

Original: Fish Division  
cc: Education-Game  
Inst. for Fish. Res.  
Skegomog Association  
J. E. Williams  
C. T. Yoder  
H. L. Thompson  
S. J. Lievense

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

ALBERT S. HAZZARD, PH.D.  
DIRECTOR

September 21, 1954

Report No. 1432

ADDRESS  
UNIVERSITY MUSEUMS ANNEX  
ANN ARBOR, MICHIGAN

CREEL CENSUS AND LIFE HISTORY OBSERVATIONS CONCERNING  
MUSKELLUNGE IN MICHIGAN INLAND WATERS

By

John E. Williams

RECEIVED  
OCT 12 1954

FISH DIVISION

Very little information has been available regarding the muskellunge in Michigan except for its distribution throughout the state. Spawning habits and the contribution of muskellunge to the angler's catch were items on which information was needed in order to manage the species more intelligently. This study was begun in the spring of 1951 when the first of several recent attempts to propagate muskellunge was undertaken. One of the main purposes of this research was to locate an adequate and reliable source of eggs for propagation. Artificial propagation and planting were not being planned on a permanent maintenance basis, but to supply fingerlings for an experimental program. This program was twofold: (1) to determine whether or not fingerling plantings could increase the supply of muskellunge for anglers in lakes in which they already exist, and (2) to determine whether or not muskellunge could be introduced into suitable lakes to produce better muskellunge fishing than exists in native muskellunge lakes.

In order to carry out this program, several steps are involved. To test the effect of fingerling plantings, the following plan must be followed:

1. Spawning habits must be learned at various locations, including the habitat used, and time of spawning.

2. An adequate supply of eggs must be located and collected for propagation.
3. The methods of propagation must be determined and enough fingerlings raised.
4. The present muskellunge population and the angler's catch at the area of proposed stocking must be determined before stocking.
5. Stocking with an adequate number of marked fingerlings should be done.
6. Creel census should be taken after the stocked fish have reached legal size to determine the ratio of stocked to wild fish and the increase to the angler attributable to the stocking.

Introduction of muskellunge into new waters involves not only the above item numbers 1, 2, 3, and 5, but in addition there must be:

7. Determination of the characteristics of an ideal muskellunge lake and selection of a lake (or lakes) which meet these requirements.
8. Creel census or other checking after the fish have been planted to determine survival and to determine the quality of muskellunge fishing after fish reach legal size.
9. Determination of the effect of the muskellunge introduction on the population structure of the native fish present. Since it is hoped that muskellunge can be introduced into at least one lake having a stunted panfish population, it should be possible to determine if this efficient predator can help balance the lake.

Besides attempting to prove whether or not planting or introduction of muskellunge would increase their stocks, present muskellunge research is aimed at another aspect of management; i.e., whether or not increased restrictions on muskellunge fishing would build up the population.

### Spawning habits

Observations have been made on muskellunge spawning habits incidental to the collection of eggs and obtainment of creel census information, at two locations in the northern lower peninsula.

At Torch River (Antrim and Kalkaska counties) in 1945 Mr. George Washburn, then of the Institute staff, attempted to get muskellunge eggs for propagation purposes. No eggs were secured by trapping adults but valuable observations were made on the numbers of muskellunge present in the spawning run. The present author made observations here in 1951 and 1952 while attempting to secure eggs for propagative purposes, and during 1953 while taking creel census and studying spawning habits.

Torch River forms part of the boundary between Antrim and Kalkaska counties and flows from Torch Lake southward for 2-1/2 miles into Round Lake. The river varies from 75 feet wide at Torch Lake (Torch River bridge) to about 300 yards wide at its mouth in Round Lake. The river ranges in depth of channel from 6 to 20 feet. Since the water flows out of Torch Lake, the deepest lake in the state, it is a cold river and its temperature rises slowly in the spring. Sunken logs from old logging drives, and the stubs of dead trees resulting from flooding, cover much of the extensive mud flats along the river. The current ranges from 1/2 mile/hour near Round Lake to 2 miles/hour near Torch Lake.

Mr. Washburn stated in 1945 (activity reports for May and June) that the season was considerably later than usual. The first fish did not appear in Torch River until late in May. Daytime observational trips on the river showed muskellunge to be mostly congregated in the lower one mile of stream in the deeper (6- to 12-foot) water of the channel. Nighttime trips with underwater lights showed conditions just the opposite. All fish seen were in shallow water (1 to 2 feet) near the shore. Very little splashing of

spawning fish was heard although the fish were badly scarred. In the lower stretches of the river 2 and 3 fish were lying side by side, similar to pike during the spawning season. Between June 1 and 15 the highest number of fish seen on one night was 24. During this period males caught by anglers were ripe and badly scarred and one female examined was spent. No actual spawning act was observed nor were any eggs taken.

During the spring of 1951 I operated a trap net in Torch River and was in the vicinity from May 9 to May 24. On May 9, local inhabitants reported that muskellunge were not in the river as yet and a night trip on May 10 confirmed this report. On May 15, two muskellunge were seen with the lights about half way up the river, but they were single fish. Water temperatures at this time were 46° F. at Torch River bridge (outlet from Torch Lake) and 52° F. at the mouth. The Rapid River enters about 1/3 of the distance downstream from Torch Lake and warms Torch River appreciably. (on May 15 Rapid River was 63° F.). In addition, this tributary brings in a heavy load of silt, largely caused by spawning suckers, which obscures visibility on the east side of Torch River all the way to its mouth. During the nights of May 17, 21 and 24 the lights revealed at least 11, 25 and 7 muskellunge, respectively, two pair being seen on each night. Numbers of muskellunge seen should reveal the trend of the spawning season--more fish being seen along the shores at the height of the season than before or after. Trips were usually made covering the major part of the shore area between Rapid River mouth and Round Lake. The trip was made by boat and outboard motor, and at a speed of 3 to 4 miles per hour it usually required from 2 to 3 hours.

Observations were terminated on May 25 when eggs were secured and taken to Drayton Plains hatchery. It is questionable whether spawning was nearly completed by this early date as was assumed at the time because of the small number of fish seen May 24. Fish caught in the trap net were: a green male

on May 20, a ripe male on May 21, a partly ripe (partly green) female on May 23 and a ripe female on May 24.

In 1952, three muskellunge were noted in Torch River by a local resident on May 18, the first day any were seen in the river. (Many of the "natives" here are extremely well versed as to presence or absence of muskellunge in the river. In the past this knowledge has been directly applied to illegal spearing). Night trips on May 22, 24, 27, 28, 29, June 3, 4 and 16 yielded counts of 19, 15, 3, 2, 9, 0, 2 and 0 muskellunge, respectively. These counts indicate a peak of spawning perhaps just before May 22 and continuing to near the end of May. Two male muskellunge taken on May 22 in the trap net were green, while a female on the same date was ripe. A female taken on May 28 was also ripe as were a male and female taken on June 4. Water temperature at Torch River bridge did not get over 50° F. until after June 2 but the temperature at the mouth of the river, and in most of the river itself, was over 50° F. by May 24. By June 16, water temperatures had reached 59° F. at the bridge and 61° F. farther downstream.

During 1953 no attempt was made to secure muskellunge eggs, but spawning and creel census observations were conducted intermittently at Torch River while spending the majority of time at Indian River.

Muskellunge were not in Torch River as of May 3 when the river temperature was 42° F. Natives reported seeing many muskellunge (15 at least) in the river by using lights on May 15 but neglected to notify me of this fact. The first night trip by myself on the river (on May 23) showed seven muskellunge, including one pair just below Rapid River. A night trip (not by myself) on May 24 gave a count of 16 fish, none of which were paired. By May 25 the water temperature had reached 50° F. downstream from Rapid River and a short night trip on May 27 from Rapid River downstream 1/2 mile revealed three fish, including one pair. On June 2, when the water

temperature was 57° F., ten muskellunge were seen at night (Figure 1). These fish were obviously spawning and were slow-moving and unwary. Only one pair was seen but both of these fish appeared to be well over 30 pounds (Figure 2). Numbers of other fish seen on this night were fairly representative of other nights on the river (except for more suckers earlier in the season) and included 8 pike, 5 rainbow trout, 50 suckers and 15 rock bass. A short trip on June 4 was rained out and had shown 3 muskellunge (including a 16-inch fish), all single fish. By June 11 the water temperature had reached 60° F. in the river (58° F. at Torch River bridge) and a night trip showed 12 muskellunge present. The trip was made from Wally's Landing, midway down river, to Torch River bridge (covering a large bayou on the east side of the river near Torch River bridge), and thence to the mouth at Round Lake and back to Wally's Landing, including both sides of the stream. Eight of the fish were seen from Rapid River downstream for 1/4 mile and the other four from Wally's Landing to Round Lake. None of the fish was paired and while nine of the fish were on the mud flats away from the channel, they were not up in the brush at all.

In 1953 only two fish were examined personally and these had been captured by anglers. The first of these, taken on May 3 between Elk and Round lakes, was a 35-pound green female. The second fish, examined on May 27, was a green male weighing 10 pounds. A third fish was reported to the author as a spent female weighing 40 pounds, 4 ounces (57-1/2 inches in length) which was taken June 28 at the mouth of the river. The angler reported that the egg sacs were shrunken and contained only a few eggs.

The bulk of the spawning at Torch River from 1951 to 1953 occurred between the dates of May 15 and June 15 (1951, May 15--June 1 (?); 1952, May 18--June 5; 1953, May 15--June 15). This coincides well with Mr. Washburn's statement that the 1945 season, which ran from May 26 to June 15, was

Figure 1.--A large (over 50 pounds) muskellunge going under the boat during night observations on Torch River on June 21, 1953.





Figure 2.--A pair of muskellunge lying close together in the logs at the edge of Torch River during night observational trip of June 21, 1953. Both fish were estimated at 35 pounds or over.



later than usual. Local people have various ways of telling when muskellunge are in the river; such as, "when oak leaves are the size of squirrels' ears," "corn planting time," "when lilacs are in bloom" or "when wild strawberries are in blossom." Most of these natural phenomena come during the last part of May, so there apparently is some correlation. The river water temperature is probably one of the stimuli which prompt the muskellunge to come up from Round Lake into the river. It was very apparent to the author that muskellunge did not come into the river until the upper river water temperature was approaching 45° F. and the temperature of lower river water was above 50° F. Temperature of the downstream section of the river during the main spawning periods varied widely from day to day but was always between 49° and 60° F.

Fish were seen paired at night on the shallow mud flats on both sides of the river. These flats extend from shore to the river channel and vary from 15 feet to 100 yards in width and up to 4 feet in depth of water. The flats are about 50 percent covered with weeds. Ninety-five percent of the weed-covered bottom is carpeted with chara sp., the other 5 percent being made up of Anacharis canadensis, Ceratophyllum demersum and a Potamogeton sp. Most of the flats are covered with fine silt and all plants and tree branches underwater are coated with a fine layer of silt. Aquatic insects or bottom organisms are extremely scarce along these flats. The water current is almost negligible on the wide flats and accounts for the sedimentation. The shoreline for the entire distance between Round Lake and Rapid River mouth is lined with dead stubs, branches and logs usually in water from 1 to 3 feet deep. Little vegetation grows in this shallow water and it is here that most of the spawning is done. A pair of fish seem to prefer to cruise in and through this tangle of stubs and logs close to shore, yet also close to the open water of the flats or channel. On both sides of the river near the mouth are wide delta areas, also covered with water 1 to 3 feet deep and

containing countless dead trees and snags. These areas, seemingly perfect for spawning, are apparently not used, as many hours spent in them in a canoe both day and night failed to show a single muskellunge. Spawning may also be done on the Chara on the flats themselves, as paired fish are seen on these flats during both the day and night. However, more pairs were seen at night up in the stubs than were seen over the flats, while more single fish were seen over the flats. Also, pairs seen occasionally on the flats usually had come from the stubs and remained paired. Spawning was never seen close by, but splashing was heard and seen at a distance at night as the boat approached. Spawning (if this may be assumed to occur when splashing was heard) always ceased as the boat drew near and, while fish would usually move out of the stubs toward the flats (and the boat), they were generally not wild and could sometimes be followed with the boat for a hundred feet. Several times fish would get out to the fringe of light, then turn and come back under the boat again.

