Some ecological relationships between the yellow perch, trout, and other fish in Thompson Lakes, Montana
by John B Echo

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

Abstract:
An investigation was made on the relationships between yellow perch and cutthroat trout in Thompson Lakes, Montana, in the summers of 1952 and 1953. These lakes originally contained cutthroat trout and were later planted with yellow perch. The spawning time of yellow perch was in early May, and for the cutthroat trout in late May. The population of yellow perch was large and growth was very slow. While the number of cutthroat trout was small, the growth rate for this species was about average. The food of yellow perch was largely immature aquatic insects and plankton while that of cutthroat trout was mostly mature aquatic insects and small perch. Yellow perch were commonly distributed along the lake margins and concentrations of perch fry and adults were found in these areas in the spring. During this same period the salmonid fishes were predominately in the deep water. Poisoning of the yellow perch concentrations was very effective. Management suggestions are given.

O O coLj.1== Introduction TfilhIle many studies of the yellow perch (Perca flavescens Mitchill) have been made, only a few concern the relationships between yellow perch and trout = Swynnerton and Worthington (l9ko) examined the food of perch and trout in Haweswater (lifestmoreland) and found little competition. Worthington (l9ii9) studied the fishes of hake Wendermere, a perch infested trout lake, and concluded that a reduction, of perch would be beneficial to the trout fishery. Ho studies of this kind are known in the United States. In western Montana there are many trout lakes which have been contaminated by the introduction of yellow perch, Zn most cases the trout fishery has apparently suffered from this introduction.

An Investigation on the ecological relationships of yellow perch, trout, and other fishes in the Thompson Lakes, Lincoln County, Montana (Fig. l), was initiated in the summer of 1952. Work was renewed in the spring of 1953, and continued through the following summer.

The three lakes selected represent perch infested trout lakes which are readily accessible to fishermen. They are approximately 5>0 miles west of Kalispell, on U. S. Highway Ho. 2. These lakes are connected by short channels and comprise the headwaters of the Thompson River. Their approximate areas and depths ares Lake Area-acres Maximum depth-feet
Upper Thompson ' 375 5o
Middle Thompson 730 160
Lower Thompson 2ltO i5o

SOME ECOLOGICAL RELATIONSHIPS BETWEEN THE YELLOW PERCH, TROUT, AND OTHER FISH IN THOMPSON LAKES, MONTANA

by

JOHN B. ECHO

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
March, 1954

Table of Contents

Abstract

An investigation was made on the relationships between yellow perch and cutthroat trout in Thompson Lakes, Montana, in the summers of 1952 and 1953. These lakes originally contained cutthroat trout and were later planted with yellow perch. The spawning time of yellow perch was in early May, and for the cutthroat trout in late May. The population of yellow perch was large and growth was very slow. While the number of cutthroat trout was small, the growth rate for this species was about average. The food of yellow perch was largely immature aquatic insects and plankton while that of cutthroat trout was mostly mature aquatic insects and small perch. Yellow perch were commonly distributed along the lake margins and concentrations of perch fry and adults were found in these areas in the spring. During this same period the salmonid fishes were predominately in the deep water. Poisoning of the yellow perch concentrations was very effective. Management suggestions are given.

Introduction

While many studies of the yellow perch (Perca flavescens Mitchill) have been made, only a few concern the relationships between yellow perch and trout. Swynnerton and Worthington (1940) examined the food of perch and trout in Haweswater (Westmoreland) and found little competition. Worthington (1949) studied the fishes of Lake Wendermere, a perch infested trout lake, and concluded that a reduction of perch would be beneficial to the trout fishery. No studies of this kind are known in the United States. In western Montana there are many trout lakes which have been contaminated by the introduction of yellow perch. In most cases the trout fishery has apparently suffered from this introduction. An investigation on the ecological relationships of yellow perch, trout, and other fishes in the Thompson Lakes, Lincoln County, Montana (Fig. 1), was initiated in the summer of 1952. Work was renewed in the spring of 1953, and continued through the following summer.

