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Report No. 1625

THE MUSKELLUNGE IN LAKE ST. CLAIR

By John E. Williams

Lake St. Clair, the various channels near the mouth of the St. Clair River, and the Detroit River have long been world-famous fishing spots for the Great Lakes muskellunge (Figs. 1 and 2). Muskellunge are found also in 25 to 30 large, inland lakes of Michigan, where they furnish some angling and winter spearing, but it is only in Lake St. Clair that the species can be considered fairly abundant. Approximately 40 percent of this 460-square-mile connecting waterway is in the United States and the remainder is in Canada. Lake St. Clair is relatively shallow--the deepest natural depression is about 21 feet deep. Most of Anchor Bay, at the north end of the lake, is less than 10 feet deep. The shipping channel, which bisects the lake near the international boundary and connects the South Channel of the St. Clair River with the Detroit River, has a maximum depth of about 30 feet. The bottom of the lake is chiefly clay with a thin covering of sand or muck. Although catch data have been compiled from a cooperative boat livery since 1939, it was not until 1954 that an effort was made by the Fish Division to study the life history of the muskellunge in Lake St. Clair.

Attempts to rear muskies at the Drayton Plains State Fish Hatchery during 1951 and 1952 from eggs secured in Torch River, Antrim County,

Figure 1. --Sketch of Lake St. Clair, showing localities of special interest in this study. The line of parallel dashes indicates the major shipping channel; the single broken line is the international boundary. The 18-foot contour is shown.