The author believes that either spawning is not as common during the day as at night or else it is done nearer the channel during the day. Rarely were fish seen on the flats during the day and were never seen in the shallow stub area. Occasionally a pair was seen cruising the edge of the channel in 3 to 5 feet of water and fairly often fish were seen at the surface of the water in the channel with their dorsal fins out of water.

Muskellunge were seen in pairs everywhere along the river from the mouth at Round Lake to the mouth of Rapid River. No fish were ever seen above Rapid River to Torch River bridge, but natives have occasionally seen them here. Natives disagree as to whether muskellunge go up Rapid River to do any spawning. No one has ever seen them up there but some attribute the roiliness of Rapid River to the presence of muskellunge. Rapid River from its mouth upstream to the first bridge is extremely shallow and weed-choked and is considerably warmer than Torch River itself. It has small mud and

sand flats and at the time muskellunge are in Torch River there are always myriads of suckers in Rapid River. No muskellunge were ever seen in Rapid River, however, although many hours were spent looking for them by day. The river was too dirty to enable the underwater lights to be used at night. In fact, visibility in Torch River was very definitely affected by the amount of silt stirred up in Rapid River. The east side of Torch River was generally more cloudy than the west side and at night the boat could be over 15 feet of water with clear, cold water on one side of the boat and dirty, warmer water on the other.

It is still unknown how much spawning occurs in lake-shore areas such as exist in the southeast corner of Round Lake and the south side of the bay near Kewadin at the north end of Elk Lake. These are extensive areas of stumps and logs much like the delta at the mouth of Torch River except that at these locations there are only tiny streams entering. The Round Lake area consists of hundreds of acres of stumps in 4 to 7 feet of water but with few weedy areas. The Elk Lake location has shallower water and more weeds. During the spawning seasons of 1952 and 1953 several days were spent searching these areas for muskellunge. None was ever seen, but on a night observational trip at the southeast end of Round Lake on May 27, 1952 a single muskellunge was seen near the lakeward edge of this stump field. The author feels it is probable that some muskellunge do use these areas for spawning. Examination of these areas at night, especially in Round Lake, is very difficult because of rough water and the presence of numerous snags and deadheads. Lights are usually snapped off as fast as they are replaced. Trap-netting these areas would probably be the most efficient method of determining if muskellunge were spawning here.

Since the number of muskellunge seen, the number of hours out, and the route taken, have been noted for most of the night trips made at Torch River,

it is possible to put the information on a "fish seen per hour" basis (Table 1). These data then take the form of an index and can be used in later years with similar data to show any change in the population of fish using Torch River for spawning. "Water Condition" refers to the relative clearness of the water which affects the visibility of the fish. "Poor" indicates a night when the water was fairly roily and it was difficult to see fish in more than 2 feet of water. If conditions were worse than this, no trip was made. "Very good" represents the rare night when the water was perfectly clear and the bottom could be seen in 8 to 10 feet of water. Above Rapid River mouth the bottom could nearly always be seen in 20 feet of water. An attempt was made nearly every night to use the lights on the river, but there were always more nights when visibility was nil than when it was poor or better.

#### Observations at Indian River

The fact that there was a spawning run of muskellunge in Indian River, Cheboygan County each year was first brought to the attention of the Fish Division in 1951 when it was reported that about 22 fish were taken by anglers in May and June. The late Mr. Howard Reynolds, Indian River sporting goods dealer, stated that the run was present for several years before 1951. Mr. Reynolds was responsible for much of the promotion of Indian River as a muskellunge fishing location and stated in 1951 that for every fish that was caught, two got away.

Indian River, flowing northeast from Burt Lake 3-1/2 miles to Mullett Lake, is a part of the Inland Waterway in Cheboygan County. The river varies in width from 100 feet at the town of Indian River (at Burt Lake) to nearly 1/2 mile on the "flats" near its mouth where it enters Mullett Lake. The current is comparable to that of Torch River, ranging from about 3 miles/

Table 1.--Index of abundance, or fish seen per hour on night observational trips at Torch River (Antrim and Kalkaska counties) and Indian River (Cheboygan County) from 1951 to 1953

Torch River

Date	Time	Hours	Number fish seen	Water condition	Fish seen per hour
5-10-51	10-12 p.m.	2	0	Good	0.0
5-15-51	?	?	2	?	?
5-17-51	9-11 p.m.	2	11	Good	5.5
5-21-51	9-11 p.m.	2	25	Good	12.5
5-24-51	9-10:30 p.m.	1-1/2	7	Good	4.7
5-22-52	9-11 p.m.	2	19	Good	9.5
5-24-52	10 p.m.-12:30 a.m.	2-1/2	15	Good	7.5
5-27-52	11:30-12 M.	1/2	3	Good	6.0
5-28-52	10-12 M.	2	2	?	1.0
5-29-52	9:45-11 p.m.	1-1/4	9	?	7.2
6-3-52	10-11 p.m.	1	0	Poor	0.0
6-4-52	9:30-11 p.m.	1-1/2	2	?	1.3
6-16-52	2-4 a.m.	2	0	Fair	0.0
5-23-53	9 p.m.-12:30 a.m.	3-1/2	7	Good	2.0
5-27-53	12:30-1:30 a.m.	1	3	Poor	3.0
5-28-53	8:30-9 p.m.	1/2	1	Poor	1.0
6-2-53	9:45 p.m.-12:30 a.m.	2-3/4	10	Fair	3.7
6-4-53	9:30-11 p.m.	1-1/2	3	Poor	2.0
6-11-53	11 p.m.-1:30 a.m.	2-1/2	12	Very good	4.8
<u>Indian River</u>					
5-21-52	9:30 p.m.-1:15 a.m.	3-3/4	20	Fair	5.3
6-8-52	10:30 p.m.-1:30 a.m.	3	0	Good	0.0
5-2-53	8:45-11:30 p.m.	2-1/4	0	Good	0.0
5-24-53	9:30-11:30 p.m.	2	3	Fair	1.5
5-31-53	9 p.m.-1 a.m.	4	5	Poor	1.25
6-1-53	9 p.m.-1 a.m.	4	13	Good	3.25
6-9-53	9:30 p.m.-12:30 a.m.	3	8	Poor	2.7
6-13-53	9-11:30 p.m.	2-1/2	9	Fair	3.6

Figure 3.--Photo showing the typical edge of the channel of Indian River, Cheboygan County. The border in the right foreground is used by muskellunge for spawning but the extensive marshy area on the left is not used.





hour in its upper reaches to less than 1/2 mile/hour in the channel in the "flats." The depth of water in the channel ranges from 10 to 15 feet near Indian River village to 5 to 8 feet near Mullett Lake. For nearly the whole of the last 2-1/2 miles the river is bordered with marsh (Figure 3), and various side channels connect extensive shallow, weedy backwaters to the main channel. Only one area of extensive stumps and dead trees exists which is on the northwest side of the river about midway downstream.

Mr. Reynolds stated in 1951 that about 50 percent of the muskellunge taken that year were spawned out. This can be a very misleading statement as it was not stated whether he could tell males from females. Many fishermen report fish as spawned out or having no eggs; in many cases these turn out to be male fish. It is very questionable if Mr. Reynolds could tell a spawned out male from a ripe male (the author cannot always).

It was also stated by Mr. Reynolds in 1951 that fourteen fish (of a total of 22) were caught in a three-day period near the end of May. From knowledge subsequently gained about the relationship of fishing to spawning muskellunge, it is probable that spawning was just beginning or at its peak. The 22 fish caught in 1951 were taken between May 15 and June 15, and ranged up to 22 pounds.

In 1952 some observations were made at Indian River in conjunction with other studies being made in the vicinity. The first fish caught by anglers were taken in Mullett Lake near the mouth of Indian River on April 26. These fish (a 15-pound female full of eggs, and a 11-pound male) probably were moving to Indian River preparatory to spawning. The next fish taken, a 13-pound male, was caught at the mouth of the river on May 5. The next fish to be sexed was a 14-1/2-pound female, containing one pint of eggs, which was caught in the river on May 15. One pint of eggs is about correct for a small female of 14-1/2 pounds, which had not yet spawned. By May 19

a total of seven fish had been taken by anglers. On May 21 a night observational trip was made on the river, starting from Indian River Village and going to the mouth of the river and back. The trip, covering much, but by no means all, of the shallow water along the edge of channels, showed 20 legal-size muskellunge present. These fish ranged up to approximately 45 pounds in weight. Only one pair was seen but since the water temperature was 55° F. and the fish were well up near shore, spawning was undoubtedly in progress. Most of the fish were seen from 1/2 mile below Indian River Village to Bowersock's Landing, about 3/4 mile up from Mullett Lake.

A night trip made on June 18 covered the river very well, but no muskellunge were seen, although water temperature was 65° F. Spawning was undoubtedly over by this time. Thus spawning occurred well within the dates of May 15 to June 18.

In 1953, forms (Figure 4) were distributed to livery operators in the vicinity of Indian River with the request that a copy be given to each successful muskellunge fisherman. A return envelope and a scale envelope were also included with each form. In addition, several livery operators (Clyde Dyer, Ralph Bowersock, and Preston Davis of Modoc Club) cooperated further by saving gonads of muskellunge caught until I could examine them.

Of the 22 muskellunge caught at Indian River in 1953, all but one were either reported as to sex or examined by myself. The first fish, a green male, was caught on April 29 in the river. The remaining fish were all taken in the river between May 14 and June 11. During the first week that a number of fish (five) were caught (May 14 to 20), all were males with the possible exception of one which was unsexed. The eight females were all taken between May 22 and June 1. Seven females were checked by the author. Of these, six were green (one had been kept in a live box for ten days) and one was very ripe. The ripe fish, weighing 15 pounds and measuring 39-1/2

Figure 4.--Questionnaire given to fishermen catching muskellunge  
during the spring of 1953.

INSTITUTE FOR FISHERIES RESEARCH  
University Museums Annex  
Ann Arbor, Michigan

Muskie Fishermen:

Congratulations on catching a muskie! For the past few years your Conservation Department has been gathering information on muskellunge in Michigan. Having caught a musky this spring you are in a position to give us valuable information about this fish. We would appreciate it greatly if you would answer, to the best of your ability, the questions asked below:

Your name \_\_\_\_\_

Your address \_\_\_\_\_

Weight of fish \_\_\_\_\_ Length of fish \_\_\_\_\_

Where was fish caught? Give exact location in lake or stream if possible. \_\_\_\_\_

Date fish was caught \_\_\_\_\_ Time of day \_\_\_\_\_

Lure or bait used \_\_\_\_\_

Method of fishing (casting, trolling, etc.) \_\_\_\_\_

How many hours did you fish for muskies this spring? \_\_\_\_\_

Check sex of fish:

- Male (Having long, white organs along each side of the air sac).
- Female (Having yellow or orange organs along each side of the air sac).
- Impossible to tell sex because organs very small.
- Not examined.

If fish was a female, check the condition of organs and eggs:

- Filling most of body cavity; organs greatly enlarged with eggs. Did eggs run out of fish before it was opened? \_\_\_\_\_
- Filling much of body cavity, but organs somewhat shrunken and only partly filled with eggs.
- Filling little of body cavity; organs shrunken and containing only a few eggs.

