



Age and growth of four species of fish, Flathead Lake, Montana
by Jerold Francis Rahrer

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

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Abstract:

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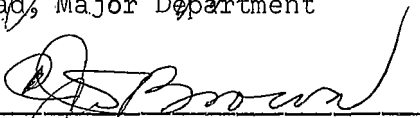
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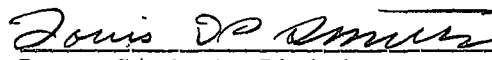
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Table of Contents

	Page
Abstract	vi
Introduction	1
Equipment and Methods	3
Fish Captured by the Various Methods	4
Age and Growth	6
Dolly Varden	6
Yellow perch	7
Peamouth	8
Squawfish	9
Acknowledgements	12
Summary	12
Literature cited	13

List of Tables

	Page
1. Species collected and percentage taken by each method (seining excluded)	5
2. Mean calculated total lengths of Dolly Varden from Flathead Lake, Montana	7
3. Mean calculated total lengths of yellow perch from Flathead Lake, Montana	8
4. Mean calculated total lengths of peamouth from Flathead Lake, Montana	10
5. Mean calculated total lengths of squawfish from Flathead Lake, Montana	11

List of Figures

	Page
1. Flathead Lake, showing study area and collection sections	2

Abstract

Age and growth of Dolly Varden, yellow perch, peamouth, and squawfish were studied in Flathead Lake during the summer of 1961 and spring of 1962. The majority of the fish was collected by gill netting, however most of the Dolly Varden were collected by angling. The scales from 289 Dolly Varden, 243 yellow perch, 192 peamouth, and 200 squawfish were examined. Dolly Varden showed slow growth rates for the first two years (2.2 inches per year) and more rapid growth from III to VIII years (5.3 inches per year). The average growth rate of yellow perch, peamouth, and squawfish was 1.5, 1.0, and 1.1 inches per year, respectively.

Introduction

While such workers as Forbes (1893), Elrod (1901), Graham and Young (1934), Young (1935), and Potter and Baker (1956, 1961), have reported on the limnology, invertebrate life, and microbial populations in Flathead Lake, very little work has appeared on the fish. Brunson and Newman (1951) studied the summer food of lake whitefish. Brunson, Castle, and Pirtle (1952) gave lengths, weights, testis size, and sex ratios of kokanee and Stefanich (1952) attempted to determine kokanee abundance and natural reproduction. Brunson, Pennington, and Bjorklund (1952) published information on age, size, and food habits of cutthroat trout, and Brunson (1957) recorded a white sturgeon from Flathead Lake.

An age and growth study on certain fishes in Flathead Lake was initiated by the Montana Fish and Game Department in the summer of 1961 and continued through the spring of 1962. It was originally planned to collect samples of all species of fish, however, due to inadequate equipment and the limited time available, the study was limited to: Dolly Varden (Salvelinus malma), yellow perch (Perca flavescens), peamouth (Mylocheilus caurinus), and northern squawfish (Ptychocheilus oregonensis). Collections were confined to that portion of the lake lying north of a line from Woods Bay on the east shore to Angel Point on the west shore (approximately 40 square miles). Six collection sections were established (Figure 1).

Flathead Lake is located in northwestern Montana within Lake and Flathead counties. It is the largest natural lake in the state, with a surface area of 120,320 acres, a shore line of 127 miles, and a maximum