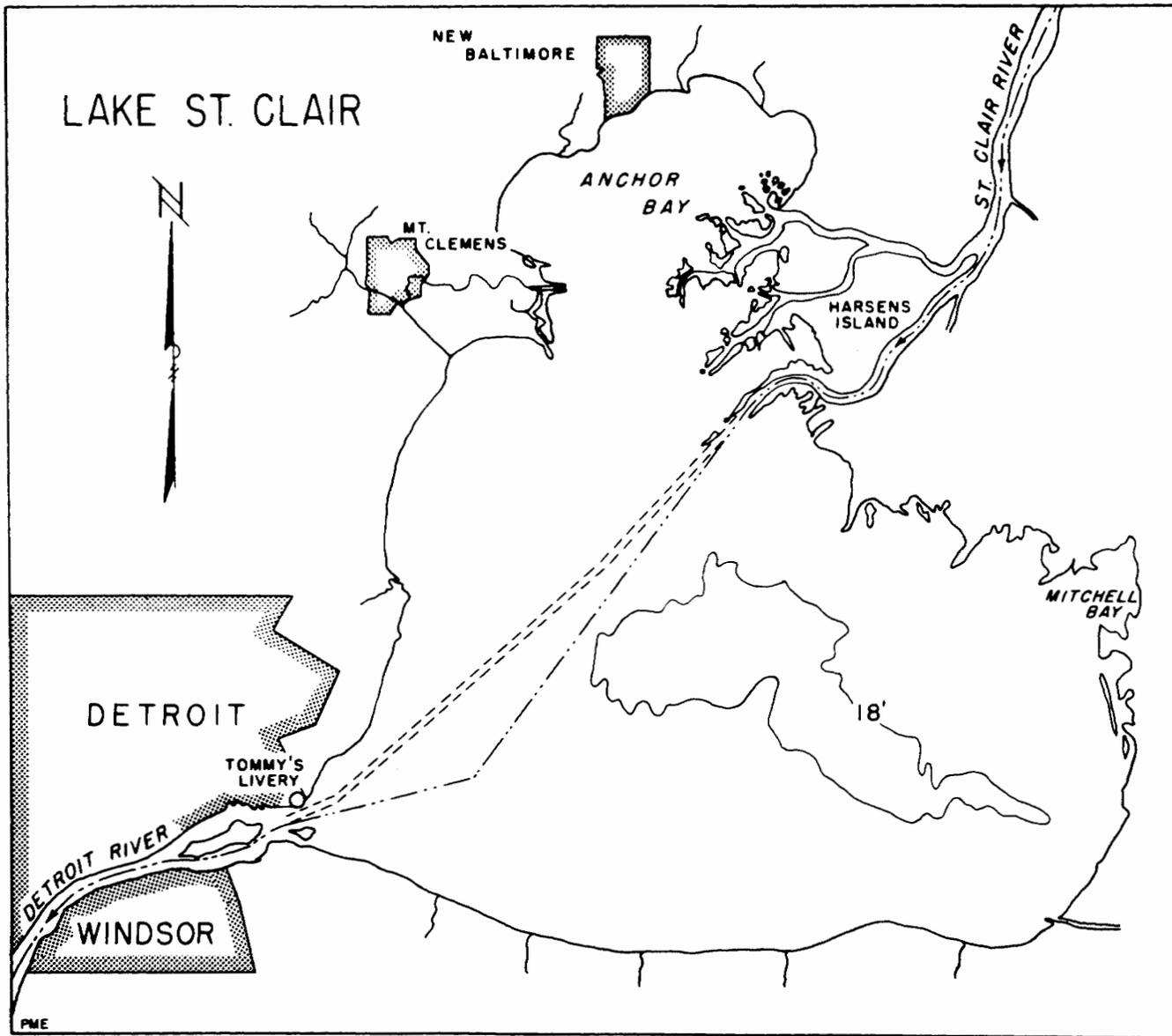


Figure 1

Figure 2. --Fifty-five muskellunge
caught in southern Lake St. Clair during
a three-day weekend, June 25-27, 1955.
Photo taken at Tommy's Boat Livery by
Mr. Joseph Tomsej.



Figure 2

had failed primarily because of inability to net enough brood stock. Reports from boat liverymen at Lake St. Clair indicated that ripe fish were commonly caught during the May-June spawning period by anglers near Mt. Clemens and in the "flats" area off the mouth of the St. Clair River. It was considered likely that, if brought to a central collecting station immediately after they were caught, these fish might furnish viable eggs and milt. Fertilized eggs could then be transported to Drayton Plains Hatchery for hatching and rearing. Simultaneously, netting was to be done at various areas of Lake St. Clair which either appeared to be likely muskellunge spawning habitat or where fishermen were most successful. These areas ranged from channels, connected marshes, and mouths of tributary streams to weed beds located in protected coves and open bays of the lake itself, including Big and Belvidere (little) bays north of Mt. Clemens and Campau Bay south of Mt. Clemens. Netting was carried out with six small trap nets (3 feet high) and one fyke net (4-foot diameter), each equipped with lead and wings (see Figure 3 for location of netting stations). High water in Lake St. Clair during the spring of 1954 resulted in ineffective netting in open-water areas. Muskellunge are difficult to trap unless the net and leads extend to the water surface.) Heavy boat traffic in channels and river mouths limited the netting at these locations, and shallow-water sets were unproductive. The netting effort totaled 128 net days at 13 locations between May 21 and June 17, but no muskellunge were taken. The 4,102 fish of 19 species netted during the period included 711 bluegills, 690 carp, 688 pumpkinseeds, 449 rock bass, 443 gizzard shad, 365 black crappies, 125 freshwater drum,

Figure 3. --Sketch of northern
Lake St. Clair, showing netting sta-
tions, May 21-June 7, 1954.