If fish was a female, check the approximate amount of eggs:

- Two quarts or more
- One quart
- One pint
- 1/2 pint
- Only a few

Was there anything in the fish's stomach? \_\_\_\_\_

Additional comments:

If you will put some of the muskie's scales in the small envelope provided, we will be happy to age the fish for you and let you know other information about this spring's muskie fishing. Thank you very much for your cooperation.

INSTITUTE FOR FISHERIES RESEARCH  
*John E. Williams*  
John E. Williams

inches, was caught on May 30 in front of the Modoc Club. The eighth female taken was reported to the author on a form, but no mention was made of the ripeness of the fish. The first male to be found ripe was taken on May 22; from this date on, all males examined were ripe. All four fish taken after June 1 were males.

The sex ratio of fish caught by anglers was thirteen males to eight females. Female fish ranged in size from 38 inches and 13-1/2 pounds to 46 inches and 22-3/4 pounds and averaged 41 inches and 17 pounds. Males ranged from 31-3/4 inches and 6 pounds to 40 inches and 16 pounds, and averaged 35-1/2 inches and 11 pounds. The average for all fish was 37-3/4 inches and 13-1/2 pounds. The average of the eight females was larger than the biggest of thirteen males taken.

Six night trips on Indian River were made during the spring of 1953. The first trip, on the night of May 2, covered much of the river banks, backwaters, and delta near the mouth; visibility in the water was good. No muskellunge were seen and apparently, if any were in the river (one was caught in the river on April 29), they were in the deeper water of the channels. Since the water temperature was only 46° F., it is not surprising that they were not spawning.

A night trip on May 24, covering much of the lower 1/2 of the river, resulted in the sighting of only three muskellunge, each of which were single fish. The next trip on May 31 showed only five muskellunge, again all single. Visibility, however, was very poor, the wind riffling the water surface. The trip was repeated the following night and, under better observing conditions, thirteen muskellunge were seen, including three very definite pairs. All fish were seen along the edges of channels and none was observed in backwaters. All fish were seen in the region from Bowersock's Landing

for one mile upstream, and nine fish were noted from Modoc Club upstream for 1/4 mile. Water temperature the night of May 31 had been 56° F. and on the night of June 1 had risen to 64°F.

Trips on the nights of June 9 and June 13 showed seven and nine muskellunge, respectively. Only one pair was seen (on June 13) which was far upstream along the edge of the stump field. All other fish were well spread out from the "flats" to the stump field.

Many daytime trips were made on the river especially covering backwaters and the stump field. Several times muskellunge were seen along the edges of, and in, the channels. Modoc Club is located on a small, dredged side channel which connects with the river at both ends. This seemed to be a favorite cruising spot for muskellunge, especially during the daytime, and several muskellunge were caught at the junctions of the canal with the main channel. Muskellunge were first seen cruising in this side channel on May 20, when one pair and two single fish were noted here during the day. On June 1 seven muskellunge were seen in this channel in the a.m. by fishermen and by Mr. Davis, owner of Modoc Club. In the p.m. the author saw a pair, consisting of a 20-pound female and a 10-pound male cruising along the drop-off at the edge of the main channel opposite one of the entrances to the Modoc channel. The pair were swimming side by side slowly over a bottom of logs in 3-4 feet of water. Water temperature during the day of June 1 reached a high of 65° F.

During the nighttime observational trips, muskellunge were noticeably absent from the large areas of shallow (1 to 2 feet) water forming the extensive backwaters. The edges of the main channel, from the drop-off back to the marshy shoreline, was by far the most common site to find muskellunge (Figure 3). This shelf on the edge of the drop-off was usually no wider than 25 feet. Muskellunge were also occasionally seen on the flats

along the edge of the channel from Bowersock's Landing to the mouth, but were usually not far from the channel itself. The last place where muskellunge were seen was in the side channels which are not too common. The stump field, extending for perhaps 200 yards along the edge of the channel and back away from the channel for 1/4 mile, was definitely not used by muskellunge except at the margin with the main channel.

Paired fish were therefore seen during the day on May 20, both during the day and night on June 1, and on the night of June 13. The males were ripe from May 22 on, and the single ripe female was seen on May 30. Thus, spawning apparently began around May 20 and possibly extended to June 13. However it is believed that the height of spawning was from May 29 to June 2. Water temperature, from May 24 to late evening on June 1, ranged from 52 to 65° F on a maximum-minimum thermometer. June 1, the day when spawning was apparently at its peak, was a warm clear day with an air temperature high of 75° F. and with a moderate northwest wind. The previous day had been cool and overcast with scattered showers and an east wind. The air temperature had dropped from a high of 58° F. to a low of 45° F. early on the morning of June 1.

Spawning at Indian River (as at Torch River) thus occurred between May 15 and June 15, from 1951 to 1953. Probably little, if any, spawning occurred before or after the period of May 20 to June 10.

#### Collection of eggs

The attempts at propagation of muskellunge fingerlings have thus far led to failure. All failures at Torch River can be laid to one reason-- the smallness of the scale of the operation. The use of ten nets by two individuals could have resulted in an adequate collection of eggs either in 1951 or 1952. As it was, one individual used one net and attempted to work several other projects elsewhere at the same time.



In 1951, before the net was placed, some time was spent at Torch River investigating the spawning run and examining areas where fish cruised. Since the net was of the large, six-foot, double-potted, trap-net type, it was desired to move it as little as possible. Since Mr. Washburn had had no luck netting in 1945 at the mouth of Rapid River, that location was ignored. The net was finally placed, on May 19, along the west shore of the river about 1/4 mile upstream from Wally's Landing (the first habitation down from Torch River bridge on the west side), and about the same distance downstream from Rapid River mouth. Here, where the river channel made a sharp bend, was a 200-foot-wide "flats" area with water up to 4 feet deep. At the shoreward margin of this shoal was a tangle of logs, stubs and other downed timber. The net was placed in a small depression near the stubs, and the 300-foot lead was run obliquely downstream across the "flats" to the channel. In this manner any fish coming around the bend and up onto the flats would be funneled into the trap.

Four muskellunge were taken from May 20 to May 24, one each day excepting May 22. The fish, in the order taken, consisted of a 21-pound spent male, an 8-pound ripe male, a 12-pound nearly spent female, and a 14-pound ripe female. The ripe male was kept in a live box, but three days later when the ripe female was taken the male would no longer strip. A trip on the river the night of May 24 revealed fewer muskellunge than previously, and it was probably incorrectly assumed that spawning was about over. The nearly spent female taken on May 23 also contributed to this assumption. It was felt therefore, by myself, that the chances of obtaining a ripe fish of each sex in the net were slim and that other steps were necessary in order to insure the success of the operation. Therefore, after observations were nearly completed on the night of May 24, it was decided to spear a male fish, if possible, to fertilize the eggs of the ripe female. It was

decided that the surest way of getting a ripe male, with the first fish speared, was to spear the smaller fish of a pair. The river was cruised until a pair was seen, and the smaller fish was speared at the first attempt. The fish proved to be a ripe 8-pound male and was immediately rushed to the live-box, where the female was stripped of about 1/2 pint of eggs (15,000-20,000 eggs). The male was then stripped yielding only a few drops of milt (the fish had probably been stripped too heavily in ascertaining if it was a ripe male immediately after spearing). Since it was questionable to me at the time whether sufficient milt had been added, the testes were removed from the fish and mashed in the egg and water mixture, then removed. The eggs were taken dry and only enough water added to cover the eggs. After washing, the eggs in a pan were carried by myself while driving to the Drayton Plains State Fish Hatchery. The eggs had been taken about midnight and were in the hatchery by 8 a.m. the next day.

Unfortunately, the eggs all died 4 to 5 days after reaching the hatchery. The opinion of Mr. Hughes, the hatchery superintendent, and myself was that the eggs had not been fertilized. Either the male fish was not potent, or the technique of stripping was incorrect.

On May 20, 1952 a trap net was placed close to the location used in 1951. On May 22, three muskellunge were taken, including an 18-pound ripe female, and two males weighing 12 pounds each and either green or spent. No more muskellunge were taken until June 4 when a pair of fish was caught, a 12-pound ripe male and a 13-pound ripe female. The fish were taken to a live box and the female stripped of about one pint of eggs. The male yielded a few drops of milt after several hard strippings. The enameled pan had been greased with olive oil to prevent sticking of the eggs, and the fish had been wiped with a cloth to prevent mucus from getting into the pan when the fish were stripped. After adding the milt the eggs were stirred with the

fingers and then enough water was added to cover the eggs. The eggs were then washed until they hardened. The hatchery at Drayton Plains was called and Mr. Hughes drove up for the eggs arriving in mid-afternoon. Until he arrived the eggs, after being transferred to a wooden barrel half full of water, were stirred every half-hour by pouring fresh water down the side of the barrel. The eggs remained well separated and there had been no trouble with them sticking. They were maintained at 54° F., the temperature of the river water when they were taken. Mr. Hughes carried the eggs in the barrel on the seat of his pickup truck. In addition, the two adult muskellunge were carried in his tank unit with the idea of keeping them as possible brood stock at the hatchery. However, the sloshing of the water beat up the fish so badly that they died shortly after reaching the hatchery.

After reaching the hatchery, the eggs were set up in a hatching jar. Eggs began to hatch on June 15 (11th day), and the remainder were mature and ready to hatch. Mortality to this date was estimated at about 35 percent. At this time the hatching jar was set up in an aquarium so that if the fry swam up they would go out with the water at the jar lip and would be held in the aquarium.

By June 19 (15th day) all the eggs were hatched, but the fry were not yet coming off into the aquarium. On June 25 it was discovered that many fry had come off into the aquarium and were dead. Approximately 1/3 of the fry were dead; they had apparently suffocated in silt from the water supply which had covered the bottom of the aquarium. The remaining living fry were then transferred to screen boxes. All fry, including the dead ones, still had large yolk sacs and had not yet developed jaws, so there was no possibility that they had starved. They were just not free-swimming when they came into the aquarium and thus were unable to stay out of the accumulated silt. Wisconsin now uses screen boxes instead of aquaria in order to avoid this possibility.

The fry, after 24 hours of tempering, were then placed in Experimental Pond number 7. Pond number 7 had been prepared to the extent of stocking with Daphnia, but was thick with muck and weeds and infested with aquatic insects. However, at this late date it was the only pond available, and it did contain an adequate food supply. To guard against the fry settling into the muck, they were placed on a screen box on stakes, and covered with screen. The screen was meant to give shade, keep off predators and keep the fry in the box until they began to swim freely. A narrow opening was left around the top of the box for their escape when strong enough to swim out.

Fathead minnows were placed in the pond where they bred and produced food for the post-daphnia feeding stage.

Two aspects of the pond caused the entire experiment to fail; abundance of insect predators and the pond's shallowness. Water was kept shut off for the first two weeks in order to retain the bloom of Daphnia. After this the pond inlet was opened to keep the temperature of the pond down. However, the damage was probably done in the first several weeks as the temperature of the pond on July 10 was 85° F. This temperature, it is believed, could be fatal to young muskellunge. Wisconsin doesn't have this trouble, since muskellunge fry are in ponds much earlier and the ponds are further north. Muskellunge from the southern states would perhaps be adapted to warmer temperatures but the northern varieties are not. The Chautauqua or Ohio muskellunge (Esox masquinongy ohioensis) spawns soon after the ice goes out in the spring and thus the fry are not subject to high water temperatures.

If more eggs had been obtained and hatched, it would have been necessary to use more than one pond for raising them. A larger, cleaner pond would perhaps have resulted in some success.

