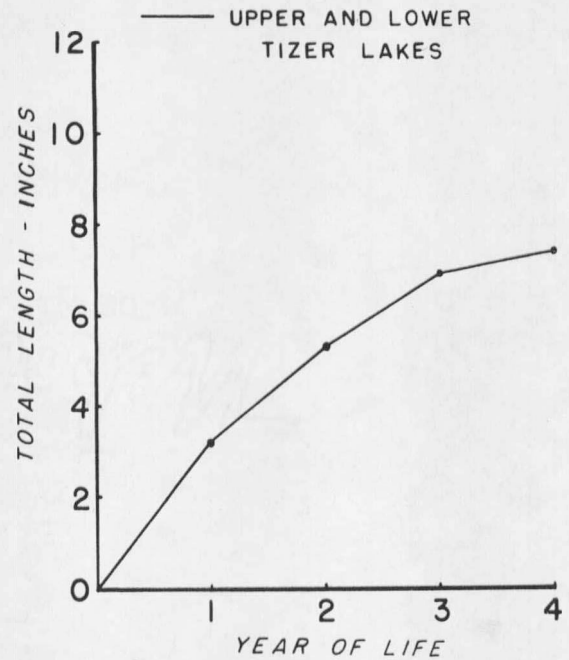


Figure 11. Crow Creek drainage.

Figures 8-11. The average calculated total length of brook trout from various lakes and streams in Montana.

erage calculated total length of 8.8 inches (Table 5; Figure 12). Trout from Culver Pond had the greatest average calculated total length (14.4 inches) in this drainage while those from other waters in this drainage had considerably less: Reservoir Lake, 8.9 inches; Trail Creek, 7.8 inches; Big Hole River (Section 1), 7.7 inches; Big Hole River (Section 2), 6.5 inches; and Bloody Dick Creek, 5.8 inches. Brook trout from this drainage showed the greatest increment during the first year of life, except in Culver Pond where the greatest growth occurred during the second year. Fish from this drainage ranged in actual total length from 4.2 to 21.9 inches and weights varied from 0.03 to 5.50 pounds.

The average calculated total length of brook trout from the Kootenai River drainage was 8.2 inches at the third annulus (Table 5; Figure 13). Those from Kilbrennan Lake attained the greatest length (9.1 inches); while those from O'Brien and Pinkham Creeks were 7.5 and 6.0 inches respectively. Growth increments were the greatest during the third year of life. The range in actual total length was 2.7-13.2 inches and the range in weight was 0.01-0.93 pounds.

Brook trout from the Flathead River drainage, represented by collections from Smith Creek and Lost Lake, had an average calculated total length of 9.5 inches (Table 5; Figure 14). Smith Creek showed the greatest growth, 9.5 inches and Lost Lake the least, 8.9 inches. In both instances the greatest growth increment occurred during the first year of life. The actual total length varied from 4.8 to 15.5 inches and weights from 0.04 to 1.56 pounds.

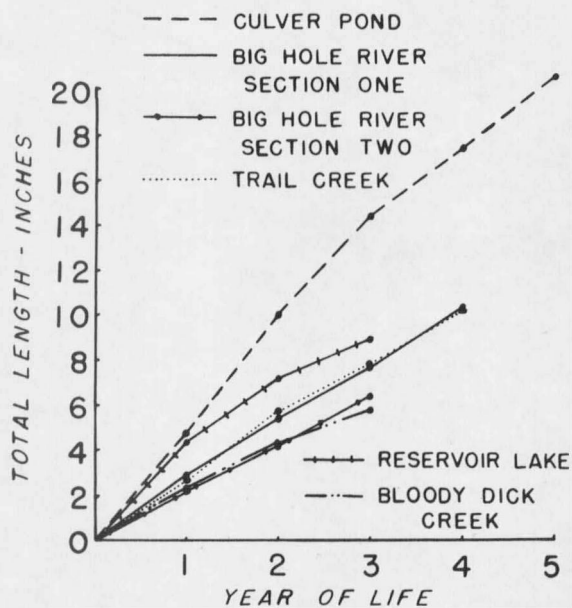


Figure 12. Jefferson River drainage.

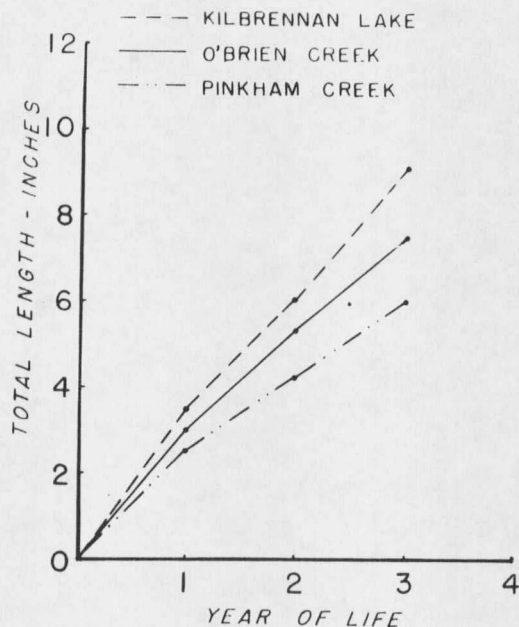


Figure 13. Kootenai River drainage.