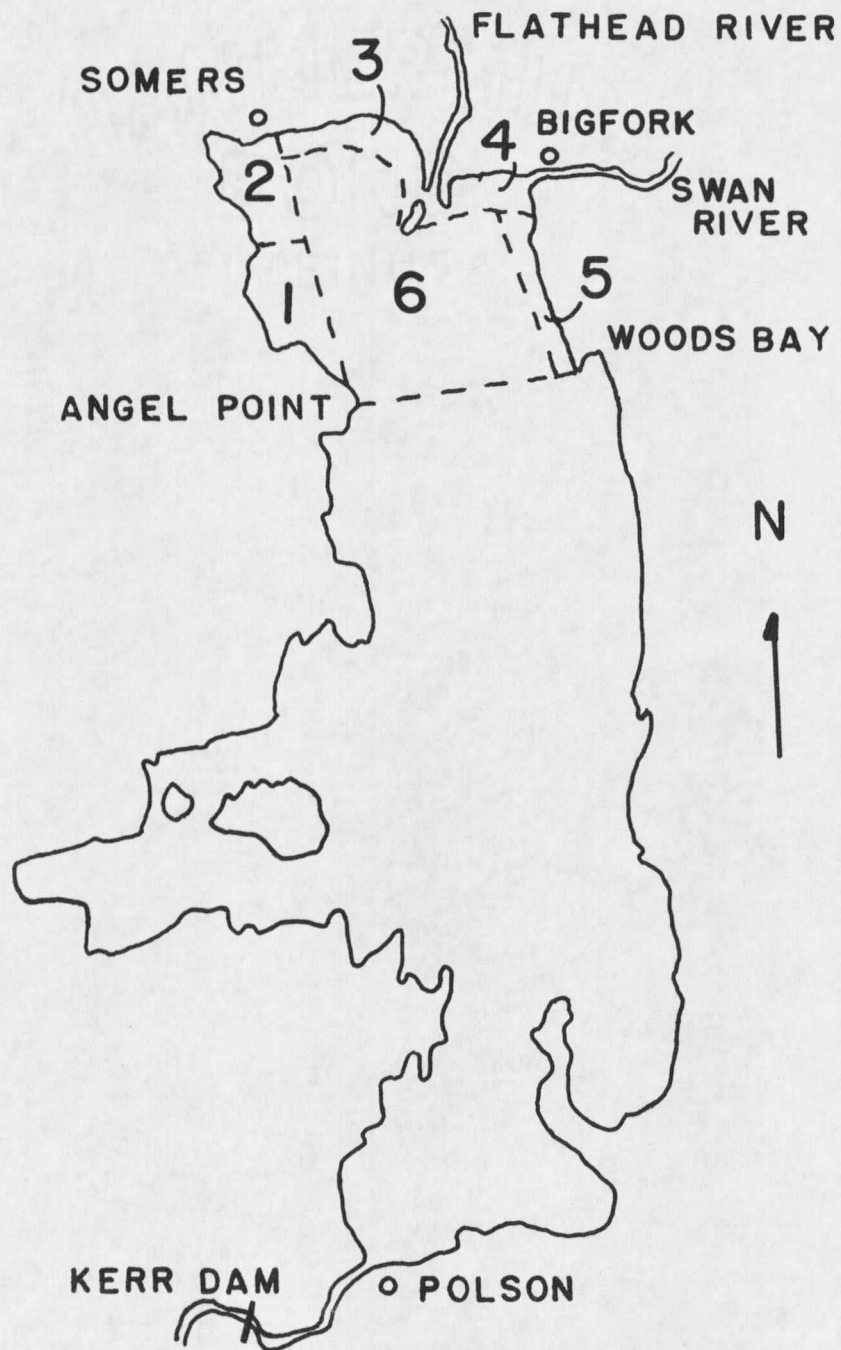


Figure 1. Flathead Lake, showing study area and collection sections.

depth of 421 feet. The principal tributaries are the Flathead River and Swan River. These enter the northern end of the lake. Kerr Dam is athwart the outlet at the southern end of the lake, and more or less controls the water level in the lake. The outlet (Flathead River), empties into the Clark Fork of the Columbia River near Paradise, Montana.

Flathead Lake is known to be low in productivity. Young (1935) described it as oligotrophic - "a deep, pure, cold mountain lake with a correspondingly low productivity of plankton and benthos." The game fish (Montana classification) found were: lake whitefish (Coregonus clupeaformis), kokanee (Oncorhynchus nerka kennerlyi), mountain whitefish (Prosopium williamsoni), cutthroat trout (Salmo clarki), rainbow trout (Salmo gairdneri), Dolly Varden (Salvelinus malma), lake trout (Salvelinus namaycush), and largemouth bass (Micropterus salmoides). Other fish included: peamouth (Mylocheilus caurinus), northern squawfish (Ptychocheilus oregonensis), redbreast shiner (Richardsonius balteatus), longnose sucker (Catostomus catostomus), largescale sucker (Catostomus macrocheilus), pumpkinseed (Lepomis gibbosus), and yellow perch (Perca flavescens).