No attempt was made during 1953 to raise muskellunge artificially.

Either Torch River or Indian River could serve as a future source of supply for muskellunge eggs if necessary. If used in the future, however, either location would demand the use of at least 8 to 10 or more trap or fyke nets in order to reasonably guarantee the success of the operation.

The author feels that the local people around Indian River would be more amenable to the taking of spawn from fish than would the people around Torch River. Some of the Torch River inhabitants feel it is inexcusable that the 50,000 eggs removed from their river have not been replaced by a considerable number of adult muskellunge.

Operations during the 1954 season at Lac Vieux Desert in Gogebic County have been reviewed in an earlier report (I. F. R. Report number 1430) and operations during 1954 at Lake St. Clair will be discussed in a later report.

#### Methods of propagation

Methods of propagation as practiced in Wisconsin have been reviewed previously (Report number 1365). A detailed description of spawning technique as conducted in Wisconsin has been included in the report on the 1954 Lac Vieux Desert spawn collecting venture. Certain changes in Wisconsin's pond raising techniques have also been discussed in that report.

#### Muskellunge abundance and the anglers' catch

Before any experimental program of stocking to increase native muskellunge numbers is embarked upon, it is absolutely essential that we have some idea of the actual populations and catches of muskellunge in these waters before stocking is done. Otherwise there will be no simple way to compare the post-stocking population with the pre-stocking population. As with any stocking of this type, anglers, resort owners, and sportsmen's clubs will be quick to applaud the stocking and insist on its being continued or increased. It is essential that this program remain an experimental one

until adequate and unquestionable results show whether or not any worthwhile increase in the population has resulted.

Of course, every effort will be made to mark the planted fish so that their ratio with the native fish may be determined. However, no long-lasting mark, easily recognized externally, is now known which would last from an 8-inch fingerling to a 30-inch or larger size. It is desirable that nothing be done to the fingerlings which would interfere with their growth or survival to legal size. Therefore, it is doubly important that some other way of estimating the population increase be available.

Apparently, muskellunge have never been really abundant anywhere. I feel, however, that in many places they are less abundant now than formerly.

In the Torch River system (Torch River, Round Lake and Elk Lake) muskellunge are perhaps as abundant as in any inland lake region in the state. Yet even here the hook-and-line catch of muskellunge is certainly less than 30 per year. This would be a catch of less than one per 300 acres, surely not indicating the fish as abundant. In many of Wisconsin's better muskellunge lakes the muskellunge catch ranges from one per acre to one per ten acres per year. In Chautauqua Lake, New York (13,376 acres) the 1953 sport catch of muskellunge was about 6,628 fish or one per two acres. It seemingly should be possible for our resource to at least approach these figures.

In a questionnaire sent to most of the winter spearkers on Elk and Round lakes (Figure 5), one question asked "Is spearing better or worse now than it was when you began?" Each person was also asked how long he had been spearing here. Of 69 persons that answered this question, 44 (64%) replied that it was worse, 15 (22%) that it was the same, and 10 (14%) that it was better. Of course, many of these had speared for only a few years. If only those who have speared for 10 years or more are considered, 60% (20 of 33) felt that spearing was worse now. If only those who have speared for 20

Figure 5.--Questionnaire sent to all shanty owners on Round  
and Elk lakes after 1954 winter fishing season.

Michigan Department of Conservation  
Institute for Fisheries Research  
University Museums Annex  
Ann Arbor, Michigan

Dear Shanty owner:

Your Conservation Department is interested in obtaining the results of your winter fishing on Round and Elk lakes, especially concerning your success with muskies. Since there has been a poor response to the shanty cards put out in January I would appreciate it if you would fill out and return this questionnaire whether or not you have sent in your card and whether or not you speared this winter.

As nearly as possible how many days did you spend spearing this winter on Round Lake \_\_\_\_\_; Elk Lake \_\_\_\_\_; or elsewhere? \_\_\_\_\_  
How many hours did you stay out each trip on the average? \_\_\_\_\_  
Was your spearing or fishing primarily for pike and musky \_\_\_\_\_, lake trout \_\_\_\_\_, or perch? \_\_\_\_\_  
How many muskies did you spear in Round Lake \_\_\_\_\_; in Elk Lake? \_\_\_\_\_  
What were their lengths \_\_\_\_\_; weights? \_\_\_\_\_  
Where in the lake did you spear them? \_\_\_\_\_  
How many muskies (legal size) did you see but did not spear? \_\_\_\_\_  
Did you see any small muskies in the water? \_\_\_\_\_ How large? \_\_\_\_\_  
\_\_\_\_\_  
How many muskies were speared by other people using your shanty? \_\_\_\_\_  
What size? \_\_\_\_\_  
How many pike did you spear in Round Lake \_\_\_\_\_, in Elk Lake? \_\_\_\_\_  
How many lake trout did you spear \_\_\_\_\_ or catch by hook and line? \_\_\_\_\_  
\_\_\_\_\_  
Would you like to see more \_\_\_\_\_ or less \_\_\_\_\_ muskies in Round and Elk lakes? Why? \_\_\_\_\_  
If you spear can you tell the difference between a pike and a musky in the water? \_\_\_\_\_  
How many years have you speared on Round and Elk lakes? \_\_\_\_\_ Is spearing better or worse now than it was when you began? \_\_\_\_\_  
Additional comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Thank you very much.

INSTITUTE FOR FISHERIES RESEARCH

*John E. Williams*

John E. Williams  
Junior Fisheries Biologist

JEW:aec



years or more are considered, 59% (10 of 17) are of the opinion spearing is worse now. However, if only those who have speared for 30 years or more on these same waters are considered, 82% (9 of 11) felt it is poorer now than formerly.

The author is at a loss to explain whether these figures mean anything or not. They are included, however, to show that the majority of spearers feel that spearing for muskellunge is poorer now than when they began. The figures undoubtedly do not prove that muskellunge are any less abundant now. As one man explained to me on Elk Lake "In those days (30 years ago) we got muskellunge every day, but there were only 10 of us spearing on the lake all winter; now there are a hundred and I feel lucky to spear 1 fish a winter." If we assume he was only half correct and thirty years ago got a muskellunge every other day, the result for 10 men for 60 days would be 300 fish. This compares to 24 fish taken this year in Elk Lake by 50 or more spearers. However, the important fact is that no more than ten spearers are present per day on Elk Lake now (the same number as 30 years ago) but they are lucky if one of them gets a fish. (It is estimated that 24 muskellunge were speared on Elk Lake during the 1954 season or about one every three days).

I realize that an estimate of former abundance based on the memories of older fishermen is very questionable because of the reputed tendency for them to remember only the good days and forget the days they returned empty handed. Whether or not this has ever been proved is doubtful. In many places in Canada where fishing pressure is limited, creel census has shown phenomenal catches of pike. One example is Cree Lake, Saskatchewan where 1,000 pounds of pike were caught in 1/2 day by 3 men. If these areas were subjected to 30 years of intensive fishing, the pike fishing would undoubtedly deteriorate. There would still be people, however, who remembered the phenomenal catches of 30 years before (i.e., today).

Whether or not muskellunge are less abundant today than in the past, there is no question as to whether or not fishermen wish there were more of them now. In the questionnaire mentioned above, another question asked was "Would you like to see more or less muskellunge in Round or Elk lakes?" This is probably a foolish question to ask fishermen who are trying to spear muskellunge. Yet there could be a possibility that many spearers could also be summer fishermen who felt that every muskellunge speared could result in more fish of other species being left. This feeling had been noted as a rationalization amongst violators who stated that they speared muskellunge illegally because the muskellunge were eating up all the other fish in the lakes! Of 77 spearers who answered this question, 74 replied they would like to see more muskellunge. The remainder were mostly lake-trout fishermen who thought muskellunge were keeping down the lake trout population. Of course most summer fishermen would undoubtedly welcome an increase in the number of muskellunge available in these waters. Wisconsin, to the best of my knowledge, has never had a complaint of too many muskellunge in a lake.

Information concerning past abundance of muskellunge at Indian River is even scarcer than at Torch River. However, the muskellunge spawning run "discovered" in Indian River in 1950 was not a new run but only the reappearance, in numbers, of a run which had always been present. One of the larger resorts on the river (Modoc Club) has catered to spring muskellunge fishermen since the early 1900's. (At that time it was a private club instead of a resort.) At that time it was advertised for its muskellunge fishing.

Mr. Ralph Bowersock, co-owner of Bowersock's Landing, stated that he was positive muskellunge were more common in the 1920's than now. He distinctly remembered one year, during the Twenties, when 80 muskellunge were caught at his camp alone in the spring (compared with 6 to 12 now). He said that their numbers decreased drastically during the Thirties and he

blamed it on the spring spearing season on noxious fish at that time. One other camp owner, Mr. Kaster, on the Pigeon River spreads, also stated that many dead muskellunge were seen during this noxious fish spearing period.

The present abundance of muskellunge in the Torch and Indian River systems is of more importance to this research than the past level of abundance. Thus far information has been collected on the number of muskellunge taken during the spring at Indian River and the numbers taken during spring, summer and winter at Torch River. The number of fish caught should reflect the total population, provided the fishing pressure does not change drastically. In addition, the number of fish seen per hour with the lights at night is expected to indicate any increase or decrease in the spawning population. This index factor should be very important in estimating future abundance. As indicated in Table 1 the index for Torch River has ranged up to 12.5 fish/hour. The average for 3 trips in 1951 (trips when no fish are seen are not included if the trip was made before or after the spawning season) was 7.6 fish/hour; for 1952, it was 4.6 fish/hour for seven trips; for 1953, it was 2.7 fish/hour for six trips. Whether this steady decrease indicates a lesser number of fish spawning each year or not is unknown, but that should be the case if the index is satisfactory. The average for all trips from 1951 to 1953 when fish were in the river is 4.5 fish/hour. Only 1 trip of 6 in 1953 was above the 3-year average.

Similarly, the index for Indian River for one trip in 1952 was 5.3 fish/hour and for 5 trips in 1953 the average was 2.5 fish/hour. Observations in the future should reveal any change in the spawning population.

Unfortunately no population estimate of muskellunge has yet been made anywhere. The estimate, in the usual manner of marking and recapturing with trap nets in the parent lakes, would be so slow and time consuming as to be impractical. Many long-range netting programs in the Cheboygan chain have

failed to take more than an occasional muskellunge in trap nets. Probably the only possible method would be to net heavily in the rivers at spawning time while collecting eggs. Tagging then, followed by angler creel census or the next year's spawn collection, might yield an estimate of the fish spawning here. Whether all of the fish in the lake spawn in one place is doubtful, however. Yet, a check of winter spearing the year after tagging might reveal enough of these tagged fish to make an estimate possible for the entire lake, assuming that the fish have become randomly mixed.

#### Spring fishing - Indian River

The number of muskellunge caught in spring fishing at Indian River from 1951 to 1953 has already been mentioned. The number of fish reported was 22, 23, and 22 for 1951, 1952, and 1953, respectively. These figures are minimum but are probably very close to the actual numbers. Mr. Reynolds kept count very carefully in 1951 and 1952. Nearly everyone in the town of Indian River was aware of the total throughout the season, and reports of fish caught were avidly sought after to add to the total. The count for 1953 obtained by the author is believed accurate, unless some fish were caught and taken from the vicinity without anyone seeing them, which is unlikely.

Fish were taken on all three years from the last of April until the end of June. No muskellunge have ever been brought in to Modoc Club or Bowersock's Landing after July 4 to the best of the operator's memory.

In 1952, over 60 percent of the muskellunge caught had been taken by June 5, and 96 percent by June 18. In 1953, all fish had been caught by June 11, 75 percent of them between May 14 and June 1.