The three lakes selected represent perch infested trout lakes which are readily accessible to fishermen. They are approximately 50 miles west of Kalispell, on U. S. Highway No. 2. These lakes are connected by short channels and comprise the headwaters of the Thompson River. Their approximate areas and depths are:

Lake	Area-acres	Maximum depth-feet
Upper Thompson	375	50
Middle Thompson	730	160
Lower Thompson	240	150

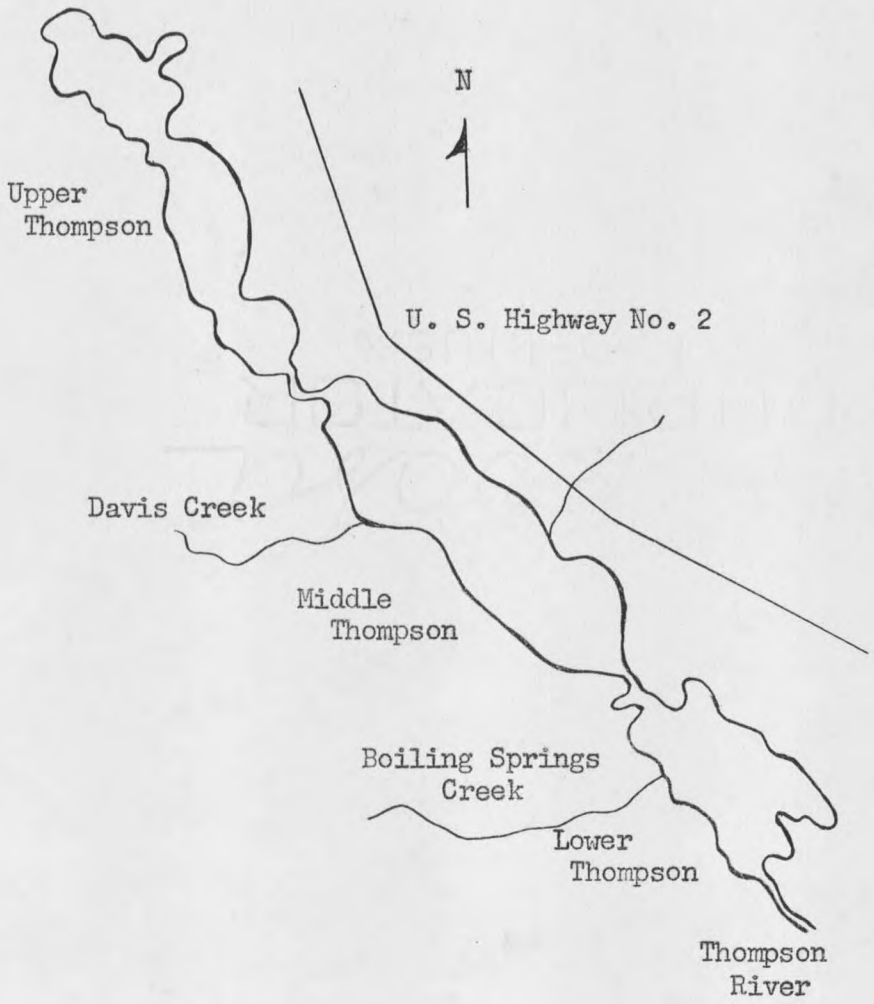
Introduction

While many studies of the yellow perch (Perca flavescens Mitchill) have been made, only a few concern the relationships between yellow perch and trout. Swynnerton and Worthington (1940) examined the food of perch and trout in Haweswater (Westmoreland) and found little competition. Worthington (1949) studied the fishes of Lake Wendermere, a perch infested trout lake, and concluded that a reduction of perch would be beneficial to the trout fishery. No studies of this kind are known in the United States. In western Montana there are many trout lakes which have been contaminated by the introduction of yellow perch. In most cases the trout fishery has apparently suffered from this introduction. An investigation on the ecological relationships of yellow perch, trout, and other fishes in the Thompson Lakes, Lincoln County, Montana (Fig. 1), was initiated in the summer of 1952. Work was renewed in the spring of 1953, and continued through the following summer.

