PRICKLEY PEAR CREEK, MONTANA

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AGE, GROWTH AND CONDITION OF TROUT IN PRICKLEY PEAR CREEK, MONTANA[1]

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INTRODUCTION

An intensive trout population study made on Prickley Pear Creek, Montana during the summers of 1949, 1950 (Stefanich, 1952), and continued in 1951, provided an unusual opportunity to collect trout for age, growth, and condition in relation to population changes during the three years. The samples collected represent near total populations for the sections covered. Alvord (1954) studied the scale characters of known age trout in Prickley Pear Creek, and Kathrein (1951) investigated age and growth of rainbow and brown trout from a section of the Missouri River adjacent to the mouth of Prickley Pear Creek. Purkett (1951) reported on the growth rate of trout in relation to elevation and temperature on three Montana streams. Two of the most important age and growth studies involving whole populations of trout are those of Shetter and Leonard (1943) in Hunt Creek, Michigan, and Schuck (1945) in Crystal Creek, New York. Shetter and Hazzard (1939) investigated age but not growth of trout populations in three Michigan trout streams.

DESCRIPTION OF STREAMS

Prickley Pear Creek is 23 miles long; it flows in a northeasterly direction and enters the Missouri River six miles upstream from Craig, Montana. According to Stefanich (1952) the lower 13 miles, from which samples were taken, varied in width from 15 to 60 feet, with a maximum depth of eight feet, and a fall of approximately 41 feet per mile. The distance between pools of three feet or greater in depth averaged approximately 260 feet. The stream bottom in riffle areas was gravel and rubble. The average water temperature during study periods for the three years was 54.6° F. (maximum of 67° F). Water levels were high in late spring and early summer with a sudden decrease in late summer followed by a small somewhat steady decrease through fall and winter.

FISH PRESENT

Brown trout (*Salmo trutta*) was the most numerous salmonid followed by rainbow trout (*Salmo gairdneri*). Small numbers of eastern brook trout (*Salvelinus fontinalis*) and only one cutthroat trout (*Salmo clarki*) were found. Mountain whitefish (*Prosopium williamsoni*) though never abundant were most numerous in the spring. The longnose sucker (*Catostomus catostomus*) was abundant especially in spring and early summer. A few western white suckers (*Catostomus commersoni sucklii*), carp (*Cyprinus carpio*) and burbot (*Lota lota maculosa*) were present. Fresh water sculpin (*Cottus bairdi punctulatis*) was abundant at all times.

[1]Contribution from the Montana Fish and Game Department and Montana State College Agricultural Experiment Station. Project No. MS 844, Paper No. 293 Journal

Fish were taken by the electric shock method from six 600 foot sections established for the population study (Stefanich, 1952). Nine collections were made as follows: four in 1949, three in 1950 (part of one section was shocked a fourth time), and two in 1951.

Captured fish were anesthetized in urethane. Total lengths were measured to the nearest 0.1 inch and weights to the nearest 0.02 pound. All fish were marked and released. No scale samples from recaptured or hatchery fish were used in this study since growth may have been effected by handling and tagging.

Scales were taken from either the right or left side between the dorsal fin and lateral line. These were cleaned and mounted in a glycerine-gum arabic medium and examined and measured on a conventional scale

TABLE 1

The numbers of each species of trout in the sample for each collection in Prickley Pear Creek.

Year	Species	First Collection	Second Collection	Third Collection	Fourth Collection	Totals
1949	Brown	304	226	169	91	790
	Rainbow	140	91	67	70	368
	Eastern brook	7	16	13	7	43
1950	Brown	58	75	93	12[1]	238
	Rainbow	47	105	117	6[1]	275
	Eastern brook	13	15	11	1[1]	40
1951	Brown	66	191	...	..	257
	Rainbow	57	166	...	..	223
	Eastern brook	13	31	...	..	44

[1]Collection in Section VI D for known age study.

projection machine. Scale measurements were made from the center of the focus along the median anterior radius. A constant ratio of scale radius to body length was assumed.

Scales from 1,285 brown trout, 866 rainbow trout, and 127 eastern brook trout were studied (Table 1).

The body-scale relationship of each species was determined by fitting a regression line to data on total length and anterior scale radius by the method of least squares.