Equipment and Methods

Fish were collected by gill netting, seining, trapping, and angling. The following types of gill nets were used at varying depths: experimental (125 feet long, 6 feet deep, with 25 foot sections of 0.75, 1.0, 1.25, 1.5, and 2.0 inch square mesh); coarse mesh (250 feet long, 6 feet deep with mesh sizes of either 2.0, 2.5, or 3.0 inch square mesh); fine mesh (75 feet long, 6 feet deep with equal sections of 0.25, 0.50, and 0.75

inch square mesh). A bag seine (75 feet long, 4 feet deep with 0.25 inch square mesh) was used to collect small fish in shallow water. A pirate trap modified from that described by Crowe (1950), with a lead 250 feet in length and 6 to 11 feet in depth, was set in water 12 and 15 feet in depth. Fish were also collected by trolling and some information was secured from the creel census of the Bureau of Sport Fisheries and Wildlife.

Total lengths (to the nearest 0.1 inch) and weights (to the nearest 0.01 pound) were taken on all fish collected. A scale sample was removed from each fish between the base of the dorsal fin and the lateral line. Annuli and scale measurements were secured with the aid of a scale projection machine. Total lengths at the end of each year's growth were determined by a nomograph. Because of the small sample size a linear relationship between scale radius and body length was assumed. Whitney and Carlander (1956) reported that a greater error may result from corrected lengths than from assuming a linear relationship when small samples are involved.

Fish Captured by the Various Methods

The fine mesh gill net captured 76 fish in 47 hours with an average catch per hour of 1.62, while experimental gill nets caught 2,309 fish in 2,218 hours for an average of 1.04. The coarse mesh gill nets only caught 5 fish in 886 hours for an average of 0.01. The pirate trap caught 287 fish in 591 hours for an average of 0.49, while more than 2,000 fish were taken in approximately 10 hours of seining. Angling produced 174 fish in 282 hours for an average of 0.62. Experimental gill nets caught the

greatest number of fish, with the possible exception of seining, but the majority of the game fish was taken by angling (Table 1).

Table 1. Species collected and percentage taken by each method (seining excluded).

Species	Total number caught	Percent- age total catch	Percentages				
			Pirate trap	Ang- ling	Gill nets		
					Experi- mental	Coarse	Fine
Mountain whitefish	175	7	4		96		
Lake whitefish	125	4	7		93		
Kokanee	3	T ^{1/}			100		
Cutthroat trout	34	1		71	29		
Rainbow trout	7	T		86	14		
Dolly Varden	220	8	2	65	32	T	
Lake trout	2	T		100			
Pumpkinseed	8	T	50		50		
Yellow perch	613	22	4		87		9
Peamouth	968	34	5		94		1
Squawfish	449	16	24		75	1	T
Redside shiner	21	1	57		10		33
Longnose sucker	77	3	35		65		
Largescale sucker	141	5	29		71	T	
Total	2843		10	6	81	T	3

^{1/} T = less than one percent.

The netting effort was distributed as follows: section 1 - 15 percent, section 2 - 18 percent, section 3 - 31 percent, section 4 - 24 percent, section 5 - 1 percent, and section 6 - 11 percent. Dolly Varden, yellow perch, peamouth, and squawfish were collected in all six sections. They made up 8, 22, 34, and 16 percent, respectively, of the total catch. Most Dolly Varden were collected in sections 1, 2, and 4; yellow perch in section 2; peamouth in sections 2, 3, and 4; and squawfish in sections 1, 3, and 4.

