J. G. Marks
County Board of
  Supervisors
County Agricultural
  Agent
Birch Lake Improvement
  Assn.
J. Huntly
R. Scholma
Mr. Harry Whiteley
ADDRESS
UNIVERSITY MUSEUMS ANNEX
ANN ARBOR, MICHIGAN

INSTITUTE FOR FISHERIES RESEARCH
DIVISION OF FISHERIES
MICHIGAN DEPARTMENT OF CONSERVATION
COOPERATING WITH THE
UNIVERSITY OF MICHIGAN

ALBERT S. HAZZARD, PH.D.
DIRECTOR

July 28, 1944

REPORT NO. 948

EXPERIMENTAL CISCO NETTING IN BIRCH LAKE,

CASS COUNTY, MICHIGAN

by

George N. Washburn

Birch Lake is a deep, spring-fed body of water having a surface area of 308 acres. It lies in the southeastern part of Cass County within the St. Joseph River drainage. For years this lake has been intensively netted each fall for ciscoes during the spawning season as provided in Act 247, P.A. 1919. It is reported by local people that this is one of the best cisco producing waters in the county, which has approximately twenty other lakes open to fall netting for this species. The principal native fish of the lake, other than ciscoes, are bluegills, perch, large- and smallmouth black bass, and suckers. Beginning in 1937 and extending to the present, experimental plantings of brook, brown, rainbow, and lake trout have been made and successful fishing developed. The introduction of trout brought about a new problem; reports began to circulate that trout were being taken in the cisco gill nets during the fall netting operations. This led to an investigation in the fall of 1939 during the cisco netting season by Harold Bowditch of the Institute staff, whose findings did indicate that some trout were being caught (Report No. 570. "Cisco Netting on Birch Lake, Cass County, During the Season of 1939" by Harold Bowditch.)

Beginning in 1940 the lake was temporarily closed to netting by Commission action awaiting further research on this problem as more specific data were needed in order to determine what future policy to follow. Is it possible to conduct a successful harvest of ciscoes with little detrimental effect on other species within the lake, especially the trout?

In the fall of 1943 George N. Washburn and Rhyner Scholma of the Institute staff spent two weeks at Birch Lake making an intensive study of this harvest problem.* The project was divided into two main issues:

(1) To determine the relative proportion of different species of fish taken in an experimental harvest of ciscoes.

(2) To thoroughly explore the field for the best practical method of harvesting ciscoes with a minimum of interference to other species.

The first objective was easily accomplished. By careful tabulation of the total fish samples collected, the proportionate number of each species was determined. However, the second point was much more complicated and many difficulties were encountered. Due to labor shortage and lack of adequate time, this field of study could not be as thoroughly explored as desirable. To attack this problem, different mesh size gill nets were employed and by setting them at various depths and locations during staggered hours of the day, several important factors were discovered which appear to be applicable for a possible future cisco harvest.

Equipment

A total of 18 nets were used. Of these, 13 were of Institute stock and the remaining five were borrowed from local fishermen. The Institute nets were from 125 to 175 feet in length and all had a depth of five feet. Eight of the 13 nets were the so-called "experimental type", the net being equally divided into five sections, each of which represented a different mesh size, beginning at section 1 with a 1 1/2 inch mesh and ending with a 4 inch mesh in section 5. The remaining five Institute nets consisted of three nets of 2 1/2 inch mesh and two of 3 inch mesh. The five borrowed nets were of 2 1/2 inch mesh of a 10 rod length and varied in depths from six to 11 feet. Other types of nets were also on hand including trap, dip net and seine, but time was not available to test the practicability of these. In addition to the nets, field record blanks were prepared for the tabulation of the field data. (See page 16 for sample field sheet.)

Methods

Each of the 13 Institute nets was marked off in five equal sections and tagged at each separation zone and the fish collections from each/net were recorded by the section. The purpose of this sectioning of each net was to learn as much as possible about the total fishing quality of each net and of each mesh size. Both experimental and straight gill nets were set in various water depths ranging from three to 95 feet. Sets were recorded in three groups according to water depth; namely: those set in depths of 10 feet or less, those from 10 to 25 feet, and last those from 25 to 95 feet. It was hoped that by accumulative data at different depths something could be learned about the vertical distribution of fishes in Birch Lake.

Sets were also made at various hours of the day and were separated into three groups. Group one included all sets made between 4:30 p.m. and lifted by 11:00 p.m. Group two included all sets made between 11:00 p.m. and lifted by 8:30 a.m. the following day, and group three included all sets at other hours than those listed above. In this way the hours of greatest production could be determined as well as a possible difference in proportion of the species taken.

As a method to study the movements of fishes in Birch Lake, some of the sets were made perpendicular to shore and others parallel, and at various intervals these sets were "switched" to compensate for any error in the fishing quality of an individual net or set location.

A few sets were made in which nets were suspended from five to 14 feet from the surface, the lead line remaining free from the bottom. The reason for this was to determine the potential harvest under this technique.

Local nets were borrowed and sets made by local fishermen in order to compare their fishing gear with ours.

A method employed to learn as much as possible about the distribution and size range of the Birch Lake fishes was to use various mesh size gill nets set at 11 different locations (see map on page 24).✻ Also, an adequate sample of fish was weighed, measured and scales sampled, which data and scale readings were later used in interpreting the relative growth of these fishes.

The gill netting operations began on November 30 and terminated December 10, 1943. During this period a total of 86 sets were made of which 19 were represented by the use of experimental gill nets, 33 with 2 1/2 inch nets, 28 with 3 inch nets and 6 private nets (2 1/2 inch mesh). Presented in the following pages are the facts and interpretations derived from this investigation.

✻ Map of Birch Lake prepared July 6, 1937 by Institute survey party composed of David C. Chandler, leader, and Walter R. Crowe and E. L. Cheatum, assistants.

SHALLOW WATER SETS (3-10 feet deep)

A total of 45 sets were made in shallow water, 20 of which were the so-called "evening sets" (in operation between the hours of 5:00 p.m. and 11:00 p.m.); 14 sets were "night sets" in fishing operation between the hours of 11:00 p.m. and 8:30 a.m., and 11 sets in operation all night (5:00 p.m. to 8:30 a.m.). Of these 11 all night sets, five were of the experimental gill nets. Each category of nets, according to the period in which they were in operation, will be discussed later under separate headings.

A total of 864 fish, composed of 842 ciscoes, 11 rainbow trout, 9 perch, and 2 brown trout, were captured in these 45 sets. The total fishing time of these nets when in operation was approximately 389 hours. In order to compare and evaluate the fishing quality of specific sets (according to mesh size, location and the period at which the net was in operation), the catch per hour per net was calculated. This was achieved by dividing the total number of fish captured by the total number of hours each net or group of nets required to capture a given number of fish. As an example, these 45 sets took 864 fish in 389 hours, establishing an average calculated catch of 2.2 fish per hour per net.