The data on rainbow trout and brook trout were such that a straight line could be considered a good fit. The fit was not as good for brown trout. However, a straight line seemed best from a practical standpoint. This was supported by test of fit of data to a second degree polynomial and by examination of the location of the actual values with reference to the straight line. Lengths for all species accordingly were calculated on the assumption that the body-scale relationship is described by a straight line. The intercepts on the length axis for the three species were: rainbow trout, 1.1 inches; brown trout, 1.0 inch, brook trout, 0.9 inch.

Coefficients of condition (C) were calculated for each fish from the formula:

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

where W = weight in pounds,
L = total length in inches.

Age and Growth

Length-Frequency

Comparison of the average length at capture for each age group with the length-frequency modes determined for these trout by Stefanich (Unpublished data), revealed good agreement with the outstanding peaks in the length distributions (Table 2). Too few brook trout were captured in any one collection to show definite modes in a length-frequency distribution.

Table 2

Comparison of average length (inches) at capture for each age group with length modes of brown trout and rainbow trout collected in 1949 and 1950.

Date of Collection	Age Group 0		Age Group I		Age Group II	
	Number of Fish	Average Length and Mode	Number of Fish	Average Length and Mode	Number of Fish	Average Length and Mode
Brown Trout						
1949						
June 22–July 13			131	5.6(5.1–6.0)		
August 11–17	95	3.3(3.1–4.0)	90	6.2(6.1–7.0)		
September 16–23	108	4.0(3.1–4.0)	44	6.6(6.1–7.0)		
November 24–27	35	4.2(3.1–4.0)	24	7.1(7.1–8.0)		
1950						
June 22–30			33	4.9(4.1–5.0)	11	7.7(7.1–8.0)
August 7–15			49	5.7(5.1–6.0)		
September 18–25	62	3.7(3.1–4.0)	24	6.4(6.1–7.0)		
Rainbow Trout						
1949						
September 16–23	24	3.5(2.1–4.0)				
November 24–27	16	3.8(3.1–4.0)	34	6.9(6.1–7.0)		
1950						
August 7–15			84	5.8(5.1–6.0)		
September 18–25	45	3.6(3.1–4.0)	63	6.2(6.1–7.0)		

·d Length

The grand average calculated lengths for brown trout for years 1–5 were: 3.8, 7.7, 11.1, 13.7, and 16.5

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Shetter, David S. and Justin W. Leonard. 1943. A population study of a limited area in a Michigan trout stream, September, 1940. Trans. Amer. Fish. Soc., 72: 35–51.

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succeeding year while the total weight of all fish declined. In yearling brown trout the length per day increased from 0.013 inch in 1949 to 0.020 inch in 1951. In two-year-old fish the increase was from 0.010 to 0.019 for the same period. Rainbow trout grew more rapidly with yearling fish increasing from 0.012 inch in 1949 to 0.030 inch in 1951 and the two-year-olds from 0.010 to 0.023. Over these same 3 years the total weight of fish in the study area decreased from 398.3 to 221.1 pounds.

TABLE 7

Relationship between total weight of fish population and the growth of two age groups of brown trout and rainbow trout.

Species and Year	Dates of Collection: First	Dates of Collection: Second	Interval Between Collection (Days)	Age Group I: Average Daily Growth (Inches)	Age Group I: No. of Fish	Age Group II: Average Daily Growth (Inches)	Age Group II: No. of Fish	Total Weight Of All Fish (Pounds)[1]
1949								
Brown	June 22–July 13	Sept. 16–23	78	0.013	175	0.010	73	398.3
Rainbow				0.012	67	0.010	117	
1950								
Brown	June 22–30	Sept. 18–25	86	0.018	57	0.015	95	245.7
Rainbow				0.019	85	0.016	32	
1951								
Brown	July 7–18	Sept. 6–14	59	0.020	138	0.019	44	221.1
Rainbow				0.030	146	0.023	95	

[1]Average for two collections.

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KATHREIN, JOSEPH W. 1951. Growth rate of four species of fish in a section of the Missouri River between Holter Dam and Cascade, Montana. Trans. Amer. Fish. Soc., 80: 93–98.

Average calculated total length and increment at each annulus of brown trout from Prickley Pear Creek (length in inches).