The most popular bait at Indian River was the Pikie Minnow, either jointed or unjointed, and in the medium or large size. Of the 22 fish, thirteen were taken on the pikie, three were taken on the L. and S. bait, two on the Dardevle, and one each on the Johnson Silver Minnow, Flatfish, June-bug Spinner with worms, and a lake-trout spoon.

Regarding the method of fishing, trolling was by far the most popular. Of 21 fish on which this information was received, eighteen had been taken by trolling and three by casting. Fishermen mostly trolled from Indian River Village to Mullett Lake on one side and back to Indian River Village on the other side of the river. Some fishermen concentrated on the middle stretch of river, others on the section near the mouth. No fish were caught further upstream than halfway (1/4 mile above Modoc Club) where two fish were taken. From Bowersock's Landing to Modoc Club six fish were taken. Six more muskellunge were taken in the channel near the mouth of the river. One fish was caught at the Pigeon River "spreads." Five other fish were caught between the mouth of Indian River and midway upstream, but with no mention of the exact area.

One fisherman was much more successful than others, catching five fish, while no one else caught more than one. His success is attributable to the amount of time spent fishing (96 hours), the use of a bait designed to stay very near the surface, and trolling as close as possible to the edge of the channel.

The time of day during which fish were caught does not indicate anything very conclusive. Fish were caught all the way from 6 a.m. to 9 p.m. (just at dusk), but none was caught after dark. Mr. Reynolds had indicated in 1951 and 1952 that most fish were caught after dark. The majority of fish (63%) taken in 1953 were caught between 9 a.m. and 3 p.m. This is surprising because there were more fishermen out in evening hours than at any other time of day.

The residence of the successful anglers indicates that many of the fishermen fishing for muskellunge are from Ohio. Eight of the successful eighteen anglers were from Ohio, catching twelve of the 22 fish. The two biggest resorts on the river cater almost exclusively to non-residents from Ohio.

The remaining ten fishermen were split equally into two divisions, five local people from Indian River and five from various downstate localities. The successful anglers were fourteen males and four females.

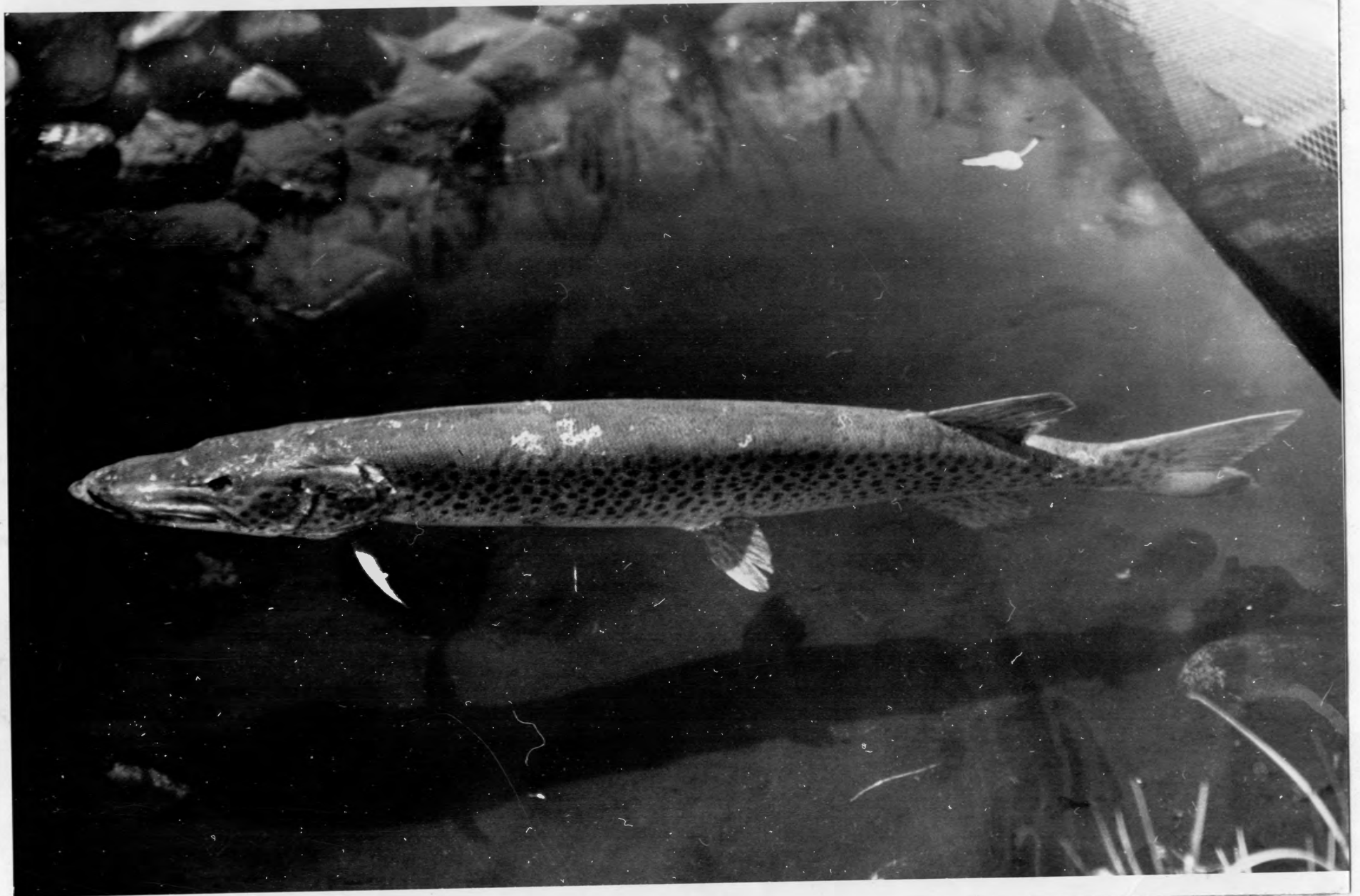
The size of these 22 fish caught in 1953 ranged from 31-3/4 inches (6 pounds) to 46 inches in length (22-3/4 pounds), and averaged 37-3/4 inches (13-1/2 pounds) (Figure 6).

According to tentative scale agings of seventeen of these fish from which scale samples were gotten, the youngest fish taken were VI\* years of age and the oldest were IX\* years. Length in inches of the fish, together with their age and sex, were as follows:

	VI*	VII*	VIII*	IX*
♂	31-3/4	33	36	
	32-1/2	34	39	
	32	36-1/2	39	
♀		38-1/2	40	43
		38	46	44
		38-1/2		
		39-1/2		
Average	32.1	36.9	40.0	43.5

It is interesting to note that males were all from VI to VIII years old while females were all VII to IX years old. From this it may be indicated that males become mature at 31 inches or less while females apparently do not mature until over 36 inches. Not enough fish, however, are included to verify this fact, but it is surprising at least to find no females under 38 inches in length, while seven of the nine males are less than that figure. It should be noted that a 33-inch, 8-pound female muskellunge which had been speared, was examined on February 22, 1953 on Round Lake (Antrim and Kalkaska counties) and was an immature fish. This fish was perhaps not unusual,

Figure 6.--The largest muskellunge (22-3/4 pounds, 46 inches)  
caught at Indian River in 1953. A green  
female, the fish was taken on June 1.





as at Lake St. Clair in June 1954, the smallest two females (33-1/2 inches, 7-1/2 pounds; 35-1/2 inches, 10 pounds) of 22 females examined were also immature.

The fact that the youngest males over 30 inches are VI years old while the youngest females are VII years old indicates that the Michigan muskellunge may be slower growing than fish from elsewhere. Schloemer (1938) stated that muskellunge in Wisconsin attain 30 inches in their 5th summer. However, this is an average based on fish ranging from 18-1/2 inches to 41 inches. Fish of 30 inches were sometimes found to be as much as XI years old. Minnesota (Eddy and Carlander, 1942) places the 30-inch size at VII years old. Ontario (Harkness, 1945) found muskellunge to be V years old at 30 inches, and IX years old at 38 inches. New York (Greeley, 1938) found 30-inch fish to be anywhere from II to VIII years old.

It is obvious that not enough fish are included in our averages here to reach any definite conclusions regarding age and growth of the muskellunge in Michigan. However, many more scale samples have been collected and will be discussed in a later report.

Fourteen of the successful fishermen answered the question concerning the number of hours that they fished for muskellunge in the spring of 1953. Many of these fishermen had finished muskellunge fishing for the year when questioned. Some, however, undoubtedly fished after being questioned. These fishermen had fished for as little as fifteen minutes to a maximum of 91 hours to get one fish, but the total number of hours required to land eighteen fish was 377 hours or 21 hours/fish (catch/hour = 0.0478). The fisherman who caught five fish, took 96 hours of trolling to catch them. The local belief is that one must fish for 100 hours on the average to catch one muskellunge. It is unfortunate that a creel census of all anglers was not undertaken, but the time for this operation was not available. It is believed that the census of all muskellunge fishermen here would show

between 50 and 100 hours of fishing per fish caught (catch/hour of 0.01 to 0.02). It is believed that fishing for muskellunge at Indian River in May and June is as good as any muskellunge fishing in the state with the possible exception of the same period at Lake St. Clair. It probably compares poorly, however, with summer muskellunge fishing in Chautauqua Lake, New York and in Wisconsin.

#### Spring fishing - Torch River

During the time the author was at Torch River in 1951 (May 9 to 24), there were only two muskellunge caught by anglers. However, in 1952 natives reported that about fifteen muskellunge had been caught during the spring of 1951.

In the spring of 1952 at least seven muskellunge were taken, ranging from 31 inches to 21 pounds.

Seven fish taken during the spring of 1953 at Torch River ranged from 32 inches to 57-1/2 inches (7 to 40-1/4 pounds). Information gathered on four of these fish showed three males at 32, 36-1/2, and 40 inches, and one female at 57-1/2 inches. Two fish were taken on silver and black S-3 Flatfish, and one each on Pikie Minnow and Pflueger Muskill. All four fish were taken in the evening from 5 to 8 p.m. and were caught near the mouth of the river at Round Lake. Four of the seven successful fishermen were local people, one was from Ohio and one from Detroit. The fish were caught from May 27 to July 6. One additional fish (35 pounds) was a female taken on May 3 in the "narrows" between Elk and Round lakes.

Actually it is surprising that as many fish are caught each spring in Torch River as there are, because the fishing pressure is not 1/10 what it is at Indian River. The season also is shorter, since the fish are later to come into the river and most people feel that there is not much use fishing for them until Memorial Day. Most people believe the muskellunge will not

bite until they have spawned. (Actually, with females, at least, there is some indication that they bite better before spawning.)

Here again fishing is done mostly by trolling and is done only from Rapid River mouth to the mouth of Torch River. Fishing is mostly on weekends with perhaps one or two boats per day during the week.

Summer fishing. No census of summer fishing for muskellunge has yet been made at Burt or Mullett lakes, Cheboygan County. After the muskellunge leave Indian River in mid-June, they are not caught again until the next spring. At least, no fish have come to my attention in three years of exploratory work on muskellunge in this region. Both Mr. Bowersocks and Mr. Davis, owners of the two largest fishing camps in the region, state that, to the best of their knowledge, no muskellunge have ever been brought into their camps any later than July 4. In fact, Mr. Bowersocks asked me where muskellunge would be in the summer, as he often has fishermen at that season that want to fish for them.

I feel that the fact that muskellunge are not caught in the summer is an indication that the population must be very small indeed, since with all the fishermen fishing for walleyes, bass and pike there should be an occasional muskellunge taken.