Evening sets (in operation between 5:00 p.m. and 11:00 p.m.) using 2 1/2 and 3 inch uniform gill nets

A total of 20 sets were made during this period. These nets were placed in fishing position at approximately 5:00 p.m. and lifted about 11:00 p.m. Of these 20 sets, nine were set parallel to shore and the remainder perpendicular, the object being to determine if possible whether or not there was any specific movement of the different fishes. It was thought that perhaps some fish might move directly shoreward from deep water while others might swim parallel to shore once they entered the shallows.

These nine sets placed parallel to shore were composed of five nets of 2 1/2 inch mesh and four of 3 inch. These nine sets took a total of 282 fish which are tabulated below in Tables 1 and 2. A total of 205 fish was caught in the 2 1/2 inch mesh nets in approximately 28 fishing hours. They consisted of 204 ciscoes and one rainbow trout. The calculated catch per hour was 7.3. Only one trout was taken in these collective sets of 2 1/2 inch mesh nets. The 3 inch nets took 67 ciscoes and no trout in 18 fishing hours, producing a catch of 3.7 fish per hour.

Table 1

Catch Record of Evening Parallel Sets

Using Two and One-Half Inch Mesh Nets

| Net number | Station | Fishing period | | | | Fish caught | |
| | | Began | Ended | Total | | | Rainbow |
				Hours	Minutes	Ciscoes	trout
7	8	4:30 p.m.	10:00 p.m.	5	30	49	...
5	2	5:00 p.m.	10:30 p.m.	5	30	27	...
7	8	5:15 p.m.	10:50 p.m.	5	35	49	...
Private	8	5:15 p.m.	11:00 p.m.	5	45	14	1
Private	8	4:45 p.m.	10:30 p.m.	5	45	65	...
Total				28	05	204	1

Table 2

Catch Record of Evening Parallel Sets

Using Three Inch Mesh Nets

| Net number | Station | Fishing period | | | | Fish caught | |
| | | Began | Ended | Total | | | Rainbow |
				Hours	Minutes	Ciscoes	trout
60	2	5:30 p.m.	9:30 p.m.	4	...	22	...
8	1	6:30 p.m.	10:30 p.m.	4	...	26	...
8	4	5:30 p.m.	9:30 p.m.	4	...	15	...
60	4	5:00 p.m.	11:00 p.m.	6	...	4	...
Total..				18		67	0

Nets set perpendicular to shore, consisting of 11 sets were composed of five $2\frac{1}{2}$ inch nets and six 3 inch. Tabulated below in tables 3 and 4 are the collective data for these perpendicular sets. The $2\frac{1}{2}$" nets fished a total of 23.5 hours catching a total of 224 fish composed of 222 ciscoes and two rainbow trout. This would represent a catch of 9.4 fish per hour. The proportion of trout to ciscoes would be 1 to 111.

Table 3

Catch Record of Evening Sets, Placed Perpendicular to Shore

Using Nets of Two and One-Half Inch Mesh

| Net number | Station | Fishing period | | Total | | Fish caught | Rainbow trout |
		Began	Ended	Hours	Minutes	Ciscoes	
55	8	5:00 p.m.	10:40 p.m.	5	40	19	...
5	1	6:00 p.m.	10:00 p.m.	4	...	99	...
7	2	6:00 p.m.	10:00 p.m.	4	...	34	...
7	2	6:00 p.m.	10:00 p.m.	4	...	55	...
Private	8	5:00 p.m.	10:45 p.m.	5	45	15	2
Total				23	25	222	2

Table 4

Catch Record of Evening Sets Placed Perpendicular to Shore

Using Nets of Three Inch Mesh

| Net number | Station | Fishing period | | Total | | Fish caught | Rainbow trout | Perch |
		Began	Ended	Hours	Minutes	Ciscoes		
8	5	4:30 p.m.	10:20 p.m.	5	50	15	1	...
8	8	5:45 p.m.	10:50 p.m.	5	05	8	...	...
60	8	6:00 p.m.	10:50 p.m.	4	50	17	...	2
60	1	5:45 p.m.	9:45 p.m.	4	...	7	1	...
8	4	5:45 p.m.	10:55 p.m.	5	10	28	...	...
8	8	4:30 p.m.	9:00 p.m.	4	30	7	...	...
Total				29	25	82	2	2

The three inch nets took a total of 86 fish composed of 82 ciscoes and 2 of each perch and rainbow trout, in approximately 30 fishing hours, making a calculated catch of 2.8 fish per hour. A proportion of 1 trout to 41 ciscoes was established.

Night sets (in operation between the hours of 10:00 p.m. and 8:30 a.m.) using 2 1/2 and 3 inch uniform gill nets

A total of 14 sets were made at these hours, six of which were placed parallel to shore and the remainder in a perpendicular position. Presented below in Table 5 are the recorded data for these sets. The six parallel sets were composed of equal numbers of $2\frac{1}{2}$ and 3 inch mesh nets.

Table 5

Catch Record of Night Sets (10:00 p.m. to 8:30 a.m.)

Using Nets of Two and One-Half and Three Inch Mesh

Type of set	Net number	Station	Mesh size	Fishing period				Fish caught		
				Began	Ended	Total		Ciscoes	Rainbow trout	Perch
						Hours	Minutes			
Parallel	7	8	$2\frac{1}{2}"$	10:15 p.m.	8:30 a.m.	10	15	4	...	2
"	7	8	$2\frac{1}{2}"$	10:50 p.m.	8:15 a.m.	9	25	5	...	...
"	5	2	$2\frac{1}{2}"$	10:30 p.m.	8:30 a.m.	10	...	24	...	...
"	60	4	3"	11:00 p.m.	8:00 a.m.	9	...	...	2	...
"	8	1	3"	10:30 p.m.	8:00 a.m.	9	30	4	...	...
"	60	2	3"	10:30 p.m.	8:30 a.m.	10	...	4	...	...
Perpendicular	7	2	$2\frac{1}{2}"$	11:00 p.m.	8:00 a.m.	9	...	1	...	1
"	7	2	$2\frac{1}{2}"$	10:45 p.m.	8:10 a.m.	9	30	12	...	...
"	5	1	$2\frac{1}{2}"$	11:00 p.m.	8:00 a.m.	9	...	2	...	...
"	55	8	$2\frac{1}{2}"$	10:40 p.m.	7:00 a.m.	8	20	...	...	...
"	60	1	3"	10:45 p.m.	7:45 a.m.	9	...	9	...	...
"	60	8	3"	10:50 p.m.	7:45 a.m.	8	55	...	...	1
"	8	5	3"	10:20 p.m.	8:20 a.m.	10	...	2	1	...
"	8	4	3"	10:55 p.m.	8:15 a.m.	9	20	9	1	...
Total						131	15	76	4	4

The $2\frac{1}{2}$ inch nets took a total of 35 fish composed of 33 ciscoes and two perch in a 30 hour period representing a calculated catch of 1.16 fish per hour. The 3 inch mesh nets took a total of 10 fish, composed of 8 ciscoes and 2 rainbow trout in a 28 hour period, making a calculated catch of 0.35 fish per hour.