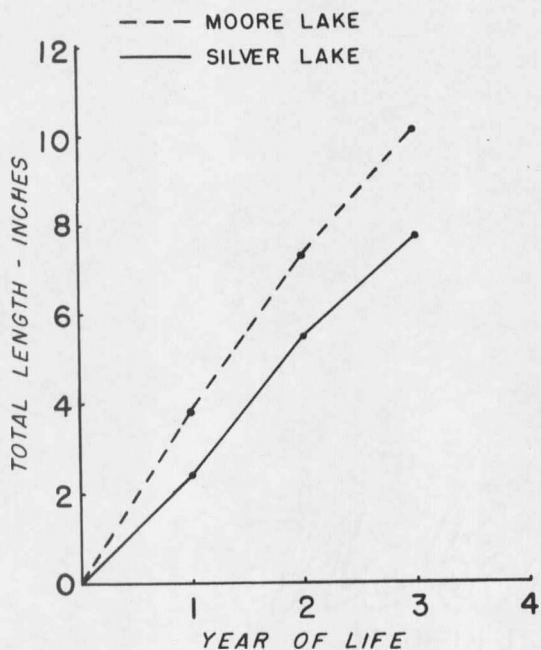


Figure 14. Saint Regis River drainage.

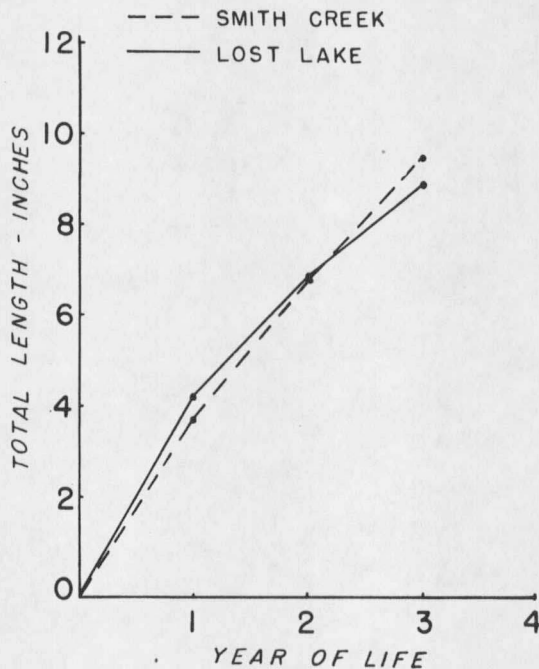


Figure 15. Flathead River drainage.

Figures 12-15. The average calculated total length of brook trout from various lakes and streams in Montana.

The average calculated total length for brook trout from the Saint Regis River drainage was 7.9 inches (Table 5; Figure 15). Fish from Moore Lake displayed the greatest growth (10.1 inches) at the third annulus. Those from Silver Lake had the least growth (7.7 inches). The largest growth increments occurred during the first year of life for fish from Moore Lake, while Silver Lake trout accrued the greatest growth in the second year. The actual total lengths of these fish varied from 6.1 to 12.5 inches, and weights ranged from 0.08 to 0.59 pounds.

Brook trout from Placid Creek and Placid Lake are in the Blackfoot River drainage. The average calculated total length of these fish was 8.1 inches (Table 5; Figure 16). Placid Creek samples had the greatest growth (8.8 inches) at the third annulus, while fish from Placid Lake were only 7.2 inches at this annulus. Brook trout from Placid Lake showed the greatest increment during the first year of life, while fish from Placid Creek grew most in the fifth year. Fish varied in actual total length from 2.7 to 24.0 inches, and in weight from 0.01 to 5.01 pounds.