The three lakes selected represent perch infested trout lakes which are readily accessible to fishermen. They are approximately 50 miles west of Kalispell, on U. S. Highway No. 2. These lakes are connected by short channels and comprise the headwaters of the Thompson River. Their approximate areas and depths are:

Lake	Area-acres	Maximum depth-feet
Upper Thompson	375	50
Middle Thompson	730	160
Lower Thompson	240	150

Fig. 1. Thompson Lakes, Lincoln County, Montana



About 25 percent of the Lower and Middle Thompson Lakes and nearly 90 percent of the Upper Thompson Lake is shoal. The maximum surface temperature near the middle of Lower Thompson Lake was 75°F. (July 11, 1953). Lower and Middle Thompson Lakes were found thermally stratified in each year studied. Additional physical and chemical data are given in Table 1.

The game fish (Montana designation) found in the Thompson Lakes were: kokanee (Oncorhynchus nerka), cutthroat trout (Salmo clarkii), rainbow trout (Salmo gairdnerii), eastern brook trout (Salvelinus fontinalis), dolly varden (Salvelinus malma), mountain whitefish (Prosopium williamsoni), and largemouth bass (Micropterus salmoides). The most abundant of these was the mountain whitefish with kokanee second and cutthroat trout third. Yellow perch (Perca flavescens) was the most abundant non-game fish. Pumpkinseed sunfish (Lepomis gibbosus) and squawfish (Ptychocheilus oregonensis) were common while longnose sucker (Catostomus catostomus) and Columbia large scale sucker (Catostomus macrocheilus) were abundant. The red-side shiner (Richardsonius balteatus) was scarce.

Acknowledgements

The writer is indebted to Dr. C. J. D. Brown who directed this study and assisted in the preparation of the manuscript. Mr. Frank Stefanich and Mr. Charles Phenicie gave valuable suggestions and assistance in the field. The Montana Department of Fish and Game provided much of the equipment. The project was financed by Federal Aid to Fish Restoration

Table 1. Physical and chemical data for Thompson Lakes in 1952 and 1953.

	Date	Depth feet	Lower Thompson Lake	Middle Thompson Lake	Upper Thompson Lake
Temperature °F.	6/16/52	0	59.0	59.0	60.5
		15	59.0	59.0	60.5
		36	42.0	41.5	43.0
	9/4/52	0	65.0	65.0	66.0
		25	54.5	58.0	62.0
		35	45.5	45.0	50.0
	6/26/53	2	60.0	60.0	
		18	54.0	59.5	
		30	43.5	44.0	
	9/1/53	2	64.5	66.0	
		22	63.5	65.0	
		35	45.0	46.5	
Methyl orange Alkalinity p.p.m.	9/4/52	2	236	220	228
	7/21/53	2	230	232	
pH	9/4/52	0	8.4	8.4	8.3
Dissolved Oxygen p.p.m.	7/21/52	15	8.5	8.0	8.4
		35	3.5	4.0	2.5
	9/4/52	15	8.0	8.0	8.0
		35	1.8	4.3	6.1
	7/21/53	35	3.0	4.2	
	9/1/53	35	2.0	3.5	
Secchi disc ft.	6/16/52		28	23	17
	9/4/52		32	30	23
	7/21/53		18	18	
	9/1/53		24	25	

Table 1. Physical and chemical data for Thompson Lakes in 1952 and 1953.

	Date	Depth feet	Lower Thompson Lake	Middle Thompson Lake	Upper Thompson Lake
Temperature °F.	6/16/52	0	59.0	59.0	60.5
		15	59.0	59.0	60.5
		36	42.0	41.5	43.0
	9/4/52	0	65.0	65.0	66.0
		25	54.5	58.0	62.0
		35	45.5	45.0	50.0
	6/26/53	2	60.0	60.0	
		18	54.0	59.5	
		30	43.5	44.0	
	9/1/53	2	64.5	66.0	
		22	63.5	65.0	
		35	45.0	46.5	
Methyl orange Alkalinity p.p.m.	9/4/52	2	236	220	228
	7/21/53	2	230	232	
pH	9/4/52	0	8.4	8.4	8.3
Dissolved Oxygen p.p.m.	7/21/52	15	8.5	8.0	8.4
		35	3.5	4.0	2.5
	9/4/52	15	8.0	8.0	8.0
		35	1.8	4.3	6.1
	7/21/53	35	3.0	4.2	
	9/1/53	35	2.0	3.5	
Secchi disc ft.	6/16/52		28	23	17
	9/4/52		32	30	23
	7/21/53		18	18	
	9/1/53		24	25	

funds under Dingle-Johnson Project Number F7R.