Age group	Number fish	Average length at capture	Annulus 1	2	3	4	5	6	7
First collection, June 22 to July 13, 1949									
I	131	5.6	4.0						
II	50	8.3	3.7	7.0					
III	70	11.4	3.9	7.8	10.6				
IV	32	14.0	4.1	8.3	11.5	13.3			
V	6	16.1	4.8	7.5	11.2	13.8	15.4		
VI	3	20.9	4.6	8.3	13.2	16.9	19.2	20.5	
VII	1	22.6	4.8	8.7	12.7	17.5	19.4	20.8	22.2
Second collection, August 11–17, 1949									
0	95	3.3							
I	90	6.2	3.9						
II	17	8.0	3.3	6.1					
III	10	12.3	4.1	8.0	11.2				
IV	2	15.8	4.1	8.7	12.4	15.0			
V	3	17.6	4.8	9.8	12.9	15.2	16.8		
Third collection, September 16–23, 1949									
0	108	4.0							
I	44	6.6	3.8						
II	9	10.1	3.7	7.5					
III	6	13.5	4.5	9.6	12.5				
IV	1	13.2	4.2	7.8	11.7	12.5			
V	1	15.8	5.2	9.9	11.7	13.7	14.9		
Fourth collection, November 24–27, 1949									
0	35	4.2							
I	24	7.1	3.9						
II	6	10.4	3.8	7.7					
III	18	12.3	4.1	8.4	10.8				
IV	6	15.2	4.7	8.4	12.5	14.4			
V	2	16.2	4.0	8.6	11.8	14.3	15.2		
Average calculated length			3.9	7.7	11.2	13.9	16.5	20.5	22.2
Increment			3.9	3.8	3.5	2.7	2.6	4.0	1.7
Number of fish	788		550	261	179	57	16	4	1
First collection, June 22–30, 1950									
I	33	4.9	4.1						
II	11	7.7	3.5	6.8					
III	7	12.2	4.7	8.7	11.6				
IV	6	13.8	4.9	9.2	11.8	13.4			
VI	1	19.7	5.1	8.2	11.6	14.5	17.3	19.1	

TABLE 3—(Continued

Age group	Number fish	Average length at capture	Annulus 1	2	3	4	5	6	7
Second collection, August 7–15, 1950									
0	3	2.1							
I	49	5.7	3.6						
II	15	9.7	4.3	7.9					
III	4	12.3	4.2	8.2	10.8				
IV	3	16.1	3.2	7.9	11.0	13.9			
V	1	16.5	4.7	8.3	11.6	13.4	15.8		
Third collection, September 18–25, 1950									
0	62	3.7							
I	24	6.4	3.6						
II	5	11.1	4.2	8.2					
III	1	11.8	4.2	7.4	9.9				
IV	1	13.8	3.9	6.5	10.3	12.8			
Average calculated length			3.9	8.0	11.3	13.6	16.6	19.1	
Increment			3.9	4.1	3.3	2.3	3.0	2.5	
Number of fish	226		161	55	24	12	2	1	
First collection, July 7–18, 1951									
I	41	5.0	3.5						
II	16	8.0	3.5	6.6					
III	6	11.7	3.5	7.6	10.5				
IV	3	13.3	3.5	6.7	9.9	12.4			
Second collection, September 6–14, 1951									
0	60	3.5							
I	97	6.2	3.4						
II	17	9.2	3.3	6.8					
III	9	12.3	3.7	8.0	10.9				
IV	7	13.6	3.5	7.3	10.8	12.7			
V	1	16.4	4.0	9.3	12.1	14.0	15.7		
Average calculated length			3.4	7.1	10.7	12.7	15.7		
Increment			3.4	3.7	3.6	2.0	3.0		
Number of fish	257		197	59	26	11	1		
Grand average calculated length			3.8	7.7	11.1	13.7	16.5	20.2	22.2
Increment			3.8	3.9	3.4	2.6	2.8	3.7	2.0
Number of fish	1271		908	375	229	80	19	5	1

CONDITION

Coefficient of condition (C) remained approximately the same for each species of trout throughout years 1–4 (Table 6). Values for rainbow trout averaged 39.5 (range 35.6–41.4); the highest for the three species. Brook trout had the lowest coefficient of condition with an average of 37.5 (range 33.9–40.1). The values for brown trout averaged 37.7 (range 35.3–39.6).

RELATIONSHIP BETWEEN POPULATION AND SUMMER GROWTH

The average total weight of all fish in the June-July and September collections for 1949 was 398.3 pounds. Weight for comparable collection periods decreased to 245.7 pounds in 1950 and to 221.1 pounds in 1951

TABLE 6

Average coefficients of condition (C) for trout from Prickley Pear Creek for each year.