Age and Growth

Dolly Varden. Age determinations were made on 289 fish ranging from 8.0 to 34.5 inches in total length. While no observations were made on early life history of this species, Block (1955) reported it spawned in September and October and that eggs are eyed by November 15, in the North Fork of the Flathead River. Schultz (1941) observed the first newly hatched young during July. Bjornn (1961) showed that scales first appeared when the fish were 1.6 to 1.8 inches in total length, and Block (1955) gave the time of annulus formation as late winter.

The youngest fish taken had three annuli. There were 44 specimens in this age group and these ranged from 8.0 to 11.0 inches. The annual growth increments for the first two years were 1.7 and 2.7 inches, respectively, and those for age classes III to VIII varied from 4.5 to 6.0 inches. The slow growth rate for the first two years may have resulted from stream residency, while the faster growth from three to eight years resulted from lake residency. Bjornn (1961) studied Dolly Varden in Idaho and said, "Their scales exhibit stream-type development during the early years, with the first two or three annuli close together and the next annulus widely separated, indicating change to the lake residence."

The mean calculated total lengths of Dolly Varden from Flathead Lake (Table 2) are lower than those given by Neave and Bajkov (1929), and higher than those reported by: Bjornn (1961) from Idaho, Carl and Clemens (1948) from Canada, Delacy and Morton (1942) and Roos (1959) from Alaska. Dolly Varden from Flathead Lake grew slower during their early years, and faster during later years, than those reported by Block (1955) and Lagler and

Table 2. Mean calculated total lengths of Dolly Varden from Flathead Lake, Montana.

Age class	Number fish	Average length at annulus formation								
		I	II	III	IV	V	VI	VII	VIII	
3	44	3.1	6.0	8.4						
4	42	3.5	6.4	9.4	11.9					
5	123	2.9	5.9	8.8	12.5	15.9				
6	66	2.5	4.9	7.8	12.6	17.3	21.8			
7	13	2.4	4.8	7.6	12.3	17.1	22.0	26.3		
8	1	2.4	4.8	7.4	14.0	20.9	26.4	30.6	34.5	
Total	289	Average	2.8	5.5	8.2	12.7	17.8	23.4	28.5	34.5
Range of back calculations			1.2-	2.8-	4.8-	8.6-	12.0-	16.8-	20.7-	34.5
			5.0	8.4	11.7	15.0	21.0	25.7	32.2	

Wright (1962).

The oldest Dolly Varden taken in Flathead Lake was eight years (total length, 34.5 inches; weight, 20 pounds). A 20-year-old Dolly Varden weighing 13.5 pounds was reported by Shebley (1931) from California, and a 7-year-old (total length, 25.0 inches; weight, 4 pounds) was reported by Roos (1959) from Alaska.

Yellow perch. Age determinations were made on 243 specimens ranging from 1.4 to 12.0 inches in total length. No observations were made on the early life of yellow perch in Flathead Lake, however Echo (1954) reported yellow perch to spawn during early May and found hatching eggs by late May in the Thompson Lakes, Montana. Joeris (1956) found scales over most of the body at a length of 1.4 inches and gave April as the approximate time of annulus formation in Green Bay, Wisconsin. The time of annulus formation was not determined for this species in Flathead Lake due to the small number of samples collected during the spring.

Only 10 young-of-the-year were collected in Flathead Lake, these

ranged from 1.4 to 1.8 inches. The mean calculated total lengths of yellow perch from Flathead Lake (Table 3) are lower than those reported by:

Table 3. Mean calculated total lengths of yellow perch from Flathead Lake, Montana.

Age class	Number fish	Average length at annulus formation							
		I	II	III	IV	V	VI	VII	
1	21	1.4							
2	23	1.4	2.5						
3	31	1.0	2.3	3.7					
4	89	0.9	2.0	3.4	5.3				
5	45	0.7	1.6	3.1	4.9	7.2			
6	30	0.7	1.6	3.2	5.1	7.2	9.3		
7	4	0.7	1.6	3.2	5.1	6.7	8.1	10.0	
Total	243	Average	1.0	1.9	3.3	5.1	7.0	8.7	10.0
Range of back calculations			0.4- 1.8	.8- 3.6	1.9- 5.3	3.4- 8.2	3.5- 9.4	6.9- 9.7	9.5- 11.0

Brown and Thoreson (1951) and Brown and Logan (1960) in Montana; Eschmeyer (1937) and Hile and Jobs (1940) in Michigan; Harkness (1922) in Ontario; Grice (1959) in Massachusetts and Roseberry (1950) in Virginia. However, the calculated lengths of fish at ages of V, VI, VII are equal to those reported by Kennedy (1949) in Manitoba and higher than the lengths given by Echo (1955) in Montana, and Stroud (1955) in Massachusetts.