Life History

An attempt was made to determine the relationships of yellow perch and cutthroat trout at each stage of their life cycles. If yellow perch proved to be vulnerable to control at some life history stage then they might be reduced in favor of the trout.

Yellow perch spawning

The first ripe males and nearly ripe females of yellow perch were caught near a known spawning area in Lower Thompson Lake in late April, 1953. Specimens taken here on May 2 were all males. On May 5, several ribbons of eggs were found on the branches of a submerged pine tree in this area (surface water temp. 57° F.). On May 6, eggs were found to be common in the littoral zones of all three lakes. Clusters were observed from the surface to a depth of about five feet; usually near three feet. Yellow perch deposited their eggs on the following substrata in the Thompson Lakes: conifers (Pinus ponderosa and Pseudotsuga taxifolia), birch (Betula fontinalis), bulrush (Scirpus validus), and stonewort (Chara). In the order named, the largest number of egg clusters was found on the submerged conifers and the smallest on Chara. A few eggs were seen directly on the bottom in areas without vegetation.

An experiment was conducted to determine whether female yellow perch showed preference in the type of substrata used. Two likely areas were selected in Lower Thompson Lake and three structures: an 8-foot fir

tree, a 10-foot birch tree without leaves, and a 2 by 8 foot chicken wire grid were placed in each. These structures were located in a favorable spot near the bottom. Egg clusters were removed daily. The experiment continued from May 2 to May 29, and in this interval the conifers received 19 egg masses, the birches 2, and the chicken wire none.

Eggs containing well developed embryos were first noticed on May 10. No new egg deposits were found after May 17, and all eggs had hatched by May 29. Newly hatched yellow perch were about 0.25-inch in total length. When they reached a length of about 0.6-inch they appeared near the surface in schools of a few to several hundred. These schools appeared over the spawning areas (depth 3 to 6 feet) and moved in short spurts which gave a shimmer to the water. Schools of fry were first seen on June 12, 1952, in Lower Thompson Lake and on June 29, 1953, in Middle Thompson Lake. On July 6, 1952, a large school estimated to have an area of 20 by 300 feet and containing many thousands of fry was observed over the shoal area in Lower Thompson Lake. What was believed to be this same school remained intact for three days. On July 23, 1953, an almost continuous band of yellow perch fry estimated to be approximately four feet wide and extending nearly a mile along the margin of Middle Thompson Lake was seen. On the following day this school had dispersed into the littoral vegetation.

Cutthroat trout spawning

A nearly ripe (13.2-inch) female cutthroat trout was caught in Lower Thompson Lake on April 16, 1953. On May 7, what was presumed to

tree, a 10-foot birch tree without leaves, and a 2 by 8 foot chicken wire grid were placed in each. These structures were located in a favorable spot near the bottom. Egg clusters were removed daily. The experiment continued from May 2 to May 29, and in this interval the conifers received 19 egg masses, the birches 2, and the chicken wire none.

Eggs containing well developed embryos were first noticed on May 10. No new egg deposits were found after May 17, and all eggs had hatched by May 29. Newly hatched yellow perch were about 0.25-inch in total length. When they reached a length of about 0.6-inch they appeared near the surface in schools of a few to several hundred. These schools appeared over the spawning areas (depth 3 to 6 feet) and moved in short spurts which gave a shimmer to the water. Schools of fry were first seen on June 12, 1952, in Lower Thompson Lake and on June 29, 1953, in Middle Thompson Lake. On July 6, 1952, a large school estimated to have an area of 20 by 300 feet and containing many thousands of fry was observed over the shoal area in Lower Thompson Lake. What was believed to be this same school remained intact for three days. On July 23, 1953, an almost continuous band of yellow perch fry estimated to be approximately four feet wide and extending nearly a mile along the margin of Middle Thompson Lake was seen. On the following day this school had dispersed into the littoral vegetation.