Species and Year	Age Group I C	I Number of fish	II C	II Number of fish	III C	III Number of fish	IV C	IV Number of fish
Brown								
1949	37.8	175	37.9	59	37.7	85	35.6	33
1950	39.0	57	37.0	16	39.6	8	35.3	7
1951	38.4	138	37.6	33	37.2	15	37.8	10
Rainbow								
1949	40.1	67	39.6	84	38.3	26	41.4	6
1950	39.1	85	35.6	22	38.2	12	....	..
1951	40.4	146	39.1	49	40.5	3	39.4	1
Brook								
1949	37.2	11	40.1	3	33.9	1		
1950	35.7	9	35.7	9	37.8	2		
1951	38.4	28	37.6	11	38.8	2		

(Table 7); this loss amounted to 44.5 percent for the two year period. The percentage loss in weight of all brown trout was about the same as the total for all fish. The weight of rainbow trout remained relatively high (13.6 percent loss). Length-frequency modes for all species remained approximately the same throughout the three years with a gradual decrease in numbers in each mode. Condition factors remained about the same.

There was no marked difference between the growth of non-tagged and tagged fish from the same collections (Alvord, 1954). Average lengths for I and II year classes were computed for the first and third collections of each year.

Due to variation in the length of the interval between the first and third collections for each of the three years (59–86 days), it was not feasible to use the difference in growth between these collections for comparison, so the average growth per day for these periods was used (Table 7). The

TABLE 5—(Continued)

Age group	Number fish	Average length at capture	Annulus 1	Annulus 2	Annulus 3
Second collection, August 7–15, 1950					
0	2	3.6			
I	12	5.8	4.0		
II	1	9.5	4.0	6.8	
Third collection, September 18–25, 1950					
0	4	4.0			
I	7	6.7	4.3		
Average calculated length			4.1	6.7	9.8
Increment			4.1	2.6	3.1
Number of fish	39		33	12	2
First collection, July 7–18, 1951					
I	8	5.0	3.9		
II	5	8.0	3.7	5.8	
Second collection, September 6–14, 1951					
0	3	3.6			
I	20	6.4	4.0		
II	6	9.2	4.2	7.3	
III	2	10.5	4.0	6.4	8.8
Average calculated length			3.9	6.6	8.8
Increment			3.9	2.7	2.2
Number of fish	44		41	13	2
Grand average calculated length			4.1	7.0	9.6
Increment			4.1	2.9	2.6
Number of fish	126		108	34	5

Legal length was reached in the second year as in the brown trout. Growth was slightly better than for rainbow trout but less than for brown trout. First-year brook trout were larger than either rainbow trout or brown trout probably because of earlier hatching. The population of brook trout contained only fish up to three years old; age-group I was best represented.

The growth rate for these trout was better than that reported by Shetter and Hazzard (1939) for three Michigan trout streams and by Shetter and Leonard (1943) for a limited area in Hunt Creek, Michigan. The average total lengths were not as great as those reported for Bridger-Spring Creek, Montana (Purkett, 1951). Growth of brook trout in Prickley Pear Creek was approximately the same as that reported for Trout Creek (Holton, 1953).

sharply in the fourth year. The population for the sections covered was made up principally of younger age-groups. Age-group I was the most plentiful and 86 percent of the fish were in age-groups I–III.

Growth rate of brown trout in Prickley Pear Creek was better than that of brown trout from Crystal Creek, New York (Schuck, 1945). The average total lengths are not as great as those reported by Purkett (1951) for the West Gallatin River, Montana or by Kathrein (1951) for the Missouri River, Montana.

Rainbow trout. The grand average calculated lengths for rainbow trout at annulus formation for years 1–4 were: 3.5, 6.6, 9.4, and 11.8 inches (Table 4). Legal length was not reached until the third year.

TABLE 4

Average calculated total length and increment at each annulus of rainbow trout from Prickley Pear Creek (length in inches).