At Elk and Round lakes, Antrim and Kalkaska counties, there apparently are a few muskellunge taken during the summer season. In July, 1953, the author visited all the resorts, boat liveries and many of the local sportsmen and asked them to keep a record on a census sheet of all muskellunge they heard were caught in the two lakes that summer. Census sheets were also put up in many restaurants, taverns, and other business places in Elk Rapids, Kewaden, Williamsburg, Alden and Torch River bridge. During January of 1954 these places were revisited and the census sheets picked up. Those which were not open to be contacted were later contacted by mail.

Returns were received from 75 percent of those originally visited. These returns contained a report of only seven muskellunge caught from July to the fall of 1953 in both lakes. Of the seven fish, six were reported at the two main boat liveries (Bagg's Landing on Round Lake, and Elk River Marine-Tire Service). The seventh fish was reported from Round Lake by one of the sportsmen. Of the seven fish, five were from Round Lake and two from the north end of Elk Lake. No fish were reported from the south end of Elk Lake, although several sportsmen were collecting records from here.

On the basis of the seven fish reported, I believe there were no more than fifteen muskellunge taken in Elk and Round lakes during the summer and fall of 1953.

Some information is available concerning muskellunge fishing in Hamlin Lake, Mason County, from various creel censuses conducted here in the past. Hamlin Lake is probably equal to or slightly poorer than Round or Elk lakes in regard to muskellunge fishing. The general creel census during the period 1931 to 1952 contacted 1,751 anglers on Hamlin Lake. These fishermen had fished a total of 4,854 hours and had taken 298 pike and one muskellunge. An intensive census of Hamlin Lake (Clark, 1941) during the summer of 1939 and the winter of 1939-1940 resulted in about 80 to 85 percent coverage of the fishing pressure of the lake. During the winter 1,329 anglers fishing 6,246 hours (average of 4.7 hours/day) had taken 288 pike and eleven muskellunge. Summer fishing by 16,565 anglers (59,314 hours) produced 244 pike and only four muskellunge.

Comparison of the figures from Elk, Round and Hamlin lakes for summer muskellunge fishing with fishing for this species in an excellent muskellunge lake such as Chautauqua Lake, New York, reveals that our summer fishing for these large predators is poor indeed. At Chautauqua Lake in 1937 a creel census (Moore, 1938) from July 1 to 5 checked 71 muskellunge taken in 1,311

trolling hours or .054 fish per hour. Five days fishing here took about as many muskellunge as an entire year of fishing in any of our best muskellunge lakes. In 1944 at Chautauqua Lake it was estimated (Heacox, 1946) that the number of hours required to catch a muskellunge was 68 (or about what it is at Indian River in May and June when the fish are concentrated for spawning).

Winter hook and line fishing - Elk and Round Lakes

For some reason hook and line fishing for muskellunge during the winter is not practiced at Elk and Round lakes. In five days spent on the ice during February, 1953 and January, 1954, the author saw no tip-ups such as are used elsewhere for pike fishing, nor did he see anyone fishing through the ice for anything but perch.

In February, 1953, post cards were distributed to all shanties on both lakes (Figure 7). One question on these cards was "How many (muskellunge) were caught by hook and line?" On 46 cards which were returned to the author, no one reported taking any muskellunge by this method.

Winter spearing - Elk and Round lakes, 1953

The cards put out on February 20 to 23, 1953 (Figure 7) asked anglers to encircle dates on which their shanty was used for muskellunge spearing. The cards also asked how many muskellunge, and of what size, were speared or caught by hook and line, and whether many small muskellunge were seen. A space for comments was also included.

Of the 162 cards put on shanties on the two lakes (110 on Round Lake, 52 on Elk Lake), 46 (28 percent) were returned. Nine shanties, scattered along the center of Elk Lake, had not been given cards since they were being used exclusively for lake-trout fishing. The 52 shanties sampled on Elk Lake included 36 which were spearing muskellunge and 16 which were spearing lake

Figure 7.--Post card questionnaire put on all shanties on Round and Elk lakes during 1953 winter fishing season.

Shanty Owner:

Your Conservation Department desires information on Musky fishing success. Please keep this card in shanty and fill out and mail at end of winter fishing season.

Circle dates below on which shanty was used for Muskies:

February 20 21 22 23 24 25 26 27 28

March 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

How many Muskies were speared in this shanty? .....

What size? .....

How many were caught by hook and line? .....

What size? .....

Did you see many small Muskies? .....

Comments: .....

.....

Thank you.

John E. Williams

trout. All 110 shanties on Round Lake were in a position to spear muskellunge. Therefore the total of muskellunge spearing shanties was 146 (110 + 36).

The cards which were returned showed a sample total of eighteen muskellunge speared--eleven in Round Lake and seven in Elk Lake. The calendar on the cards only included from February 20 (the day the first cards were put out) on, and it was assumed that anglers would list only fish taken after that date. It was then planned to project the total fish taken during the last nine days back over the entire two months of the season, by assuming that fish were caught at a uniform rate throughout the season. It is believed, however, that most if not all of the anglers mistook what was wanted and listed fish they had caught earlier in the season as well.

The cards returned from Round Lake (29 of 110) represented 26 percent of the shanties on the lake and reported eleven muskellunge speared. By direct proportion this projects to an estimate of 42 muskellunge for the lake. Since it was believed most anglers had reported all fish speared during the season this was considered a reliable estimate. Two factors tend to make this figure inaccurate. First, the successful fishermen may have sent back their cards more often than the unsuccessful fishermen. Second, some fishermen may have listed only fish taken during the last nine days. These two factors would tend to counteract each other, so it is believed the figure of 42 is fairly correct.

The cards returned from Elk Lake (17 of 52) represent 33 percent of the cards distributed. However, cards were distributed to sixteen shanties fishing lake trout exclusively; one of which was returned. Thus cards returned from muskellunge shanties (16 of 36) represent 44 percent of the muskellunge spearers, who reported spearing seven fish. The projected total then for the season for Elk Lake is sixteen muskellunge speared.



The number of hours needed to spear one muskellunge can be calculated by the following formula:

$$\text{Hours/muskellunge} = \frac{\text{Number of days reported spent spearing in 9-day period} \times 6.5 \times \text{Average number of hours spearing/day}}{\text{Number of muskellunge reported speared}}$$

The 6.5 represents the number of times the nine-day reporting period (for days spent spearing) is found in the 59-day season. The average number of hours spent spearing each day is not known for 1953, but in 1954 the average trip was found to be 5.5 hours for Round Lake, and 5.2 hours for Elk Lake. Substituting these figures in the formula for Round Lake gives:

$$\text{Hours/muskellunge} = \frac{100 \times 6.5 \times 5.5}{11} = 325$$

Similarly, substitution for Elk Lake gives:

$$\text{Hours/muskellunge} = \frac{74 \times 6.5 \times 5.2}{7} = 378$$

These figures--325 hours for Round Lake and 378 hours for Elk Lake-- seem like a tremendous number of hours to spend spearing for one muskellunge. Fortunately, a very rough check on these figures is available. While distributing the cards on Elk and Round lakes, seventeen contacts were made with spearkers who were able to tell me personally how many days they had been spearing, the number of hours they averaged, and the number of muskellunge they had speared. These seventeen spearkers had speared a total of 285 days with an average of 4 hours/day to spear four muskellunge. This figures out to 285 hours per muskellunge speared, and gives some corroboration for the figures gained from the cards. It may indicate that the figures derived from the cards were a bit high, perhaps because spearing success or amount of time spent was not proportionally the same earlier in the season as in the last nine days or because the more successful spearkers were more apt to return their cards.

It seems safe, however, to estimate that 250-300 hours were necessary to spear a muskellunge on Elk and Round lakes in 1953. This was reported as a very poor year by many of the spearers.

One immediately wonders what type of superhuman patience is required to wait out these hours in order to get one muskellunge. If muskellunge were the only fish to be speared here, it would appear that the pressure would probably fall off through sheer boredom. However, on Elk Lake, lake trout are also available; and on Round Lake, pike make up the bulk of the spearing take. The same seventeen spearers contacted on the ice had also taken, in addition to their four muskellunge, 76 pike. Thus, over the 1,135 hours, there was one pike speared every fifteen hours.

It would appear from the above figures that if four muskellunge and 76 pike were speared by the same spearers, that pike must be about nineteen times as abundant as muskellunge. No figures were obtained on the number of lake trout taken.

The cards returned indicated that, while spearing eighteen muskellunge, spearers had seen 27 other muskellunge; most of these were sublegal fish.

It will be interesting to note where in the lakes muskellunge were speared. In Round Lake, spearers seem to concentrate in four locations. These locations, with the number of shanties and muskellunge reported from each, are as follows: for 1/2 mile south from the "narrows" along the west side of the lake (42 shanties--four muskellunge reported); just west of the mouth of Torch River on the north side of the lake (21 shanties--six muskellunge); the "pike grounds" in the center of the lake, 1/3 of the way between Torch River mouth on the north side and Barker Creek on the south side (41 shanties--one muskellunge); in Smith Bay, just north of the "narrows" in the northwest corner of the lake (six shanties--no muskellunge).

In Elk Lake there are five main areas of spearing in the shallower water: just southwest of the "narrows" (ten shanties--one muskellunge); the southwest corner of the lake (seven shanties--one muskellunge); in the "flats" area of Elk River on the northwest side of the lake near Elk Rapids (six shanties--three muskellunge); the north end of the lake about one mile south of Kewadin (three shanties--one muskellunge); and the south side of the little bay opposite Kewadin at the extreme north end of the lake (twelve shanties--one muskellunge).

It was surprising to note on the cards that two spearers requested larger size limits. Mr. M. W. Lewis of Kalkaska said "Make muskellunge size larger, also pike, and give them a chance to spawn." Mr. George Gill of Kalkaska stated "Am in favor of 36-inch minimum limit for muskellunge and 20 inches for pike."

Eleven muskellunge speared on Round Lake averaged 34 inches and 10 pounds. The largest fish was 45 inches and 25 pounds. Seven muskellunge speared on Elk Lake averaged 35 inches and 12 pounds.

Winter spearing--Elk and Round lakes, 1954

On January 15 and 16, 1954, post cards were again put out among shanties on Elk and Round lakes in an attempt to gain additional and more complete information in perhaps a more typical year than 1953. The cards were put out early in the season hoping to sample the entire season, and the calendar on the post card covered both January and February. Spearers were asked whether their shanty was used mostly for muskellunge, pike or lake trout. Also asked was the number of muskellunge speared in the shanty and their size.

A total of 101 cards were put out, including nine on Elk Lake and 92 on Round Lake. Elk Lake was frozen over only on the river near Elk Rapids where seven shanties were out; two other cards were passed out to known

spearers for Elk Lake. Of the 101 cards put out, only nineteen (19 percent) were returned. It was fairly evident that these were either mainly returned by successful spearers or else this was an unusual year.

Of fifteen cards from Round Lake (16 percent of the total put out) twelve reported that they had speared, and of these only nine reported the days they spent spearing. These nine reported a total of 195 days of spearing. At an average of 5.5 hours per spearing day, this represents a total of 1,072 hours. However, the nine spearers reported eleven muskellunge speared. Thus each muskellunge required an average of 97.5 hours of spearing. Actually a total of twelve muskellunge were reported speared. Since only twelve of the fifteen cards reported they speared, this reduces the estimated total number of spearers (cards put out) on Round Lake from 92 to 74. If nine spearers reported eleven muskellunge speared, then the 74 spearers would have speared an estimated 90 muskellunge on Round Lake.

Of nine cards given out on Elk Lake there were four returned. Again it is believed that they represent the more successful spearers. In 140 days of spearing (728 hours), eight muskellunge were reported speared. It is not possible to estimate the total number of muskellunge for the entire lake, since it is known that there were many more shanties on the lake later in the season.