The grand average calculated total lengths of brook trout from the nine river drainages at annuli 1-5 were: 3.2, 5.8, 8.4, 13.6, and 16.9 inches respectively. Comparisons between drainages showed that brook trout from the Flathead River drainage had the greatest average calculated total length (9.5 inches) at the third annulus - except for the one fish from the Smith River drainage. Specimens from the Crow Creek drainage showed the least average growth (6.9 inches). In general, the greatest average growth increment of brook trout for the nine river drainages occurred during the first year of life. The few exceptions to this involve

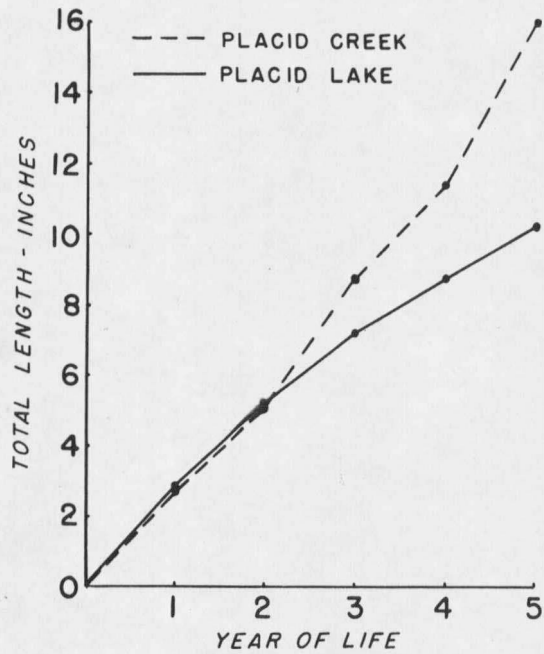


Figure 16. The average calculated total length of brook trout from the Blackfoot River drainage.

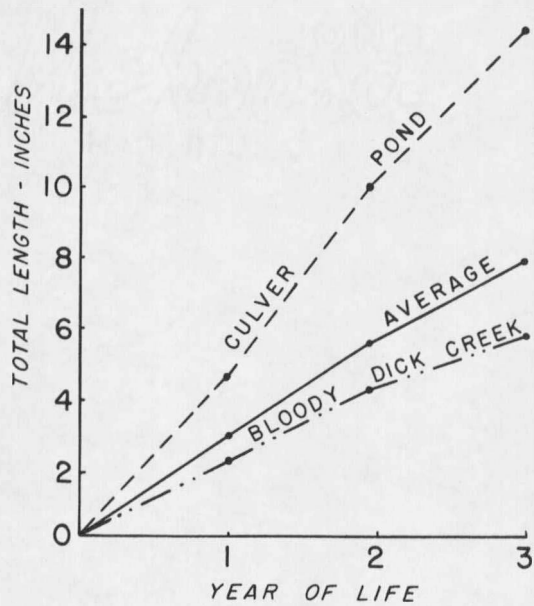


Figure 17. The average calculated total length of brook trout showing the maximum (Culver Pond), overall average (average), and minimum (Bloody Dick Creek) growth rates at annuli 1-3.

very small samples and may be disregarded.

The majority of brook trout from all collections attained a maximum of either three or four annuli. Those from the Blackfoot and Beaverhead River drainages had a maximum of five annuli, while those from the Mussel-shell River drainage had a maximum of only two annuli.

The growth rates for brook trout reported in previous Montana studies were greater than that of the present study. Brook trout from Bridger and Spring Creeks of the Gallatin River drainage (Purkett, 1951) showed an average calculated total length of 10.9 inches at the third annulus, while those from Prickley Pear Creek, which is tributary to the Missouri River, had an average calculated total length of 9.8 inches at this annulus (Bishop, 1955). Holton (1953) studied the growth of brook trout from Trout Creek of the Gallatin River drainage and gave only the average actual total length. This was 8.8 inches at the second annulus, but cannot be compared with the calculated total lengths of the present study.

DISCUSSION

The combined data of brook trout for all the lakes and streams in this study showed a grand average calculated total length at annuli 1-6 of: 3.0, 5.6, 7.9, 10.3, 14.4 and 14.2 inches respectively. Figure 17 compares the average calculated total lengths of the combined age and growth data at annuli 1-3 with maximum (Culver Pond) and minimum (Bloody Dick Creek) growth rates for this study. The growth rate of brook trout from the Beartooth Mountain lakes was only slightly less than the overall state average of all collections.

The average calculated total lengths for 13 streams in New York (Hazzard, 1932) at annuli 1-3 were 3.5, 5.3, and 6.6 inches respectively. Shetter and Leonard (1943) reported the average calculated total lengths at annuli 1-3 of: 3.0, 5.0, and 6.8 inches respectively for a limited section of Hunt Creek, Michigan. Brook trout from New York streams were larger at the first annulus than the overall Montana average of the present study, while those from Hunt Creek were about the same as the Montana average. However, the Montana brook trout exceeded the average calculated total length of both New York and Michigan collections at the second and third annulus.