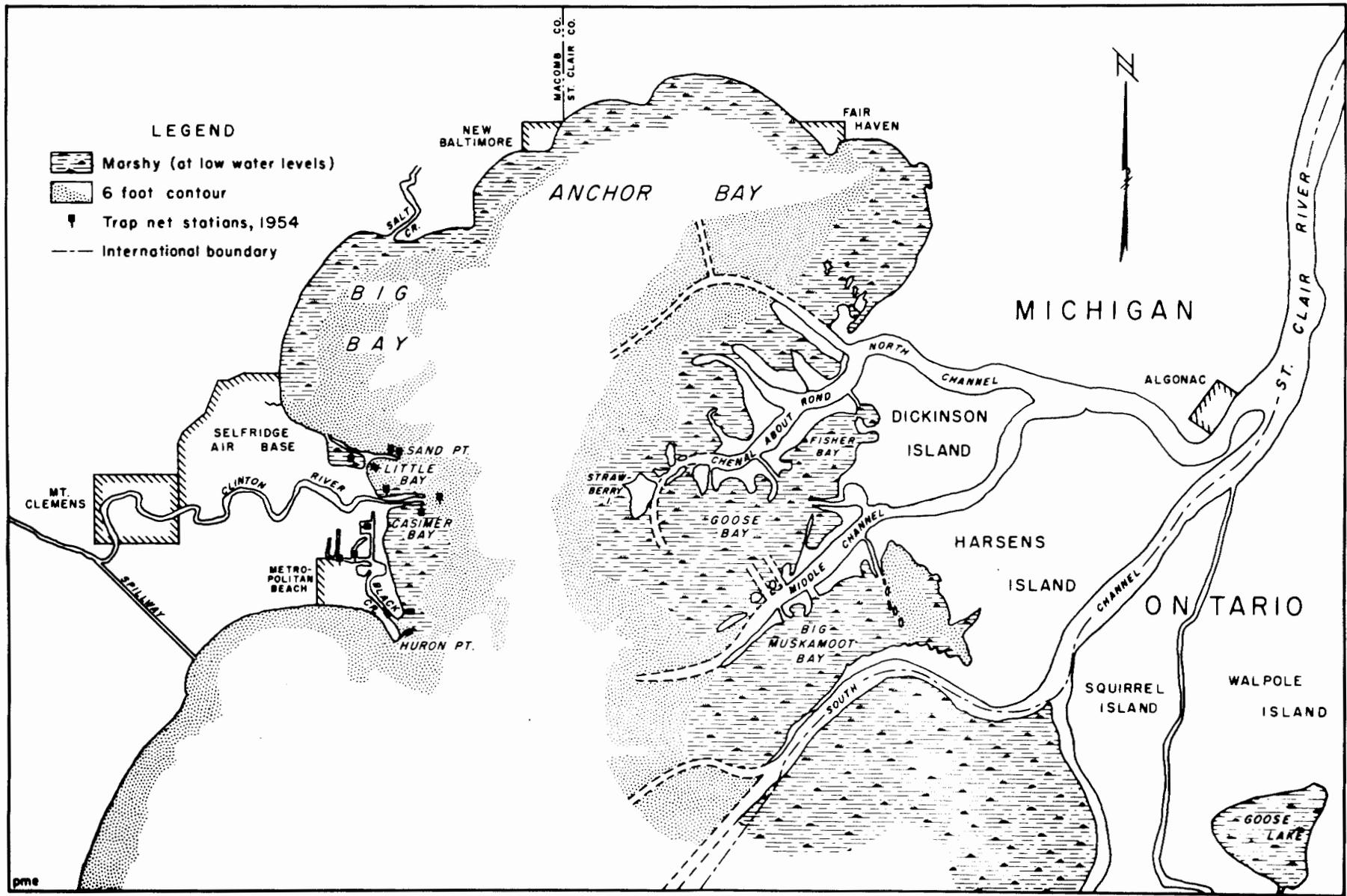


Figure 3

117 bullheads, 113 bowfin, 110 channel catfish, 89 longnose gar, 65 white suckers, 45 white bass, 23 goldfish, 22 smallmouth bass, 15 northern pike, 14 yellow perch, 13 largemouth bass and 5 walleyes. Most of the rock bass, largemouth and smallmouth bass, yellow perch and white bass were taken in typical lake habitat, whereas carp, longnose gar, bowfin, gizzard shad, channel catfish and bullheads were most common in marshy areas and canals. Water temperatures during the netting period varied from 56° to 72° F. and were slightly higher in marshy locations than at lake sites.