The eight perpendicular sets were equally divided into $2\frac{1}{2}$ and 3 inch mesh nets. The former mesh size took 16 fish including one perch in 36 hours of fishing, representing a catch of 0.44 fish per hour; while the 3 inch nets took 23 fish, including two rainbow trout and one perch in 37 hours, having a calculated catch of 0.62 fish per hour.

All night sets (in operation between the hours of 5:00 p.m. and 8:30 a.m.) using uniform $2\frac{1}{2}$ and 3 inch gill nets

A total of six sets were recorded for this period, four of which were made with the three inch mesh, equally divided into parallel and perpendicular positions. The remaining two nets of $2\frac{1}{2}$ inch mesh were placed perpendicular to shore. Presented below in Table 6 is the fish capture record for these sets. The catch per hour for the three inch nets set perpendicular to shore was 1.09 and for the $2\frac{1}{2}$ inch nets 2.0. The 3 inch nets set parallel to shore had a catch per hour of 0.21 fish. Two trout, one of each rainbow and brown were taken in the 3 inch mesh nets.

Table 6

Catch Record of All Night Sets

Using Nets of Two and One-Half and Three Inch Mesh

Type of set	Net number	Station	Mesh size	Total hours fished		Fish captured		
				Hours	Minutes	Ciscoes	Rainbow trout	Brown trout
Parallel	60	8	3"	14	30	1	1	1
"	8	1	3"	13	15	3	...	...
Perpendicular	8	8	3"	13	15	23	...	...
"	60	5	3"	13	15	6	...	...
"	5	3	$2\frac{1}{2}$"	15	...	32	...	...
"	5	8	$2\frac{1}{2}$"	15	...	28	...	...
Total				84	15	93	1	1

All night sets (in operation between 5:00 p.m. and 8:30 a.m.) using experimental gill nets

As mentioned in the introduction each experimental gill net is composed of five mesh sizes, the net being equally divided into specific sections starting

at one end with an inch and one-half mesh and terminating at the other with a four inch section. Five of these nets were placed in shallow water for the purpose of determining the most suitable mesh size for the taking of ciscoes and in comparison, the selective sizes which would be more liable to take other species. The findings from these sets are presented below in Table 7.

Table 7

Recorded Catch of Fish In Experimental Gill Nets

Fish caught	Sectional mesh size in inches (stretch measure)				
	$1\frac{1}{2}$"	2"	$2\frac{1}{2}$"	3"	4"
Ciscoes	3-	8	49	32	6
Perch	0	1	1	1	0
Rainbow trout	0	0	0	1	0
Brown trout	0	0	0	1	0
Total	3	9	50	35	6

A total of 103 fish composed of 98 ciscoes, three perch and one of each rainbow and brown trout. About 85 per cent of the total catch were taken were taken in the $2\frac{1}{2}$ and 3 inch sections, also, both trout were taken in the 3 inch mesh section. These five sets more or less verify the expected catch when using $2\frac{1}{2}$ and 3 inch mesh gill nets.

SETS MADE IN 10 TO 25 FEET OF WATER

A total of 16 sets were made within a depth range of 10 to 25 feet. Six of these were set perpendicular to shore and the remaining 10 placed parallel.

Perpendicular sets (evening and all night) $2\frac{1}{2}$ and 3 inch uniform gill nets

The six sets placed perpendicular to shore fished a total of 65 hours, taking 304 fish representing a catch per hour of 4.6. One net of each mesh size, $2\frac{1}{2}$ and 3 inch, were evening sets (5:00 p.m. to 11:00 p.m.); the $2\frac{1}{2}$ inch net took 105 fish in about 4 hours, representing a catch per hour of

26 fish. The figure above includes 4 perch which were taken in this net.

Presented in Table 8 is the tabulated data for the perpendicular sets.

Table 8

Fish Capture Record of Nets in Operation During

Evening and All Night --Perpendicular Sets

Net number	Station	Mesh size (inches)	Hours fished		Fish caught	
			Hours	Minutes	Ciscoes	Perch
7	8	$2\frac{1}{2}$	4	15	101	4
7	8	$2\frac{1}{2}$	....	...	...	3
5	8	$2\frac{1}{2}$	15	...	61	7
7	5	$2\frac{1}{2}$	15	30	97	...
8	8	3	4	30	14	...
8	5	3	16	12	17	...
Total			55	27	290	14

The 3 inch net (evening set) took 14 ciscoes in 4.5 hours representing a catch of 3.1 fish per hour. The overnight sets were composed of two nets of $2\frac{1}{2}$ inch mesh and one set of a 3 inch mesh net. One of the above sets had to be omitted in calculation, due to lack of the time data. The catch per hour for the $2\frac{1}{2}$ inch nets was 5.4 and 1.1 for the 3 inch net.

Parallel sets (evening and all night) $2\frac{1}{2}$ and 3 inch uniform gill net

A total of 10 sets was made, composed of 9 nets of $2\frac{1}{2}$ inch mesh and one 3 inch. The 10 sets fished a total of 110 hours taking 435 fish representing a catch of 4.9 fish per hour. Presented in Table 9 is the capture data for these sets.

The evening sets of $2\frac{1}{2}$ inch mesh fished a total of about 11 hours taking 109 ciscoes, representing a catch of 11.0 fish per hour. The all night sets composed of 8 nets, 7 of which were $2\frac{1}{2}$ inch mesh and one 3 inch mesh, took a total of 326 fish in about 100 hours representing a catch of 3.2 fish per hour. Of the 326 fish, 320 were ciscoes, or a very high proportion.

Table 9

Fish Capture Record of Nets in Operation

During Evening and All Night--Parallel Sets

Net number	Station	Mesh size (inches)	Hours fished		Fish caught					
			Hours	Minutes	Ciscoes	Perch	P'seed	Brown trout	Bluegill	Largemouth bass
5	5	$2\frac{1}{8}$	13	05	41	1	1	...	...	...
5	8	$2\frac{1}{2}$	9	...	...	...	...	...	...	...
5	8	$2\frac{1}{8}$	4	45	50	...	...	...	...	...
Private	1	$2\frac{1}{8}$	5	40	40	...	...	...	...	...
Private	1	$2\frac{1}{8}$	5	40	69	...	...	...	...	...
55	4	$2\frac{1}{8}$	14	20	42	...	...	...	1	1
5	9	$2\frac{1}{8}$	14	...	61	...	...	...	...	...
7	10	$2\frac{1}{8}$	14	55	70	...	...	...	...	...
Private	9	$2\frac{1}{2}$	13	50	42	1	...	1	...	...
60	5	3	15	20	14	...	...	...	...	...
Total			110	35	429	2	1	1	1	1

SETS MADE IN WATER DEEPER THAN 25 FEET

A total of 12 sets were made in depths ranging from 25 to 95 feet of water. Ten of the 12 nets used in these sets were of the experimental gill net type and the remaining two consisted of $2\frac{1}{2}$ inch and 3 inch mesh. Presented in Table 10 is the compiled data for these deep water sets.