The oldest yellow perch collected in Flathead Lake was 7 years. An 8-year-old yellow perch was reported by Kennedy (1949) from Lake Manitoba, and one of 11 years of age was reported by Carlander (1949) from Lake of the Woods, Minnesota.

Peamouth. Age determinations were made on 192 peamouth, which ranged from 1.4 to 14.0 inches in total length. No observations were made on the

time of spawning in Flathead Lake. Hill (1958) reported peamouth to spawn during May. The approximate time of annulus formation was May in Flathead Lake.

Young-of-the-year peamouth, collected on September 10, ranged from 1.4 to 2.8 inches. Peamouth of age class I were not captured, and only small samples (10 or less) were collected from age classes II, III, and IX through XIII (Table 4). The mean calculated total lengths of peamouth from Flathead Lake (Table 4) were lower than those reported by: Hill (1958) from Placid Lake, Montana, and Clemens, et al. (1939) from Okanagan Lake, Canada.

The oldest peamouth collected from Flathead Lake was 13 years (total length, 14.0 inches). A peamouth of 9 years (total length, 13.5 inches) was the oldest reported by Hill (1958) while 5 years (total length, 9.8 inches) was the oldest given by Clemens, et al.

Squawfish. Age determinations were made on 200 fish ranging from 1.2 to 21.2 inches in total length. Although no observations were made on the time of spawning in Flathead Lake, Hill (1958) reported squawfish to spawn during May and June in the Big Blackfoot River drainage, Montana. The approximate time of annulus formation was late May in Flathead Lake.

Young-of-the-year squawfish, collected on September 10, ranged from 1.2 to 1.8 inches. No squawfish of age class I were captured. Less than 10 specimens were captured for each of age classes II, III, V, XVI, and XVII (Table 5). The mean calculated total lengths of squawfish from Flathead Lake (Table 5) were lower than those reported by: Hill (1958) from Alva Lake, Montana, and Clemens, Rawson and McHugh (1939) from Woods Lake,

Table 4. Mean calculated total lengths of peamouth from Flathead Lake, Montana.

Age class	Number of fish	Average length at annulus formation													
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	
2	4	1.9	3.6												
3	10	2.2	3.5	5.2											
4	33	2.4	3.8	5.3	6.6										
5	28	2.3	3.7	5.1	6.6	7.8									
6	23	2.3	3.5	5.0	6.4	7.7	8.7								
7	20	2.2	3.4	4.7	6.1	7.4	8.5	9.6							
8	27	2.0	3.2	4.4	5.7	7.1	8.4	9.6	10.6						
9	10	1.9	3.0	4.2	5.4	6.8	8.2	9.4	10.5	11.5					
10	7	1.9	3.0	4.1	5.4	6.6	7.8	9.2	10.4	11.4	12.3				
11	5	1.7	2.6	3.7	4.9	6.2	7.7	9.0	10.1	11.1	11.8	12.5			
12	2	1.9	3.3	4.3	5.5	6.9	8.2	9.3	10.2	11.4	12.3	12.8	13.2		
13	1	1.6	2.5	4.0	5.0	6.4	7.8	8.5	9.3	10.4	11.4	12.3	13.0	13.5	
Total	192	Average	1.9	3.3	4.5	5.8	7.0	8.2	9.2	10.2	11.2	12.0	12.5	13.1	13.5
Range of back calculations			1.6-	2.5-	3.7-	4.9-	6.2-	7.7-	8.5-	9.3-	10.4-	11.4-	12.3-	13.0-	13.5
			2.4	3.8	5.3	6.6	7.8	8.7	9.6	10.6	11.5	12.3	12.8	13.2	

Table 5. Mean calculated total lengths of squawfish from Flathead Lake, Montana.