SUMMARY

1. Age and growth determinations were made for brook trout collected from 13 streams and 8 lakes over a 10-year period (1950-1959), and in addition for collections of this species from seven lakes in the Beartooth Mountains collected during the summer of 1959.
2. Fish samples were taken by one or more of the following methods: experimental gill nets, fine mesh gill nets, fish toxicants, electric shocking, seining, and angling.
3. Annuli were read with the aid of a microprojector. A straight line relationship of scale length to body length was assumed in the calculations.
4. The seven Beartooth Mountain lakes (Yellowstone River drainage) studied lie at elevations from 8,070 to 10,480 feet and vary in size from 15 to 160 acres and range in depth from 30 to 200 feet.

5. Forty percent of brook trout scales from Round Lake and 16 percent from Timberline Lake were judged to lack the first annulus.
6. The average calculated total lengths of brook trout for the seven Beartooth Mountain lakes at annuli 1-4 were: 2.7, 5.5, 7.8, and 9.6 inches respectively. Round Lake attained the greatest length at the fourth annulus (12.0 inches) while Timberline Lake had the least (7.9 inches). Greatest growth increments occurred during the second year of life.
7. The average coefficients of condition of brook trout for the Beartooth Mountain lakes ranged from 32.0 (Ship Lake) to 45.4 (Glacier Lake). A progressive decline in condition was noted as fish increased in size.
8. The grand average calculated total lengths of brook trout for the other lakes and streams studied (exclusive of the Beartooth Mountain lakes) at annuli 1-5 were: 3.2, 5.8, 8.4, 13.6 and 16.9 inches, respectively. Brook trout from the Flathead River drainage attained the greatest growth at the third annulus (9.5 inches), while those from Crow Creek drainage showed the least growth (6.9 inches) at this annulus. The greatest growth increment occurred during the first year of life.
9. The grand average calculated total lengths of brook trout for all collections in this study at annuli 1-6 were: 3.0, 5.6, 7.9, 10.3, 14.4 and 14.2 inches respectively.

LITERATURE CITED

- Bean, Tarleton H. 1894. Report on the propagation and distribution of food fishes. Report U. S. Comm. Fish and Fisheries, pp. 20-80.
- Bishop, Clinton G. 1955. Age, growth and condition of trout in Prickley Pear Creek, Montana. Trans. Am. Micros. Soc., 74(2): 134-145.
- Brown, C. J. D., and Jack E. Bailey. 1952. Time and pattern of scale formation in Yellowstone cutthroat trout Salmo clarkii lewisii. Trans. Am. Micros. Soc., 71(2): 120-124.
- Cooper, Edwin L. 1953. Periodicity of growth and change of condition of brook trout Salvelinus fontinalis in three Michigan trout streams. Copeia, 1953, No. 2, pp. 107-114.
- Curtis, B. 1934. Golden trout of Cottonwood Lakes (Salmo aqua-bonita Jordan). Trans. Am. Fish. Soc., 64: 259-265.
- Hanzel, Delano A. 1959. The distribution of cutthroat trout Salmo clarki in Montana. Proc. Mont. Acad. Sci., 19: 32-71.
- Hazzard, A. S. 1932. Some phases of the life history of eastern brook trout, Salvelinus fontinalis Mitchell. Trans. Am. Fish. Soc., 62: 344-350.
- _____. 1935. A preliminary study of an exceptionally productive trout water, Fish Lake, Utah. Trans. Am. Fish. Soc., 65: 122-128.
- Henshall, James A. 1906. A list of the fishes of Montana. Bull. Univ. of Mont., 11(34): 12 pp.
- Holton, George D. 1953. A trout population study on a small creek in Gallatin County, Montana. J. Wildl. Mgmt., 17: 62-82.
- Nelson, Perry H. 1954. Life history and management of the American grayling (Thymallus signifer tricolor) in Montana. J. Wildl. Mgmt., 18: 324-342.
- Purkett, Charles A., Jr. 1951. Growth rate of trout in relation to elevation and temperature. Trans. Am. Fish. Soc., 80: 251-259.
- Rawson, Don. 1940. The eastern brook trout in the Maligne River system, Jasper National Park. Trans. Am. Fish. Soc., 70: 221-235.
- Reimers, Norman. 1958. Conditions of existence, growth and longevity of brook trout in a small high altitude lake of the eastern Sierra Nevada Mountains. Calif. Fish and Game, 4(44): 319-333.

Robertson, O. H. 1947. An ecological study of two high mountain lakes in the Wind River Range, Wyoming. *Ecology*, 4(28): 87-112.

Shetter, David S. and Justin W. Leonard. 1943. A population study of a limited area in a Michigan trout stream. *Trans. Am. Fish. Soc.*, 72: 35-51.

MONTANA STATE UNIVERSITY LIBRARIES



3 1762 10013581 1

~~_____~~
N 378
D 716a
Cop. 2

J

141124