Table 10

Capture Record of Nets Set in Water

Ranging From 25 to 95 Feet Deep

Net number	Station	Type of nets	Fish caught					
			Ciscoes		Perch	Bluegill	Green Sunfish	P'seed
			Male	Female				
60	8	3" mesh	5	2	1	...	...	...
7	3	$2\frac{1}{2}$" mesh	19	4	4	1	...	...
9	11	Exp. gill	3	7	4	...	1	...
89	11	" "	2	6	1	...	...	...
1	11	" "	2	4	1	1	...	...
14	11	" "	3	3	2	...	...	...
14	6	" "	18	5	...	...	...	...
1	6	" "	11	2	...	...	...	...
89	6	" "	10	1	...	...	...	1
9	6	" "	7	2	...	...	...	...
14	6	" "	5	0	...	...	...	...
89	5	" "	6	14	3	...	...	...
Total			91	50	16	2	1	1

A total of 161 fish were taken in the above sets,of which 141 were ciscoes representing 87 percent. These nets were set at various hours of the day and due to the fact that two different types of nets were used, no catch per hour was computed. The significant point derived from table 10 is the greater proportion of other fish taken to ciscoes in these deep water sets. Another point of interest is that as in the shallow water sets when experimental gill nets were used, the greatest proportion of fish taken were in the $2\frac{1}{2}$ and 3 inch mesh sections.

Although parts of the field data derived from private net investigations were used (when found valid and justifiable) in the preceeding discussion, as well as parts of the information obtained from suspended sets, it is thought desirable to present this information also under separate heading. Consequently, suspended sets, private nets and the total catch from all of the field stations are discussed separately.

SUSPENDED NETS

As a possible method of cisco harvest, a technique of suspending nets at various depths from the surface was tried out. (Floating nets are forbidden in the present cisco fishing regulation.) This was accomplished by using two-gallon screw cap oil cans as master buoys, evenly spaced along the net and connected to the float line by select lengths of ropes. With a net, ten rods in length, four floats evenly spaced along the linear distance were found to be needed to assure good buoyancy. The process of making one of these sets consisted of anchoring one end of the net to the bottom by using a long anchor rope; then to attach master buoys at equal distances as the net is being played out. The suspension depth of the net will depend upon the length of rope between the master buoys and net float line. A long anchor rope is attached to the remaining free end of the net and pulled tight before releasing. This last operation is essential to

assure a tight net without sags. One caution to take in making this type
of a set is to be sure that the end anchor ropes are of a sufficient
length to allow for suspension. A simple criterion to follow is to have
anchor ropes of lengths equal to the depths of water where the set is
anticipated.

A total of 10 sets were made in this manner, being suspended from
the surface at depths ranging from 5 to 14 feet. The results of eight of
the 10 sets are presented in Table 11. The two remaining sets are omitted
from the table, due to the fact that they were so near the bottom that in
reality they were technically not suspended nets. The results of these
two sets will be discussed in a later paragraph. A total of 269 fish were
taken in the eight sets in a fishing period of 107 hours, representing a
catch of 2.5 fish per hour. Of the 269 fish, 265 were ciscoes or 98 per-
cent of the total catch. Only one net was set and lifted during the evening
run. This net (number 7) took 58 fish in five hours of fishing, representing
a catch of 11.6 fish per hour. It could be expected, from the results of
other evening sets, that all of the above suspended nets took the greater
proportion of fish during the evening hours. Assuming that this condition
did exist, and that five hours was the average fishing period for each net,
then the expected catch per hour would be 6.7 even though two sets failed
to take a fish.

Table 11

Recorded Fish Capture in Suspended Nets

Net number	Station	Mesh size	Hours fished		Water depth range in feet	Suspension depth in feet	Fish caught			
			Hours	Minutes			Ciscoes		Perch	Largemouth bass
							Male	Female		
8	8	3"	14	...	32-35	10	...	...	...	...
60	8	3"	14	...	33-35	10	...	...	...	...
55	8	$2\frac{1}{2}"$	15	15	24-34	12	34	3	...	...
5	8	$2\frac{1}{2}"$	15	...	34-38	5	8	1	1	...
7	8	$2\frac{1}{2}"$	14	05	28-34	14	6	1	...	...
7	8	$2\frac{1}{2}"$	5	...	17-28	10	54	1	2	1
5	8	$2\frac{1}{2}"$	15	45	14-25	5	27	2	...	...
55	8	$2\frac{1}{2}"$	14	...	16-26	5	125	3	...	...
Total			107	05			254	11	3	1

The above nets were suspended at different depths from the surface in varying water depths, ranging from 14 to 35 feet, thus some sets would be nearer to bottom than others. Those nets which were suspended closest to the bottom took a greater proportion of other fish to ciscoes than those of higher elevation. As an example, two sets not included in Table 12, though set as suspended nets, being dropped five feet from the surface before soundings were made, were found at later soundings to be partially resting on the bottom, as the water depth ranged from 10 to 12 feet. As a result, one of these nets (see Plate I for set record) took 12 perch and one large mouth bass near the lead line and two ciscoes in the upper portions. The other net took five perch near the lead line (see Plate II for set record) and 20 ciscoes in the upper portions, near the float line. The results of these two sets clearly indicate that the ciscoes were occupying the upper layers of water, while the perch were hovering near the bottom. A good illustration of this vertical distribution of fishes is presented in Plate III, a field record sheet for net number eight, set on the night of December 8. This net was suspended 10 feet from the surface over water varying in depth from 17 to 28 feet. This would place one end of the net (5 feet wide) two feet off of the bottom, while the other end of the net would be 13 feet from the bottom. That end of the net nearest to the bottom took two perch and one largemouth bass near the lead line and only ciscoes in the upper meshes. The other end of the net took only ciscoes, of which all were captured at least 18 inches above the lead line.

PRIVATE NETS USED DURING THE CISCO INVESTIGATION

A total of six private nets were used during the investigation. These nets were owned by local fishermen and were used by these men in taking ciscoes from various cisco lakes. During our investigation they were used

SUSPENDED NET, TOP FIVE FEET FROM SURFACE, SHOWING APPROXIMATE FISH CAPTURE POSITIONS

FISH NETTING RECORD

Date 12/8 Net No. 8   Station 8 Wind Dir. W.   Sky Cl'dy Temp: Water 30° Air 38° Time set was made 5:15 p.m.

Time lifted 8:35 a.m. Type of set: Floating from surface (x) Bottom ( ) Position to shore: Parallel (x) Perpendicular (.)

Fish Capture Record

Depth of water: Shallow end 10 feet   Top of net   Depth of water: Deep end 12 feet

Bottom of net

Directions: Record the fish in the diagrammatic net above in relatively the same position as captured in the net. Use a different symbol for each species and supply a key for symbols used.

Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight

(continued over)

Record marked fish on back. *Preserved as specimens. **Stomach preserved.

X   Cisco
O   Yellow perch   (Copy from field record sheet)
Δ   Largemouth bass

Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight

PLATE II

SUSPENDED NET, TOP FIVE FEET FROM SURFACE, SHOWING APPROXIMATE FISH CAPTURE POSITIONS

FISH NETTING RECORD

Date 12/8 Net No. 60 Station 8 Wind Dir. W Sky Cl'dy Temp: Water 38° Air 37° Time set was made 5:20 p.m.

Time lifted 8:40 a.m. Type of set: Floating from surface (x) Bottom ( ) Position to shore: Parallel (x) Perpendicular ( ).

Fish Capture Record

Depth of water: Shallow end 10 feet   Top of net   Depth of water: Deep end 11 feet

Directions: Record the fish in the diagrammatic net above in relatively the same position as captured in the net. Use a different symbol for each species and supply a key for symbols used.

Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight

(continued over)

Record marked fish on back. *Preserved as specimens. **Stomach preserved.

X   Cisco
O   Perch

(Copy from field record sheet)

(Continued)

Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight

PLATE III

SUSPENDED NET, TOP TEN FEET FROM SURFACE, SHOWING APPROXIMATE FISH CAPTURE POSITIONS

FISH NETTING RECORD

Date 12/8 Net No. 7   Station 8   Wind Dir. W   Sky Cl'dy Temp: Water 38° Air 38° Time set was made 5:45 p.m.

Time lifted 10:45 p.m. Type of set: Floating from surface (x) Bottom ( ) Position to shore: Parallel ( ) Perpendicular (x).

Fish Capture Record

Depth of water: Shallow end 17 feet   Top of net   Depth of water: Deep end 28 feet

Bottom of net

Directions: Record the fish in the diagrammatic net above in relatively the same position as captured in the net. Use a different symbol for each species and supply a key for symbols used.

Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight

(continued over)

Record marked fish on back.   *Preserved as specimens.   **Stomach preserved.

X Cisco
O Yellow perch
△ Largemouth bass

(Copy from field record sheet)

Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight

for the purpose of collecting data for comparison with the Institute nets. These nets were 10 rods in length, six to eleven feet deep and of a two and one-half inch mesh. Four of the six nets were set by the owners at locations of their own choosing. The remaining two sets were placed in locations according to our instructions. Presented below in Table 12 are the results of these sets.

Table 12

Fish Capture Record for Private Nets

Owners	Depth of net	Mesh size (inches)	Depth of water at set	Time of set			Fish captured			
				Interval	Duration		Ciscoes	Rainbow trout	Brown trout	Perch
					Hours	Minutes				
1	6'	$2\frac{1}{2}$"	7-9'	p.m. 5:00-10:45	5	45	15	2	...	...
2	6'	$2\frac{1}{2}$"	7-8'	p.m. 5:15-11:00	5	45	20	1	...	...
3	6'	$2\frac{1}{2}$"	8-10'	p.m. 4:45-10:30	5	45	65	...	...	...
4	11'	$2\frac{1}{2}$"	16-25'	p.m.-a.m. 5:45-7:30	14	...	42	...	1	1
5	10'	$2\frac{1}{2}$"	18-24'	p.m.-a.m. 5:30-7:35	14	...	28	...	...	...
6	8'	$2\frac{1}{2}$"	10-13'	p.m. 5:20-11:00	5	40	63	...	...	...
Total					50	55	233	3	1	1

The six nets fished a total of 51 hours taking 238 fish, representing a catch of 4.6 fish per hour. Those nets set in the evening took 163 fish in about 23 hours, representing a catch of 7.0 fish per hour. The two nets fishing all night took 72 fish in 28 hours, making a catch of 2.5 fish per hour. The total catch of 238 fish included four trout and one perch. Three of the four trout were taken in water less than 10 feet deep.

COMPARISON OF THE ACCUMULATIVE DATA

FROM ALL OF THE EXPERIMENTAL AND STRAIGHT GILL NETS SET

As mentioned on page 4, a total of 19 experimental gill net sets and 67 straight net sets were used in these operations. By combining these data as to catch record (see Table 13 below) it can be well illustrated that the two and one-half and three inch mesh nets are the most productive in taking ciscoes.

Table 13

Total Fish Capture Per Section

In Experimental and Straight Gill Nets

Section of net	Experimental gill nets 5 mesh sizes in each net Total fish capture in various mesh sizes						Straight gill nets of 2½ and 3 inch mesh Total fish capture	
	1½ inch	2 inch	2½ inch	3 inch	4 inch	Per cent of total	Number per 25' section	Per cent of total
1	9					3.5	374	19.2
2		32				12.6	413	21.3
3			116			45.8	385	19.8
4				75		29.6	360	18.5
5					21	8.3	407	20.9
Total	9	32	116	75	21	99.8	1,939	99.7

The total catch from the experimental gill nets was 253 fish, of which 191 or approximately 75 per cent were taken in the 2½ and 3 inch sections. (See plate IV typical field sheet, showing mesh selectability) In contrast, the uniform mesh gill nets did not show such discrepancy, each section, more or less, possessing an equal capture record. (See Plate V typical field sheet, showing uniformity of capture) Another point which is brought out in Table 13 is the fact that these uniform gill nets took as many fish in the terminal sections as in the middle, indicating that ciscoes show very little tendency to lead. This finding would discredit any thought that perhaps the reason for the greater capture in the middle sections of the experimental gill nets was due to fish leading along the finer mesh of the one end.

PLATE IV

DISTRIBUTION PATTERN OF FISH CAPTURED IN EXPERIMENTAL GILL NET (COPY FROM ORIGINAL FIELD SHEET)

FISH NETTING RECORD

Date 11/30 Net No. 14   Station 3 Wind Dir. SW   Sky Clear Temp: Water 38° Air 30° Time set was made 5:30 p.m.

Time lifted 4:00 p.m. Type of set: Floating from surface ( ) Bottom (x) Position to shore: Parallel ( ) Perpendicular (x)
12/1

Fish Capture Record

Depth of water: Shallow end 4 feet   Top of net   Depth of water: Deep end 7 feet

(1)	(2)	(3)	(4)	(5)
(1½ inch mesh)	(2 inch mesh)	(2½ inch mesh)	(3 inch mesh)	(4 inch mesh)

Bottom of net

Directions: Record the fish in the diagrammatic net above in relatively the same position as captured in the net. Use a different symbol for each species and supply a key for symbols used.

Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight

(continued over)

Record marked fish on back. *Preserved as specimens. **Stomach preserved.

X   Cisco

(Continued)

Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight

PLATE V

DISTRIBUTION PATERN OF FISH CAPTURED IN UNIFORM TWO AND ONE-HALF INCH GILL NET SET IN SHALLOW WATER

FISH NETTING RECORD

Date 12/5 Net No. 7 Station 8 Wind Dir. N Sky Cl'dy Temp: Water 36° Air 38° Time set was made 4:30 p.m.