Age group	Number fish	Average length at capture	Annulus 1	Annulus 2	Annulus 3	Annulus 4	Annulus 5
First collection, June 22 to July 13, 1949							
I	45	5.6	3.7				
II	68	8.1	3.4	6.6			
III	21	10.9	3.4	7.1	10.1		
IV	6	12.5	3.6	7.4	10.0	11.9	
Second collection, August 11–17, 1949							
0	3	2.7					
I	61	6.1	3.5				
II	22	9.2	3.6	6.8			
III	3	11.0	3.4	6.1	9.1		
IV	2	10.4	3.3	4.8	6.9	8.6	
Third collection, September 16–23, 1949							
0	24	3.5					
I	22	6.3	3.2				
II	16	8.6	3.4	6.0			
III	5	11.9	4.0	8.0	10.4		
Fourth collection, November 24–30, 1949							
0	16	3.8					
I	34	6.9	3.5				
II	17	9.8	3.6	6.7			
III	2	12.8	3.5	9.1	11.4		
V	1	17.3	4.4	8.1	11.6	15.1	16.7
Average calculated length			3.5	6.8	10.0	11.5	16.7
Increment			3.5	3.3	3.2	1.5	5.2
Number of fish	368		325	163	40	9	1

TABLE 4—(Continued)

Age group	Number fish	Average length at capture	Annulus 1	2	3	4	5
First collection, June 22–30, 1950							
I	22	4.6	3.6				
II	15	7.1	3.5	6.4			
III	10	8.5	3.4	5.5	7.7		
Second collection, August 7–15, 1950							
0	1	2.0					
I	84	5.8	3.4				
II	13	8.9	3.5	6.7			
III	7	10.4	3.1	5.8	8.6		
Third collection, September 18–25, 1950							
0	45	3.6					
I	63	6.2	3.4				
II	7	9.0	3.8	6.9			
III	2	11.0	3.9	6.5	9.3		
Average calculated length			3.4	6.3	8.2		
Increment			3.4	2.9	1.9		
Number of fish	269		223	54	19		
First collection, July 7–18, 1951							
I	25	4.8	3.5				
II	30	7.7	3.5	6.2			
III	1	9.7	3.3	6.1	9.1		
IV	1	15.4	3.7	7.8	12.1	14.5	
Second collection, September 6–14, 1951							
0	24	2.9					
I	121	6.6	3.5				
II	19	9.6	3.6	7.0			
III	2	9.0	3.3	6.0	8.1		
Average calculated length			3.5	6.5	9.4	14.5	
Increment			3.5	3.0	2.9	5.1	
Number of fish	269		199	53	4	1	
Grand average calculated length			3.5	6.6	9.4	11.8	16.7
Increment			3.5	3.1	2.8	2.4	4.9
Number of fish	860		747	270	63	10	1

This was substantially less than for brown trout. Growth rate was greatest in the first year and declined gradually through the third year. Age-group I was the largest, closely followed by age-group II; 98 percent of the rainbow trout population was made up of fish in age groups I–III.

With the exception of yearling fish, rainbow trout grew at a more rapid rate in Prickley Pear Creek than in three Michigan trout streams (Shetter and Hazzard, 1939). The average total lengths at the end of each year of life were about the same as those reported by Purkett (1951) for the West Gallatin River and by Holton (1953) for Trout Creek, Montana. Rainbow trout taken from the Missouri River by Kathrein (1951) showed a faster rate of growth.

Brook Trout. The grand average calculated lengths for brook trout at annulus formation for years 1–3 were: 4.1, 7.0, and 9.6 inches (Table 5).

TABLE 5

Average calculated total length and increment at each annulus of eastern brook trout from Prickley Pear Creek (length in inches).

Age group	Number fish	Average length at capture	Annulus 1	2	3
First collection, June 22 to July 13, 1949					
I	5	5.9	4.4		
II	1	9.2	3.7	6.0	
III	1	12.1	5.1	8.4	10.6
Second collection, August 11–17, 1949					
0	4	3.3			
I	10	6.0	4.2		
II	2	8.8	3.8	7.4	
Third collection, September 16–23, 1949					
0	5	3.7			
I	6	6.3	4.1		
II	2	9.4	5.2	8.4	
Fourth collection, November 24–27, 1949					
I	4	6.8	4.1		
II	3	9.9	4.8	8.1	
Average calculated length			4.3	7.8	10.6
Increment			4.3	3.5	2.8
Number of fish	43		34	9	1
First collection, June 22–30, 1950					
I	2	6.0	4.2		
II	9	7.9	4.2	6.7	
III	2	10.8	4.3	7.0	9.8