Cutthroat trout spawning

A nearly ripe (13.2-inch) female cutthroat trout was caught in Lower Thompson Lake on April 16, 1953. On May 7, what was presumed to

be a pair of spawning cutthroat trout was observed on a small riffle about three miles up Davis Creek, a tributary to Middle Thompson Lake. One was captured; a ripe male 13.7 inches in total length. On April 17 and 18, 11 cutthroat trout were seen in this area. They were estimated to average about 13 inches in total length. In the previous year on July 29, a 150-foot section of this area was censused by the electric shock method and 140 cutthroat trout averaging 3.8 inches in total length were taken. No other species were found. From May 21 to June 11, 1953, 21 adult cutthroat trout were removed from a sucker trap at the mouth of Boiling Springs Creek, a tributary to Lower Thompson Lake. These were spent spawners and averaged approximately 13 inches in length. On May 16, 1953, numerous fingerling trout were seen approximately one mile up Boiling Springs Creek and on June 17 and 18, about 25 to 50 fingerling trout were observed in the vicinity of the sucker trap. They disappeared from this area on June 19. No trout fry or young-of-the-year were found in the lakes.

During May, 1953, schools of approximately 20 to 70 suckers, either Catostomus macrocheilus or C. catostomus gresius or both, were seen in the spawning area used by the perch. Smaller schools of squawfish were here also. No aggressive behavior on the part of one species toward another was observed. Suckers were trapped in the tributary streams beginning May 20, 1953. The largest number was taken on June 2, after which their number declined. Gravid squawfish were caught in the lake around the stream mouths during this period but were never taken in the traps.

No apparent competition for spawning sites between the yellow perch, cutthroat trout or any of the other fishes was found in Thompson Lakes. Yellow perch eggs were distributed very widely over the entire shoal areas. Cutthroat trout undoubtedly confine their spawning to suitable areas of the tributary streams.

Age and growth

Yellow perch: Scale samples from 150 yellow perch were taken during the study period. Age was determined by the usual method and calculations assumed a straight line relationship between the length of scale and that of fish (Table 2). The average calculated mean total lengths in inches for the year classes I through V were: 1.9, 3.4, 4.4, 5.6, 6.6. The average total length of 900 yellow perch taken by hook and line was 6.2 inches. The grand average of 3200 fish captured by all means (angling, gill nets, poison) was 6.4 inches, and only one percent was over 7.5 inches. There is little question that this population is slow growing and stunted. Carlander (1950), Hile (1942), and Eschmeyer (1938), in their studies of yellow perch, report few instances of such poor growth.

Cutthroat trout: Scale samples from 41 cutthroat trout caught by trolling in the Middle and Lower Thompson Lakes during the summer of 1953 were analyzed. Calculations assumed a straight line relationship between the length of scale and that of fish (Table 3). The average calculated mean total lengths in inches for the year classes I through IV were: 5.1, 7.8, 10.3, 12.5. The largest fish captured was 23.7 inches in total length, and the average of all cutthroat trout taken was 10.6

No apparent competition for spawning sites between the yellow perch, cutthroat trout or any of the other fishes was found in Thompson Lakes. Yellow perch eggs were distributed very widely over the entire shoal areas. Cutthroat trout undoubtedly confine their spawning to suitable areas of the tributary streams.

Age and growth

Yellow perch: Scale samples from 150 yellow perch were taken during the study period. Age was determined by the usual method and calculations assumed a straight line relationship between the length of scale and that of fish (Table 2). The average calculated mean total lengths in inches for the year classes I through V were: 1.9, 3.4, 4.4, 5.6, 6.6. The average total length of 900 yellow perch taken by hook and line was 6.2 inches. The grand average of 3200 fish captured by all means (angling, gill nets, poison) was 6.4 inches, and only one percent was over 7.5 inches. There is little question that this population is slow growing and stunted. Carlander (1950), Hile (1942), and Eschmeyer (1938), in their studies of yellow perch, report few instances of such poor growth.