While the netting was going on, 222 muskies were brought in by anglers and guides to two boat liveries near the mouth of the Clinton River at Mt. Clemens. Most of the 44 male muskellunge, but only a few of the 22 females, examined during this period were ripe (Fig. 4). The females were green from mid-May until June 1. Few fish were examined during the first week of June, but of 4 large females examined on June 6 and 7, 2 were ripe, 1 was green and 1 was spent. Between June 9 and 14, all of the 8 females examined were partially or completely spent. Many of the females taken after June 8 had large, purplish egg sacs containing eggs attached to the ovarian tissue, rather than the yellowish ovaries and loose eggs associated with ripe or actively spawning females. Based on this retention of some ovarian eggs, I judge that spawning may have been only partially successful in 1954, although no possibly adverse conditions (other than high water) were noted.

Observations on the stage of maturity of angler-caught muskellunge were again made at the boat liveries in 1955 and 1956 (Fig. 4), but netting

Figure 4. --Stage of development
of ovaries of mature muskellunge
examined at Lake St. Clair, 1954-1956.

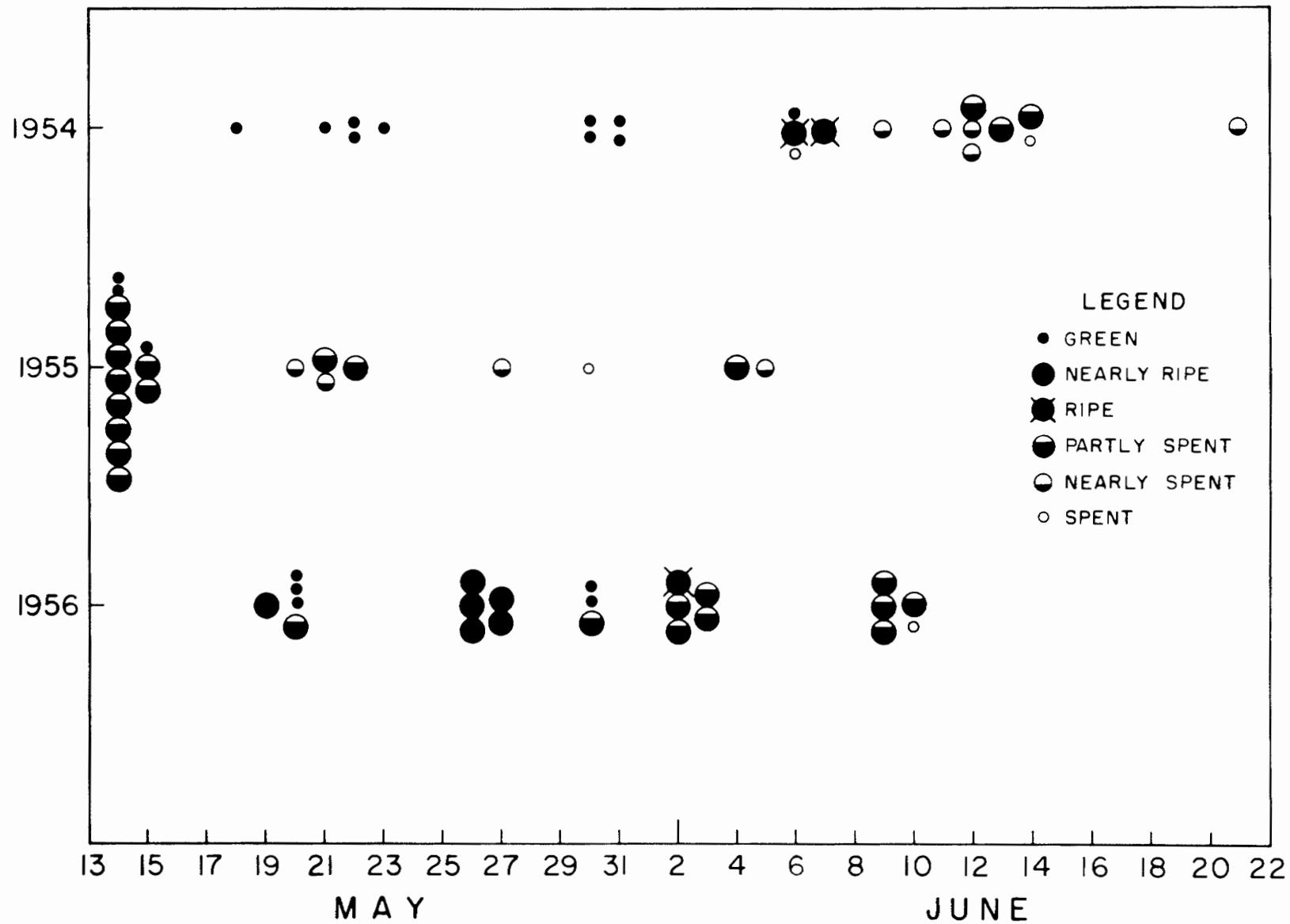


Figure 4

was not undertaken during these seasons. Of 35 fish opened between May 14 and June 5, 1955, 24 were females. Among these females, 2 were definitely immature (19.3 and 29.2 inches), 1 was either immature or completely spent (36.0 inches), 3 were green (May 14 and 15), and 18 were in various stages of spentness. Most females were partially spent by May 14 and no green or ripe ovaries were seen after May 15. In 1956, of 32 fish opened between May 19 and June 10, 24 were females, including 1 immature (33.0 inches), 11 green or nearly ripe (all before June 1), 1 ripe (June 2), and 11 partially or completely spent. All female muskellunge examined after June 2 were at least partially spent. As in 1954, some females were seen in both 1955 and 1956 which were only partially spent 2 or 3 weeks after the main spawning period. The large, fibrous, purple egg sacs of these fish again seemed to indicate that spawning conditions were not completely satisfactory.