The average size for the twelve muskellunge reported from Round Lake was 12-1/2 pounds (about 38 inches), while the eight fish from Elk Lake averaged 19 pounds (41 inches).

While passing out cards on Elk and Round lakes, spearers present on the ice were questioned as to their luck thus far in the season. Four spearers on Elk River near Kewadin had spent nineteen hours but had speared no muskellunge. Fifteen spearers contacted on Round Lake had thus far been out for 102 days, a total of 502 hours (4.9 hours/day) and had speared only one

muskellunge and 21 pike. The ratio of 21 pike to 1 muskellunge is close to last year's ratio of 19 pike to 1 muskellunge. However, the number of hours spent for one muskellunge indicates that possibly the early part of the season was poorer than later on, as success was drastically poorer than reported on cards for the entire season. However, the results of both types of census involved insufficient data and were questionable.

The fact that very little response was forthcoming from the cards put out in January was a bit disturbing. Either the spearers resented being questioned, or else, being put out early in the season, the cards had been lost or forgotten by the end of the season. The latter explanation was believed the true one, since spearers always seemed interested in talking about muskellunge and anxious to assist in the census. Since further information in greater detail was desired concerning the 1954 spearing season, it was decided to make one last attempt to secure this information.

On April 15, 1954 a questionnaire (Figure 5) was sent to all people who had speared in 1953 and 1954 on Round and Elk lakes. Their names and addresses had been obtained from their shanties while passing out the post cards each year. There had been few new names encountered in 1954, and it is believed nearly everyone currently spearing these two lakes was contacted.

A total of 185 questionnaires were sent out and the extremely surprising total of 101, or 55 percent, of these were returned. This confirmed my opinion that it was the earliness of putting out the cards and not the excessive questioning that was responsible for the poor return of post cards.

Several aspects of the questionnaire have already been evaluated, namely whether muskellunge spearing is better or worse now than when the spearer began, and whether the spearer would like to see more or fewer muskellunge in Elk and Round lakes. Briefly, 64 percent of the spearers felt

spearfing was worse now than when they began, and 96 percent of the spearers would like to see more muskellunge in these lakes.

It may be of interest to point out the average number of years spearers have speared these lakes. Eighty-three spearers answered this question. The number of spearers and the percentage are given below for each year group.

Year group	Number	Percentage
5 years or less	35	42.2
6-10 years	22	26.5
11-15 years	8	9.7
16-20 years	3	3.6
21-30 years	7	8.4
31-40 years	6	7.2
41-48 years	2	2.4
Total	83	100.0

Thus 68.7 percent, or over two-thirds, of the spearers have speared here for ten years or less. In other words it is possible that, in numbers of people participating, spearfing has increased by 200 percent since World War II! Of course, some older people who were spearfing ten years ago are no longer spearfing, but it is probably also true that the majority of the people who did not answer this question (18 percent) have only speared for two years or less. The average spearer on these lakes has participated in the sport here for nearly twelve years.

Some bias may have been introduced into these figures since spearers were asked not "How long have you speared?" but "How long have you speared on Round or Elk lakes?" A spearer may have speared for 40 years but only the last two years on Round Lake. Hence these figures cannot be used to show the average number of years experience spearers as a whole have had. The question was asked deliberately in the manner given in order to help shed some light on answers given to the question "Is spearfing better or worse now on Round and Elk lakes than when you began?"

Forty-five spearkers on Round Lake answered the question concerning the number of hours they spent spearing on the average trip. This average was 5.5 hours per trip. The total number of days reported spearing on Round Lake was 725. The total number of hours was figured according to the formula:

$$\text{Hours} = \sum (\text{days} \times \text{average number of hours})$$

In other words each spearkers' reported average number of hours per trip was multiplied by the number of days he speared. Spearkers who reported the number of days spent but not the average number of hours were credited with 5.5 hours for an average, the average of the 45 spearkers who reported their hours. Total number of hours computed was 3,560. Seventeen muskellunge were reported speared, thus an average of 209 hours were spent per muskellunge speared. This is considerably more hours than were reported on cards (97-1/2 hours) and considerably less hours than were reported on personal contacts (502 hours) early in the season. Apparently the cards did represent the more successful spearkers while the personal contacts perhaps did reflect poorer spearing early in the season.

The same 45 spearkers on Round Lake reported spearing, in addition to the seventeen muskellunge, 267 pike, or one pike every thirteen hours. The ratio of pike to muskellunge was figured at 16 to 1.

As mentioned above, 45 spearkers reported spearing on Round Lake. Twenty-five spearkers reported spearing on Elk Lake. Fourteen spearkers speared on both lakes, thus the total number of spearkers was only 56 (45 + 25 - 14) of the 101 reports returned. The remaining 45 fishermen either did not fish this year or on these lakes (24), fished only lake trout (11) or perch (10).

One question on the questionnaire asked "How many muskellunge were speared by other people using your shanty?" On Round Lake this brought to light an additional fifteen muskellunge. Thus, 45 of 101 returns showed seventeen muskellunge speared by shanty owners on Round Lake. Therefore,

$\frac{45}{101} \times 185$  shows a theoretical total of 82-1/2 muskellunge spearing shanties on Round Lake. If 45 shanty owners speared seventeen muskellunge, 82-1/2 shanty owners should have speared 31 muskellunge. Similarly, if 101 returns show an extra fifteen fish speared by other persons than the owner, the total of this type should be  $\frac{45}{82.5} = \frac{15}{x}$ ;  $x = 27$ . Therefore, the estimated total number of muskellunge speared on Round Lake should be 31 + 27 or 58.

Twenty-five muskellunge spearkers on Elk Lake reported that they had spent from 3 to 7 hours per spearing day with an average of 5.2 hours/day. The total number of days reportedly spent spearing for muskellunge on Elk Lake was 336 days. "For muskellunge" is underlined above because considerable spearing is also done for lake trout here. However, on the questionnaire a question was asked "Was your spearing or fishing mainly for pike and muskellunge \_\_\_\_\_, lake trout \_\_\_\_\_, or perch \_\_\_\_\_?" This, together with the question "How many days did you spend spearing this winter on Round Lake \_\_\_\_\_, Elk Lake \_\_\_\_\_, or elsewhere \_\_\_\_\_?" enabled me to determine exactly what kind of fishing the angler did and where. The summation of each angler's number of spearing days on Elk Lake times his average number of hours gave the total hours reported for Elk Lake or 1,955. Together with this information there were twelve muskellunge reported speared or one fish every 163 hours.

The 25 muskellunge spearkers also reported spearing two pike (one pike every 977 hours). Pike are apparently much less abundant in Elk Lake than in Round Lake; at least they are taken less frequently. The ratio of pike to muskellunge speared in Elk Lake is 1:6, as compared to 16:1 on Round Lake.

Twenty-five of the 101 questionnaires were returned by muskellunge spearkers (or shanty owners) from Elk Lake. Therefore, for the 185 questionnaires sent out, there must have been about 46 muskellunge spearing shanties on Elk Lake. If 25 shanty owners reported spearing 12 muskellunge, then 46 shanty owners are estimated to have speared 22 muskellunge. Only one other



muskellunge was reported speared in the 25 shanties by persons other than the owner. This would be estimated as two muskellunge in the 46 shanties. Therefore, the total estimated number of muskellunge speared on Elk Lake is  $22 + 2 = 24$ .

The estimated total number of muskellunge speared on Round and Elk lakes in January and February, 1954 is thus  $58 + 24$  or 82. This estimate is based on the assumption that the same percentage of unsuccessful as successful anglers returned their questionnaires. If anything, the estimate may be a little too high. It is doubtful that the estimate is low, unless several extremely successful spearers did not return their questionnaires.

Winter spearing is a sport that attracts few visitors to a lake from further than 50 miles. This is borne out by a compilation of the residences of the spearers contacted. The 185 winter fishermen came from the following locations (with numbers in parentheses): Williamsburg (41), Traverse City (39), Rapid City (32), Kalkaska (17), Kewadin (15), Manton (14), Elk Rapids (12), Alden (3), Sigma (2), Acme (2), Mancelona (2), and one each from Bellaire, Ellsworth, Central Lake, Fife Lake, Cadillac and Grand Rapids. Less than one percent listed their address as further than 50 miles from these lakes.

The spearers were questioned as to where in the lakes they speared their muskellunge. In Round Lake seven were speared on the south side of the lake off Bagg's Landing, five on the "Pike Grounds" in the north-central part of the lake, one to the west of Torch River mouth, three on the west side of the lake south of the "narrows" and one on the north side of the "narrows" in Smith Bay. In Elk Lake four were reported speared in Elk River near Elk Rapids, three at the south end of the lake, two just north of the "narrows," one just south of the "narrows," and one at the north end of the lake near Kewadin.

Lengths and weights were supplied for 32 muskellunge speared in Round Lake and for 13 from Elk Lake. The Round Lake fish averaged 35-1/2 inches and 11 pounds; the largest fish taken was 43 inches and 18 pounds. Elk Lake muskellunge averaged 38 inches and 15 pounds; the largest fish was 46 inches and 26-1/2 pounds. Again, as last year, Elk Lake muskellunge averaged larger than those taken in Round Lake (1953 averages: Round Lake, 34 inches, 10 pounds; Elk Lake, 35 inches, 12 pounds).

It is perhaps worth noting the answers to the question "Did you see many small muskellunge?" Of all the fishermen spearing on Elk Lake only two reported seeing, in the water, one small muskellunge (undersize) each. However, 19 fishermen from Round Lake answered this question in the affirmative, 7 saying "Yes" and 12 enumerating a total of 59 small muskellunge. This, combined with the smaller average size of muskellunge speared in Round Lake, seems to substantiate the theory that most of the spawning is done in Round Lake (and Torch River).

Information gathered as to the extent of the lake trout fishing in Elk Lake will undoubtedly be of value. Six reports were returned by exclusively lake trout fishermen, who had indicated the days and average number of hours they had fished. They fished 30 days, or 152 hours, and took 15 trout (one per 10 hours). In all, 19 of the 101 reports indicated they had done some lake trout fishing. These 19 reported taking 123 trout of which 94 were taken by hook and line and 29 by spearing. It is estimated that about 225 lake trout were taken from Elk Lake during the winter of 1954.

#### Muskellunge regulations

Muskellunge fishing in Michigan inland lakes is, at present, legal from the last Saturday in April to March 15. In addition, spearing of muskellunge through the ice on all Michigan inland lakes (with the exception of Brevoort

Lake, Mackinac County) is allowed from January 1 to February 28. The closed season (March 15 to the last Saturday in April) does not protect the muskellunge in Michigan (except for the subspecies present in the Michigan-Wisconsin border lakes) during its spawning season, which is roughly May 15 to June 15. There is no daily or creel limit on muskellunge in this state but there is a 30-inch size limit.

None of the major muskellunge states or Canadian provinces (New York, Minnesota, Wisconsin or Ontario) is as lenient with its regulations on muskellunge as is Michigan and, as far as is known, none of these states or provinces is considering any further relaxation on muskellunge fishing regulations (Table 2).

New York State (Heacox, 1946) noted that the muskellunge population of Chautauqua Lake had fallen off drastically in the late Thirties. New York, therefore, put on extensive regulation restrictions involving shortening of the season to July 1 to October 15, increasing size limit from 24 inches to 32 inches, restricting the tackle, and limiting the catch to one per day and five per season. From 1941 to 1944 the sport catch under these restrictions rose from 817 fish to 3,488 fish and by 1945 the spawn-taking crews once again were taking the average of 2,000 fish in their nets, the figure that they formerly took at the turn of the century. The sport catch for 1953 was estimated as 6,628 muskellunge. Since New York also stocked Chautauqua Lake with fingerlings during the same period, it is not known which has been the most effective, the regulations or the stocking. In 1950, Wisconsin eliminated late-fall and winter angling for muskellunge by changing the closing date of the season from January 15 to November 1.