Age class	Number of fish	Average length at annulus formation																
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII
2	2	1.4	2.8															
3	1	1.6	2.9	4.9														
4	10	1.6	2.8	4.5	6.5													
5	6	1.3	2.7	4.4	6.3	7.6												
6	13	1.3	2.5	4.0	5.6	7.4	8.7											
7	21	1.1	2.1	3.3	4.8	6.4	7.9	9.2										
8	20	1.1	1.9	2.9	4.3	5.9	7.4	8.8	10.1									
9	12	1.2	2.0	2.8	4.0	5.5	6.8	8.2	9.5	10.9								
10	16	1.0	1.8	2.8	4.1	5.3	6.6	7.9	9.1	10.2	11.4							
11	17	1.0	1.8	2.8	4.0	5.2	6.4	7.7	9.0	10.2	11.3	12.3						
12	17	1.0	1.8	2.8	4.1	5.3	6.5	7.7	9.0	10.1	11.1	12.1	13.1					
13	24	1.1	1.8	2.8	4.1	5.3	6.5	7.7	8.8	9.9	11.0	12.0	12.9	13.8				
14	14	1.0	1.9	2.6	4.0	5.1	6.5	7.7	8.9	10.0	11.0	12.0	13.1	13.9	14.8			
15	16	1.1	1.9	2.8	4.2	5.4	6.8	8.3	9.6	10.8	12.0	13.1	14.2	15.2	16.1	16.9		
16	5	0.8	1.5	2.3	3.3	4.5	5.8	7.1	8.4	9.7	11.2	12.6	13.9	15.2	16.2	17.1	17.8	
17	6	0.8	1.6	2.6	3.8	5.3	6.6	8.0	9.4	10.6	12.1	13.3	14.6	15.6	16.4	17.4	18.3	19.1
Total	200 Av.	1.2	2.1	3.2	4.4	5.7	6.9	8.0	9.2	10.3	11.4	12.5	13.6	14.7	15.9	17.1	18.0	19.1
Range of back calculations		0.4-2.1	1.0-3.8	1.7-5.8	2.7-7.0	3.6-8.2	4.8-9.5	5.8-11.0	7.4-12.1	8.3-13.4	9.2-14.9	10.2-16.0	11.4-17.3	12.4-18.0	13.2-18.0	14.7-19.3	16.7-20.3	18.0-21.2

Canada.

The oldest squawfish collected in Flathead Lake was 17 years (total length, 21.2 inches). Old squawfish reported by other authors were: 15 years (total length, 17.4 inches, Hill, 1958), 13 years (total length, 26.5 inches, Jeppson, 1957), and 11 years (total length, 18.0 inches, Clemens, Rawson, and McHugh, 1939).

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Summary

1. A study was made on the age and growth of Dolly Varden, yellow perch, peamouth, and squawfish in Flathead Lake during the summer of 1961 and spring of 1962.
2. Fish were collected by gill netting, seining, trapping, and angling.
3. Fine mesh and experimental gill nets captured the majority of fish, however most of the game fish were captured by angling.
4. The scales from 289 Dolly Varden, 243 yellow perch, 192 peamouth, and 200 squawfish were examined.

5. The average growth rate of Dolly Varden was 2.2 inches per year, for the first two years, and 5.3 inches per year from age III to VIII. The maximum age for this species from Flathead Lake was 8 years.

6. The average growth rate of yellow perch was 1.5 inches per year with a range of 0.9 to 1.9 inches. The oldest yellow perch collected was 7 years.

7. The average growth of peamouth was 1.0 inch per year with a range of 0.4 to 1.4 inches. The oldest peamouth captured was 13 years.

8. The average growth rate of squawfish was 1.1 inches per year with a range of 0.9 to 1.3 inches. The oldest squawfish collected was 17 years.

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