Cutthroat trout: Scale samples from 41 cutthroat trout caught by trolling in the Middle and Lower Thompson Lakes during the summer of 1953 were analyzed. Calculations assumed a straight line relationship between the length of scale and that of fish (Table 3). The average calculated mean total lengths in inches for the year classes I through IV were: 5.1, 7.8, 10.3, 12.5. The largest fish captured was 23.7 inches in total length, and the average of all cutthroat trout taken was 10.6

Table 2. Summary of the mean total lengths and annual length increments in inches calculated from scales of yellow perch at Lower Thompson Lake in 1952 and 1953.

Age	Number of fish	Calculated mean total lengths				
		1	2	3	4	5
I	35	1.8				
II	30	2.0	3.6			
III	11	1.9	3.2	4.3		
IV	32	1.8	3.2	4.4	5.6	
V	42	2.0	3.3	4.5	5.6	6.6
Average mean length		1.9	3.4	4.4	5.6	6.6
Increment		1.9	1.5	1.0	1.1	1.0

Table 3. Summary of the mean total lengths and annual length increments in inches calculated from scales of cutthroat trout at Middle Thompson Lake in 1953.

Age	Number of fish	Calculated mean total lengths			
		1	2	3	4
I	6	5.3			
II	18	4.9	7.7		
III	10	4.9	7.7	10.4	
IV	7	5.3	7.9	10.3	12.5
Average mean length		5.1	7.8	10.3	12.5
Increment		5.1	2.7	2.5	2.2

inches. This growth is as good or better than that found for other lakes within the drainage, and slightly less than that reported by Calhoun (1944) in Blue Lake, California.

Food relationships

A total of 900 yellow perch stomachs was examined from specimens collected by hook and line in the areas of greatest adult concentration in Lower Thompson Lake. A sample of 50 fish was taken approximately every 10 days during the period from June to September in 1952, and from May to September in 1953. Captured fish were immediately preserved in formalin and stomach analyses were made at a later time. The stomachs of 83 cutthroat trout were examined at the time of capture. Specimens were taken by trolling in the Middle and Lower Thompson Lakes during the summers of 1952 and 1953.

Only those food items occurring in more than one percent of the specimens were considered. Ninety percent of the yellow perch and 98 percent of the cutthroat trout had eaten some identifiable food organism. Small fish were eaten by 2 percent of the yellow perch and by 40 percent of the cutthroat trout. Yellow perch fry made up 99 percent of these while the remaining one percent consisted of sucker fry and unidentified fish. The maximum number of yellow perch fry found in the cutthroat trout stomachs was 21, with an average of 7.5. The smallest cutthroat trout containing these fry was 6.5 inches in total length and the largest specimen examined contained three yellow perch and one sunfish all of which were over 4 inches in length.

inches. This growth is as good or better than that found for other lakes within the drainage, and slightly less than that reported by Calhoun (1944) in Blue Lake, California.

Food relationships

A total of 900 yellow perch stomachs was examined from specimens collected by hook and line in the areas of greatest adult concentration in Lower Thompson Lake. A sample of 50 fish was taken approximately every 10 days during the period from June to September in 1952, and from May to September in 1953. Captured fish were immediately preserved in formalin and stomach analyses were made at a later time. The stomachs of 83 cutthroat trout were examined at the time of capture. Specimens were taken by trolling in the Middle and Lower Thompson Lakes during the summers of 1952 and 1953.

Only those food items occurring in more than one percent of the specimens were considered. Ninety percent of the yellow perch and 98 percent of the cutthroat trout had eaten some identifiable food organism. Small fish were eaten by 2 percent of the yellow perch and by 40 percent of the cutthroat trout. Yellow perch fry made up 99 percent of these while the remaining one percent consisted of sucker fry and unidentified fish. The maximum number of yellow perch fry found in the cutthroat trout stomachs was 21, with an average of 7.5. The smallest cutthroat trout containing these fry was 6.5 inches in total length and the largest specimen examined contained three yellow perch and one sunfish all of which were over 4 inches in length.