Table 2.--1954 regulations concerning muskellunge in other states and provinces

Location	Size limit, inches	Daily creel limit	Number per season	Open season	Spearing allowed
Georgia	None	2		All year	No
Kentucky	24	No limit		All year	No
Massachusetts	20	5		Apr. 15-Feb. 15	No
Minnesota	None	2		May 15-Feb. 15	No
New York	32	1	5	July 1-Dec. 1	No
North Carolina	24	1		All year	No
Ohio	30	2		All year	No
Pennsylvania	24	2		July 1-Nov. 30	No
Tennessee	None	5		All year	No
Vermont	12	No limit		June 15-Apr. 14	No
West Virginia	None	No limit		Apr. 28-Mar. 14	No
Wisconsin	30	1		May 22-Nov. 1	No
Manitoba	24	2		May 15-Oct. 31	No
Ontario					
North and west	30	2	14	June 20-Oct. 15	No
South	30	2	14	July 1-Oct. 15	
Connecting waters	30	2	14	June 25-Dec. 15	
Quebec	24	3 (or 30 lbs.)		June 16-Oct. 15	No

### Discussion

The findings stated in this report prove that the muskellunge is being harvested chiefly during its spring spawning season and through the ice by spearing in winter. The elimination of both the winter spearing season, and the spawning fishing by an extension of the closed season to the period from December 1 to the 3rd Saturday in June would very possibly increase the abundance of muskellunge in our waters and enable fishermen to catch more muskellunge by the more-sporting hook-and-line method.

I am not, however, recommending that the closed season be increased immediately, statewide. It is desired that this be put on an experimental basis in the Torch River chain of lakes from Torch River bridge to Elk Rapids, thus encompassing Torch River, Round Lake and Elk Lake. Pike fishing and spearing should remain the same as before, although it is recommended that the daily limit of five and the size limit of 14 inches be removed here. It might eventually prove desirable to eliminate these restrictions on pike fishing in muskellunge waters on a state-wide basis. It is believed our muskellunge waters would produce more muskellunge if it were not for the predation (in the early stages) and competition of the pike. In fact, it may very well be that populations of muskellunge in our native muskellunge lakes will never be high unless the pike populations in these lakes are greatly reduced. The pike can probably not be eliminated from these lakes, but they certainly should not be given the same protection as muskellunge. It is realized that if the pike season were also closed on these lakes in the winter, shanties would probably be absent and there would be no enforcement problem. That is why it is being recommended that winter hook-and-line fishing for muskellunge also be outlawed here (by the closed season). Then possession of a muskellunge will constitute a violation. However, it is hoped that pressure will increase on the pike. At the same time spearing

will not be withdrawn from the local people, since sixteen times as many pike as muskellunge are speared in Round Lake and some pike and lake trout are at present speared in Elk Lake. The loss of 1/17 of the winter spearing take should not be felt heavily by the spearers.

It will immediately be questioned whether or not spearers can differentiate between pike and muskellunge in the water in order to avoid violating. If they could not, the enforcement problem would be great and result in much ill feeling between the local people and the Field Administration Division. However, in the questionnaire sent out to spearers this spring, the question was asked "If you spear, can you tell the difference between a pike and a muskellunge in the water?" Of the 81 answers to this question 73, or 90 percent, said "Yes" (most very emphatically!). Of the ten percent who said "No", or were unsure, all had speared for a very short while (except for one lake-trout fisherman) and had probably not yet seen a muskellunge in the water. The two fish are obviously not similar when seen in the water (the pike being dark, while the muskellunge is very light), and thus the beginner should soon be able to tell the difference, as the old timers have learned. Mistakes will be made, of course, but I feel it will not be a serious factor.

Whether or not a daily or seasonal creel limit is needed at the present time is debatable. If the muskellunge populations are low because of heavy fishing pressure and because of the abundance of pike, any regulation that would decrease the take would be beneficial. If the populations are small but at or near the carrying capacity of the lake, no amount of restrictions would increase them to any great extent. A daily limit of one and a season limit of five would save some muskellunge. The psychological effect of this restriction would be advantageous as it would certainly bring to the angler's attention the scarcity of these fish. The daily limit of one would occasionally save a fish and it would seem that 6 pounds or more per day would be

enough for anyone. However, I do not completely approve of a season limit. For one reason, a season limit would require that the angler bought or was given special tags or seals which would be an administrative headache. However, it would be a valuable method of gathering statistics about the number of muskellunge fishermen and their catch. New York has been selling five seals with each license for many years and requires a report of each seal used. In addition I feel that a season limit would be unfair to the confirmed muskellunge fishermen who spend most of their fishing year fishing for this species alone. It can, of course, be argued that there are probably few who catch more than five per year and that they can choose the fish they want to keep. With a season limit the use of a gaff should perhaps be forbidden.

The matter of a daily and/or season creel limit should probably not be decided at this time. If the experiment at Round and Elk lakes results in more muskellunge being taken during the summer, a further restriction in the form of a creel limit can be added. If more information was forthcoming as to why the populations of muskellunge are small, it would be more easily determinable whether or not a creel limit would be of practical use or purely psychological.

There is a possibility that, after further research, a recommendation will be forthcoming to raise the size limit on muskellunge to about 36 inches. Few female muskellunge under this size have been encountered and studied. If more small females could be collected, this question could be easily answered. Thus far, there is some evidence that female muskellunge in Michigan do not mature until nearly 36 inches in length.

### Conclusions

Information has been presented in this report giving the results of research into the spawning habits of muskellunge in Torch River, Antrim and Kalkaska counties and in Indian River, Cheboygan County. Results are also presented on the extent of spring, summer and winter muskellunge fishing in these locations but chiefly in the vicinity of Torch River. The conclusions reached concerning these two aspects of research are as follows:

1. Observations conducted at Torch River indicate that a substantial portion of the muskellunge from Round Lake spawn in this region, usually during the period of May 15 to June 15. Spawning is done along the edges of the channel and the shore, mainly in logs and brush, in a depth of 1 to 4 feet of water, and at a water temperature ranging approximately from 50° to 60° F.
2. At Indian River it is evident that a portion of the muskellunge from Mullett Lake, at least, spawn along the edge of the river during the period May 20-June 10. Spawning occurs at a water temperature range of approximately 52° to 65° F.
3. At both locations no spawning is done in shallow water more than 50 feet from the river channel or "flats" area.
4. Night observations at both locations have established an index by which future fluctuations in the spawning populations may be determined and measured.
5. Collection of eggs has been accomplished at Torch River, and both Torch River and Indian River might serve as sources of eggs for propagative purposes in the future. Any further attempts to collect eggs should be carried out on a wider scale.
6. Thus far the attempts to rear muskellunge to fingerling size have been failures, but considerable information and knowledge has been gained on this practice.



7. Information has been advanced which tends to show that muskellunge have been more abundant in the past at both the Torch and Indian river vicinities.
8. During the spring spawning season at Indian River about 22 muskellunge have been taken yearly by hook and line from 1951 to 1953. Most of these fish had not yet spawned when they were caught. Most of the fish were taken during mid-day by trolling; for the successful anglers the number of hours spent trolling per fish caught in 1953 was 21. Male fish ranged from VI to VIII years of age and female fish from VII to IX years of age.
9. During the spring spawning season at Torch River from 7 to 15 fish were taken each year from 1951 to 1953. Fishing pressure is considerably lighter here than at Indian River.
10. Few muskellunge are taken during the summer months in Burt and Mullett lakes and apparently no more than 15 were taken in Round and Elk lakes during the summer of 1953.
11. It is estimated that winter spearing during 1953 took 42 muskellunge from Round Lake and 16 from Elk Lake. It is further estimated that it required from 250 to 300 hours to spear a muskellunge in these lakes. Nineteen times as many pike were taken from these waters as were muskellunge.
12. In 1954, 64 percent of the spearers on Elk and Round lakes indicated that spearing was worse now than when they began. Of those who had speared for over 30 years, 82 percent felt it was worse now. Over two-thirds of the spearers had been spearing on Elk and Round lakes for ten years or less.
13. In 1954 the average spearer spent 5.5 hours per spearing trip on Round Lake and 5.2 hours per trip on Elk Lake.
14. In 1954 a sample of 55 percent of the spearers on Round and Elk lakes revealed the average amount of time necessary to spear a muskellunge as 209 hours on Round Lake and 163 hours on Elk Lake.

15. The estimated total number of muskellunge speared in 1954 was 58 on Round Lake and 24 on Elk Lake. In addition an estimated 55 percent of the fishing pressure speared 267 pike on Round Lake, and speared or caught 123 lake trout and 2 pike on Elk Lake.
16. Less than one percent of the shanty owners on Elk and Round lakes came from more than 50 miles away.
17. Muskellunge taken by spearing from Round Lake were smaller on the average than those taken from Elk Lake. More small muskellunge are also seen by spearers in Round Lake than in Elk Lake.
18. Michigan muskellunge regulations are less restrictive than those of the other major muskellunge states and provinces.
19. It has been demonstrated that the catch of muskellunge in Michigan inland lakes is decidedly poorer than the catch in some of the better muskellunge lakes in other states.
20. It has been proven that most of the muskellunge caught in Michigan (at least in the vicinity of Torch River and Indian River) are taken during their spawning season and by spearing during the winter.
21. It is felt that elimination of the spring fishing and winter spearing of muskellunge by a closed season from December 1 to the 3rd Saturday in June would increase the muskellunge populations and increase the summer hook-and-line catch.

#### Recommendations

1. It is recommended that Torch River, Round Lake and Elk Lake (Antrim, Grand Traverse and Kalkaska counties) serve as an experimental area for the testing of the effect of a closed season on muskellunge extending from December 1 to the 3rd Saturday in June for a period of five years.
2. It is further recommended that in the above area, the creel and size limits be removed on pike.

Literature cited

Clark, O. H.

- 1941 Progress Report of Investigation of the Winter Fishing Problem in Several Southern Michigan "Bluegill Lakes". Report (unpublished), Institute for Fisheries Research, No. 661, April 2, 1941.

Eddy, Samuel and Kenneth D. Carlander

- 1942 Growth Rate Studies of Minnesota Fish. Minn. Dept. Conserv. Fish. Res. Invest. Rept. No. 28, 64 pp. mimeo.

Greeley, John R.

- 1938 Fishes of the Area with Annotated List. pp. 48-73 in A Biological Survey of the Allegheny and Chemung Watersheds. Supp. 27th Ann. Rept. N. Y. Conserv. Dept. Biol. Surv. No. 12.

Harkness, W. J. K.

- 1945 Rate of Growth of Game Fish. (unpublished) 6 pp. mimeo.

Heacox, Cecil

- 1946 The Chautauqua Lake Muskellunge: Research and Management Applied to a Sport Fishery. Trans. N. Am. Wildl. Conf., 11: 419-425.

Moore, Emmeline and Staff Members

- 1938 A Creel Census at Chautauqua Lake, New York. T. A. F. S. Vol. 67: 130-138.

Schloemer, Clarence L.

- 1938 A Second Report on the Growth of the Muskellunge, Esox masquinongy immaculatus (Garrard), in Wisconsin Waters. Trans. Wisc. Acad. Sci., Arts, and Lett. 31: 507-512.

INSTITUTE FOR FISHERIES RESEARCH

John E. Williams

Approved by: G. P. Cooper

Typed by: P. R. Darling