Time lifted 10:15 p.m. Type of set: Floating from surface ( ) Bottom (X) Position to shore: Parallel (X) Perpendicular ( ).

Fish Capture Record

Depth of water: Shallow end 7 feet   Top of net   Depth of water: Deep end 8 feet

(1)   (2)   (3)   (4)   (5)

Bottom of net

Directions: Record the fish in the diagrammatic net above in relatively the same position as captured in the net. Use a different symbol for each species and supply a key for symbols used.

Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight

(continued over)

Record marked fish on back. *Preserved as specimens. **Stomach preserved.

X   Cisco
O   Yellow perch

(Note: Copy from original field sheet)

-22-

Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight

DISTRIBUTION RECORD OF ALL SETS

During this investigation sampling was conducted at 11 stations (see
distribution map of lake, page 24) distributed at various intervals around
the entire lake. Presented in Table 14 is the total catch record for each
station listing the fish by species.

Table 14

Fish Capture Record According to Stations

Species	Station numbers and total fish taken at each											
	1	2	3	4	5	6	7	8	9	10	11	
Ciscoes	274	179	161	137	210	61	20	835	131	70	30	2,108
Perch	...	1	4	4	4	...	1	40	1	...	7	62
Rainbow trout	1	...	...	3	1	...	1	4	...	...	...	10
Brown trout	...	...	...	1	...	...	...	1	1	...	...	3
Bluegill	...	...	1	1	...	...	...	...	...	...	1	3
Largemouth bass	...	...	...	1	...	...	...	2	...	...	...	3
Pumpkinseed	...	...	...	...	1	1	...	...	...	...	...	2
Green sunfish	...	...	...	...	...	...	...	...	...	...	1	1
Brown bullhead	...	1	...	...	...	...	...	...	...	...	...	1
Total	275	181	166	147	216	62	22	882	133	70	39	2,193

Ciscoes were taken at each of the 11 stations, perch at 8, rainbow trout
at 5, brown trout and bluegills at 3, largemouth bass and pumpkinseeds at
2 and one of each for the green sunfish and bullhead. Some stations were
sampled lightly while others extensively, this was just chance as no
definite procedure was followed for a limit of sets per station.

SUMMARY OF NETTING OPERATIONS AND CONCLUSIONS

Species of fish taken during the investigation

A total of 86 sets, distributed over 11 stations, produced 2,193
fish composed of 2,108 ciscoes, 62 perch, 10 rainbow trout, 3 brown trout,
3 bluegills, 3 largemouth bass, 2 pumpkinseeds and one of each green
sunfish and bullhead. The ciscoes accounted for 96 per cent of the total
catch. Of the 13 trout taken, 10 were released unharmed, as they were not
gilled, but only tangled in the net by their teeth. Most of the above
trout were taken in shallow water sets (3-10 feet) in nets of 3 inch mesh.

LEGEND

BOTTOM
- ☐ Sand
- ☐ Marl
- ☐ Pulpy peat
- Gravel
- Spawning beds

OUTLINE & CONTOURS
- ⌒ Shoreline
- —⟋— Contours

SHORE FEATURES
- ♣ Brush
- ⌣ Marsh
- Ⓦ Wooded
- ⬤ Partly wooded
- Ⓟ Pasture
- ⇌ Outlet

VEGETATION
- T Floating
- I Emergent
- — Submergent

STATIONS
- ① Vegetation station
- Ⓧ₁ Plankton
- Ⓐ₁ Temp.,chem.,analysis
- Ⓓ₁ Temp.,chem.,plankton
- Ⓧ₁ Bottom sample
- Ⓑ₁ Bottom sample for chem.,analysis
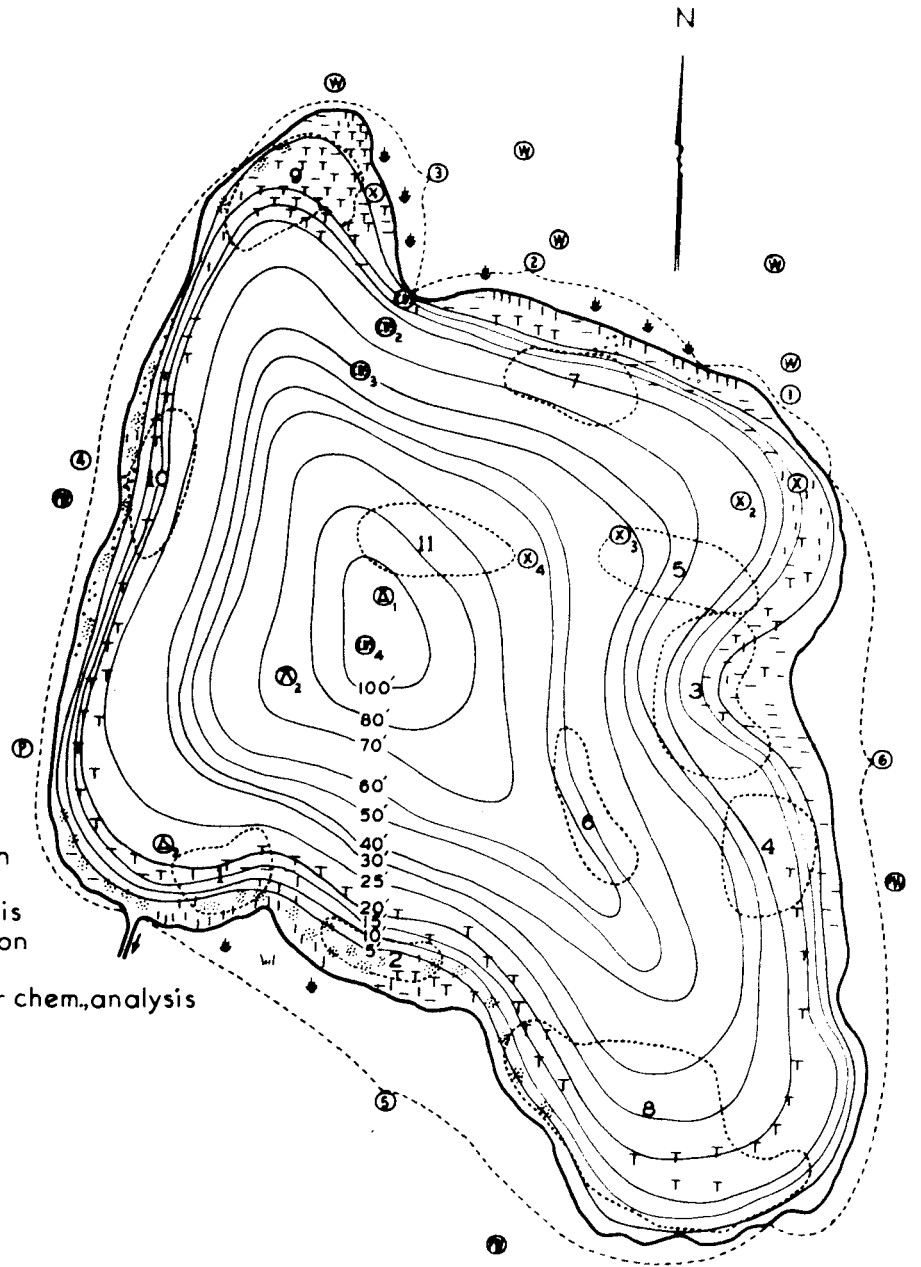
INSTITUTE FOR FISHERIES RESEARCH

DIVISION OF FISHERIES   MICHIGAN CONSERVATION DEPT.