In summary, during the 3 years of observation at Lake St. Clair, muskellunge spawning was nearly completed by May 14 in 1955, by June 2 in 1956 and not until about June 9 in 1954. Inasmuch as May was cool in 1954 and 1956 but very warm in 1955, it is likely that muskellunge spawning in Lake St. Clair is directly affected by the water temperature, as has been demonstrated at other locations.

Although few ripe female muskellunge were observed, information gathered from anglers and guides during 1954 revealed that most green, nearly ripe, and partially-spent females caught during the peak of the spawning season were taken in weed-bed areas near the center of Big Bay

and off the mouths of tributary streams such as the Clinton River diversion or spillway, the Clinton River, Black Creek and the various channels of the St. Clair River. These areas at river mouths, and the actual channels of the St. Clair River in the "flats" area, where some water current is present, are believed to be the spawning grounds. Evidence that the Great Lakes muskellunge requires some current on spawning grounds comes from Round Lake, Grand Traverse and Kalkaska counties, and Mullett Lake, Cheboygan County, where this fish ascends the Torch and Indian rivers, respectively, to spawn in lotic environments, ignoring quiet, shallow bayous that would be considered ideal spawning areas for the northern muskellunge of Wisconsin.

Gasow's Boat Livery at Mt. Clemens has promoted musky fishing and kept records on fish brought in from 1939 until about 1957. These records are summarized in Table 1 and included in Figures 5 and 6. The majority of Gasow's fish were caught during the months of May and June and in the northern part of Lake St. Clair, including the "flats" area. Inasmuch as these fish were entries in annual contests, they perhaps were of larger average size than the average for all angler-caught fish. However, anglers and guides were encouraged by Gasow's to bring in and register every legal-size fish caught. Thus the fish recorded at Gasow's probably reflect any major change in average size of the muskellunge in the northern end of Lake St. Clair and changes in fishing pressure and/or abundance of the fish.