Immature aquatic insects were present in 28 percent and adults in 4 percent of the yellow perch stomachs. Cutthroat trout had immature aquatic insects in 24 percent and adults in 43 percent of their stomachs. About one-half of the aquatic insects were dipterans. Damselflies were second in abundance and mayflies third. Yellow perch apparently showed preference for immature forms while the cutthroat trout ate more adults. Crustacea (Daphnia, Leptodora, and Gammarus) were found in 82 percent of the yellow perch stomachs and in 23 percent of the cutthroat trout. Snails appeared in only two percent of the yellow perch stomachs and in none of the cutthroat trout.

Moffett and Hunt (1943) reported that Perca flavescens showed a change in diet from plankton and insects to forage fish after reaching about five inches in length. Allen (1935) had previously recognized this for Perca fluviatilis. The yellow perch in Lower Thompson Lake showed no marked shift to a diet of fish as evidenced by the fact that only two percent had fish in their stomachs.

The stomach contents of mountain whitefish and kokanee was exclusively plankton. Thirty suckers taken from tributary streams had empty stomachs while 25 specimens captured in the lake contained only detritus.

Fish Distribution

Graded experimental gill nets and trolling were used to determine fish distribution. Gill net sets were made in Lower Thompson Lake during the periods from June to August 1952, and from March to July 1953. These

were of 24-hours duration and were made in the following areas (Table 4): 26 sets in deep water (35 to 70 feet), 22 on open shoals (5 to 10 feet), and 24 in weed beds (10 to 15 feet). Yellow perch were caught predominately in deep water in March and April. Beginning April 29, 1953, heavy catches were made in shoal and weed bed areas in Lower Thompson Lake and continued throughout the summer. Cutthroat trout were never taken by gill nets in deep water or on the open shoal areas. Three specimens were captured in the weed beds in April.

Additional information on distribution was secured by 28 gill net sets made over deep water. In this area surface catches of kokanee and cutthroat trout were common during May, and gradually declined until June 10, when the last kokanee was caught. Trolling catches of kokanee and cutthroat trout also declined in June. Gill nets set from the surface to 30 feet failed to catch any of these fish during July and August.

An Experiment to Reduce the Numbers of Yellow Perch

Schools of yellow perch fry along the shoals were treated with poison (Derris root or Fish-Tox) using a liquid solution and power pump or towing the sack of the dry powdered poison behind a boat. The towed sack method created too much disturbance to be effective and was discontinued. A tank of solution and a power pump was carried by boat to a position out beyond (lakeward) a school of yellow perch fry. Poison was introduced slightly below the surface in a line parallel to the school of fry. When this barrier of poison was complete the entire area containing fry was sprayed. The minimum amount of poison necessary

were of 24-hours duration and were made in the following areas (Table 4): 26 sets in deep water (35 to 70 feet), 22 on open shoals (5 to 10 feet), and 24 in weed beds (10 to 15 feet). Yellow perch were caught predominately in deep water in March and April. Beginning April 29, 1953, heavy catches were made in shoal and weed bed areas in Lower Thompson Lake and continued throughout the summer. Cutthroat trout were never taken by gill nets in deep water or on the open shoal areas. Three specimens were captured in the weed beds in April.

Additional information on distribution was secured by 28 gill net sets made over deep water. In this area surface catches of kokanee and cutthroat trout were common during May, and gradually declined until June 10, when the last kokanee was caught. Trolling catches of kokanee and cutthroat trout also declined in June. Gill nets set from the surface to 30 feet failed to catch any of these fish during July and August.

An Experiment to Reduce the Numbers of Yellow Perch

Schools of yellow perch fry along the shoals were treated with poison (Derris root or Fish-Tox) using a liquid solution and power pump or towing the sack of the dry powdered poison behind a boat. The towed sack method created too much disturbance to be effective and was discontinued. A tank of solution and a power pump was carried by boat to a position out beyond (lakeward) a school of yellow perch fry. Poison was introduced slightly below the surface in a line parallel to the school of fry. When this barrier of poison was complete the entire area containing fry was sprayed. The minimum amount of poison necessary