LAKE INVENTORY MAP

BIRCH LAKE

AREA 308.8 ACRES

MARGINAL SURVEY AND SOUNDINGS   7/6/37

CASS COUNTY   T. 7 S., R. 13 W., SEC'S. 5, 6, 7, 8

0   500'
SCALE

The most numerous species taken in deep water, other than ciscoes was perch.

Types of sets

1) Whether a set is made parallel or perpendicular to shore is of little significance; the catch per hour and selection of species was found to be little altered, as can be seen from the data in Table 16.

Table 16

Comparison By Catch Per Hour of Various Sets

Made in Water Depths Ranging Up to Twenty-Five Feet

Mesh size in inches	Fishing period and catch per hour			Depth of water (feet)	Type of set
	5:00 p.m. to 11:00 p.m.	11:00 p.m. to 8:30 a.m.	5:00 p.m. to 8:00 a.m.		
2.5	7.3	1.16	...	3-10	Parallel
2.5	9.4	.44	2.0	3-10	Perpendicular
3.0	3.7	.35	.21	3-10	Parallel
3.0	2.8	.62	1.09	3-10	Perpendicular
2.5	13.5	...	5.40	10-25	Parallel
2.5	9.9	...	3.30	10-25	Perpendicular
3.0	3.1	...	1.0	10-25	Parallel
3.0	...	...	.91	10-25	Perpendicular

Evening sets of $2\frac{1}{2}$ inch mesh recorded a catch per hour of 7.3 to 9.4, and 9.9 to 13.5 in water depths of 3 to 10 feet and 10 to 25 feet respectively, regardless of the type of set. Sufficient data were not available to apply this condition with nets of other mesh size or at other hours.

2) The fishing period (hours at which the net is in actual fishing operation) and the mesh size of the nets are important factors to be considered. Nets fishing between the hours of 5:00 p.m. and 11:00 p.m. of $2\frac{1}{2}$ inch mesh had an average catch per hour of 8.3 in 3-10 feet of water and 11.7 in 10-25 foot depths. In contrast these same nets at other hours (11:00 p.m. to 8:30 a.m. and 5:00 p.m. to 8:30 a.m.) had an average catch of 0.8 and 2.0 (see Table 13) in the 3-10 foot depths. (The only comparable data.) Nets of 3 inch mesh also exhibited this same characteristic, though the catch per hour being much lower. The average

catch per hour in 3-10 feet of water was 3.3 for the evening sets, 0.48 for the night sets and 0.65 for the all night sets. No comparative data are available for the deeper water sets. Therefore the evening fishing (5:00 p.m. to 11:00 p.m.) was found to be the most productive time for the taking of ciscoes.

3) Shallow water sets (3-10 feet) in operation between 5:00 p.m. and 11:00 p.m. took a total of 582 fish composed of 575 ciscoes, 5 rainbow trout and two perch (see pages 5-8). At the same time those sets operating in 10 to 25 feet of water took 719 ciscoes, 16 perch and one of each pumpkinseed, brown trout, bluegill and largemouth bass. The significant point is that while 5 trout were taken in the shallow water (3-10 feet) making a proportion of 1 trout to 115 ciscoes, only 1 trout to 719 ciscoes was taken in the 10 to 25 foot zone. However, the low proportion of trout recorded for the latter depths was somewhat offset by the fact that 16 perch and one of each of the 3 other species mentioned above were netted. Since these other species spawn in the lake and trout do not, netting some perch and a few bass would not be serious. Briefly in summarizing the above paragraph, a greater proportion of ciscoes to other fish (trout) as well as a higher productive rate was found to be present when netting was confined in the 10 to 25 foot depth zone.

4) The depth of water in relation to fish segregation and movements is only partially responsible for the heavier take of trout in the shallow water, as findings indicate that the specific mesh size of nets plays an important part. Nets of $2\frac{1}{2}$ inch mesh (evening sets) took a proportion of 1 trout to every 142 ciscoes while those of 3 inch mesh had a ratio of 1 to 75. Nets in operation between 11:00 p.m. and 8:30 a.m. had a ratio of 1 trout to 20 ciscoes for the $2\frac{1}{2}$ inch mesh and 1 to 4 for the 3 inch mesh. As only 45 fish were present in the above collections,

these data are undoubtedly somewhat in error, but are inserted to indicate the contrast in mesh selection. Conclusion: Nets of $2\frac{1}{2}$ inch mesh were found to be the most productive size for the taking of ciscoes and at the same time offered the least interference to trout.

5) Suspended nets proved to be highly productive and selective to ciscoes if operated correctly. Nets suspended at varying depths had a high rate of capture; the fish per hour was calculated at 11.6 for evening fishing. Suspended nets, if kept several feet from the bottom will take ciscoes only, as indicated in the results of this test where out of a total of 269 fish, 265 were ciscoes. However if this type of a set is placed in deep water and is allowed to sag on bottom, large numbers of perch will be taken.

6) Fish disposal: A large number of fish (2,193) were taken from Birch Lake during the netting operations. The largest bulk of these fish, (2,108) ciscoes, with the exception of about 100 pounds which were furnished to Michigan State College for taste tests, were sold locally at the rate of five cents per pound. A total of 177 sales were made represented by purchases from 142 different people. The total sales amounted to $46.35. As the demand was much greater than the supply, a limit of five pounds per person was imposed to assure a better distribution. Care was also taken during this disposal to allow new customers first choice from each days catch.

<div align="center">

GENERAL OBSERVATIONS DURING

THE CISCO INVESTIGATION

</div>

1. <u>Spawning Observations</u>

Spawning had begun in the fall of 1943 a few days before the investigation started, according to Ruel Harvey, local lake resident, who reported seeing a considerable amount of surface commotion. At the

beginning of the investigation ciscoes were observed in shallow water (2 to 6 feet) on several large shoal areas. It was noted that these fish were more abundant over areas which were sparsely covered with aquatic vegetation. The fish were seen darting about singly and in pairs, occasionally coming to the surface and splashing the water. The appearance of these fish on shoals would take place just before dark or at about sunset and continue until 10:00 p.m. As the spawning season progressed and passed the peak, less activity was noted on the shoals and later this entirely subsided. Likewise, the shallow sets of gill nets took more fish during the earlier part of the season, indicating a shift in the location and movement of the fish.

2. Age and growth of the Birch Lake ciscoes

A total of 200 scale samples were collected between December 1 and 9 during the current investigation. The ciscoes representing these samples were also weighed and measured. In addition to the above sample four other collections from Birch Lake were studied, (1937[1], 1938[2], 1939[3] and 1944[4]) and the age group determined.[*] Presented in Table 15 are the results of this study.

Most of the ciscoes in Birch Lake apparently mature during their fourth year of life, as the largest percentage (83.0) of this collection was represented by this group. From samples secured in 1937, 1938, and 1939 and compared with the later samples, a rapid growth is present during the first two years of life. Three specimens in their second year of life from the 1937 collection had an average length of 242 mm., while 3 other specimens from the same collection in their fifth year averaged

---

[1] Collections taken from Birch Lake 7/7 and 8/37 by C.J.D. Brown
[2] [3] Collections taken from Birch Lake on 9/15/38 and 8/25/39 by R. Ball
[4] Collections taken from Birch Lake on 2/18/44 by A. S. Hazzard and G. N. Washburn
[*] Age determination by G. N. Washburn.

only 338 mm. This indicates that the growth was very rapid in the first
two or three years of life, slowing up during the latter years. From the
1943 collection this condition is also manifest, exemplified by fish in
their third and fourth year. The three year fish have attained a length
of 303 mm. while the fourth year fish are only 305 mm., indicating again
that growth slackened after the third year. As only a few specimens were
collected representing age group two and none for age group one, it is
surmised that the larger majority of the Birch Lake ciscoes do not reach
maturity until the fourth year of life. It appears from these collections
that the average survival of these fish does not extend much beyond six
years, or a larger collection representing this group would be present.

Table 15

Comparative Growth Data of Birch Lake Ciscoes

Age Group and No. of specimens	Time of collection and total lengths in millimeters (average)					
	7/7/37	7/8/37	9/15/38	8/25/39	12/1-10/44	2/18/44
I	242.3	239.0	237.0	211.0	...	...
No. of specimens	(3)	(1)	(1)	(2)	...	...
II	292.5	245.3	265.2	274.0	303.8	290.5
No. of specimens	(4)	(3)	(14)	(1)	(6)	(2)
III	...	...	285.0	281.3	305.6	308.6
No. of specimens	...	...	(1)	(8)	(160)	(5)
IV	338.3	...	...	316.0	312.2	339.3
No. of specimens	(3)	...	...	(1)	(23)	(3)
V	...	...	...	...	349.0	...
No. of specimens	...	...	...	...	(3)	...
VI	...	...	...	402.0	...	390.0
No. of specimens	...	...	...	(1)	...	(1)
IX	...	...	...	...	447.0	...
No. of specimens	...	...	...	...	(1)	...

Very little work has been done on the age-weight relationship as our
specimens collected in the fall of 1943 were represented by such a large
single age group. The weight for these fish was roughly 8 ounces per fish.

The largest specimen taken from the lake (age group IX) weighed 1 pound 15 ounces.

3. Other observations

The largest take of fish in the nets was during the first three days of the investigation. The numbers of fish taken appeared to be somewhat influenced by the weather conditions; cold, dark, stormy nights were found to be the best for production. Poor runs were observed during moonlight nights, in contrast more perch and other species were taken during these nights. During the entire investigation the water temperature ranged between 37° and 40° F. at the surface. Fish taken in shallow water sets were usually found near the mid-portion of the net; very few being present near the lead or float line (see Plate V for characteristic shallow water field sheet record). When nets extended from shallow water (3 feet) into deeper water (15 feet) the fish were present in all areas of the net (see Plate VI) at the deeper end and only through the mid-section at the shallow set portion.

<div align="center">RECOMMENDATIONS</div>

That Birch Lake be opened to the taking of ciscoes for the next three years beginning in the fall of 1944 under certain restrictions as follows:

a. Harvest - A maximum harvest limit be placed at 20,000 ciscoes for the fall of 1944. According to Bowditch's report this was the approximate number removed in 1939. It is planned to increase the number removed each successive year if possible, in order to determine the maximum crop which can be harvested without affecting the future production.

b. Season - November 25 to December 10 inclusive or if maximum harvest is achieved sooner than December 10 to close lake accordingly. Reason: According to testimony secured from a number of cisco fishermen by interview last fall, the cisco spawning season in Birch Lake is the latest of any

PLATE VI

DISTRIBUTION PATTERN OF FISH CAPTURED IN UNIFORM MESH GILL NET SET IN SHALLOW AND MODERATE DEPTH WATER

FISH NETTING RECORD

Date 12/5 Net No. 5 Station 8 Wind Dir. N. Sky Cl'dy Temp: Water 38° Air 36° Time set was made 5:00 p.m.

Time lifted 8:00 a.m. Type of set: Floating from surface ( ) Bottom (x) Position to shore: Parallel ( ) Perpendicular (x)

Fish Capture Record

Depth of water: Shallow end 5 feet   Top of net   Depth of water: Deep end 14 feet

Bottom of net

Directions: Record the fish in the diagrammatic net above in relatively the same position as captured in the net. Use a different symbol for each species and supply a key for symbols used.

Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight

(continued over)

Record marked fish on back. *Preserved as specimens. **Stomach preserved.

X Cisco

O Yellow perch

(Note: Copy from original field sheet)

-31-

(Continued)

Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight	Species	Section	Length	Weight

in the county and does not begin by the customary November 15 opening date. In this way, by restricting nets to a shorter period, during which the cisco run is the heaviest, a less number of other fish can be expected to be taken.

c. Fishing hours - To be restricted between 5:00 p.m. and 11:00 p.m. (prevailing time). Reason: It was found during the investigation that at this period the largest run of ciscoes was present, hence the heaviest harvest can be expected with a minimum of interference to other species.

d. Water depths - Netting should be restricted within depths of 8 to 25 feet inclusive. Reason: At these depths according to the investigation, the least number of trout was taken. Note: A number of perch can be expected to be taken at these depths but no immediate solution for the protection of this fish is available.

e. Markers for nets - Each net in fishing operation should have a white float marker (minimum size 3" X 6") inscribed with name and address at each end of the net. Reason: This would clearly indicate the set position, thus eliminating the possibility of fishermen crossing each others nets; also the depth of water at which the sets were made could be easily checked.

f. Permits - Each fisherman should be required to obtain a permit each night before setting and to clear his evenings catch through a checking station located at the lake. This is essential in order to determine the number removed and to secure the necessary weights, lengths, scale samples and other data required to follow any changes in the growth rate and condition of the fish which may occur following the removal of any given number of fish.

It is recommended that the Fisheries Division should place a research man in charge of the checking station in order to gather the statistical data.

INSTITUTE FOR FISHERIES RESEARCH

George N. Washburn

Report approved by: A. S. Hazzard

Report typed by: M. Klaphaak