Table 1. --Number and average size of muskellunge recorded at Gasow's Boat Livery, Mt. Clemens, 1939-1951 and 1954

Year	Number	Average total length (inches)	Average weight (pounds)
1939	51	38.5	13.9
1940	70	37.8	12.9
1941	87	38.9	13.5
1942	56	39.2	14.5
1943	14	39.1	14.1
1944	66	40.4	15.5
1945	23	41.1	16.8
1946	82	41.0	17.5
1947	54	40.7	15.5
1948	134	39.9	13.9
1949	130	42.2	16.5
1950	110	...	17.7
1951	110	...	16.2
1954	169	39.0	13.2
Total or average	1,156	39.9 (except '50 and '51)	15.1

Figure 5. --Average length of muskellunge entered in contests at various liveries, Lake St. Clair, 1939-1960. The two open circles on the Gasow curve are length estimates based on average weights.

Figure 6. --Average weight of muskellunge entered in contests at various liveries, Lake St. Clair, 1939-1960. Gasow's and Zinner's are records for the northern part of the lake; Tommy's for the southern part.

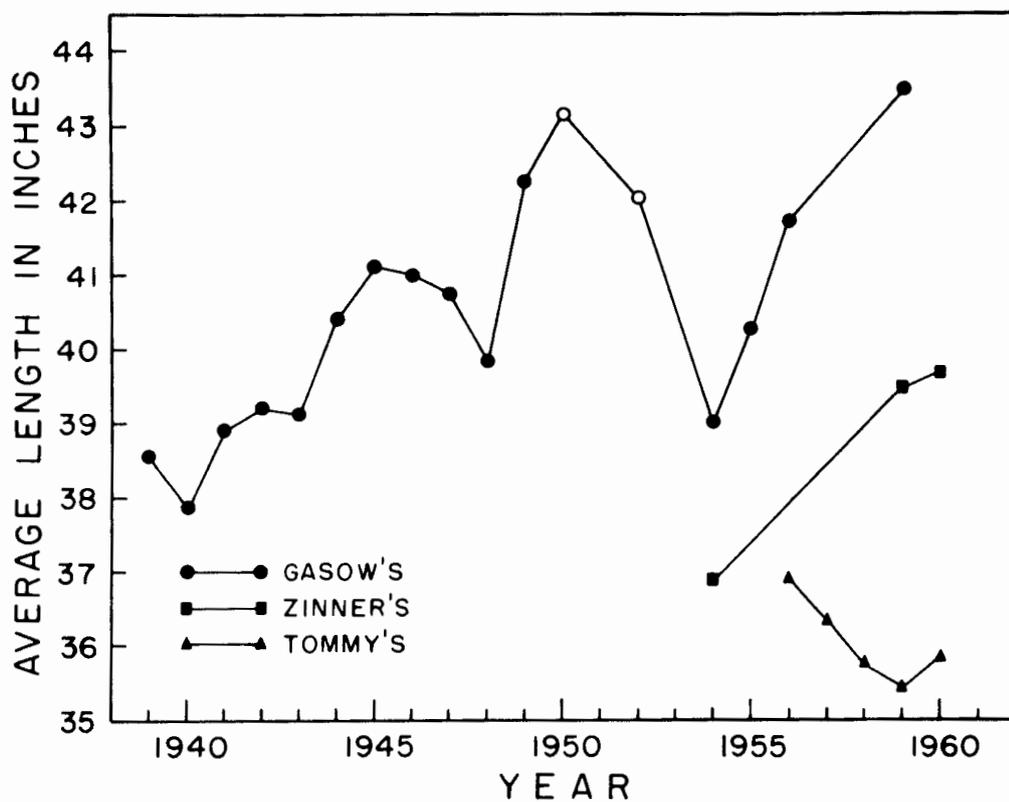


Figure 5

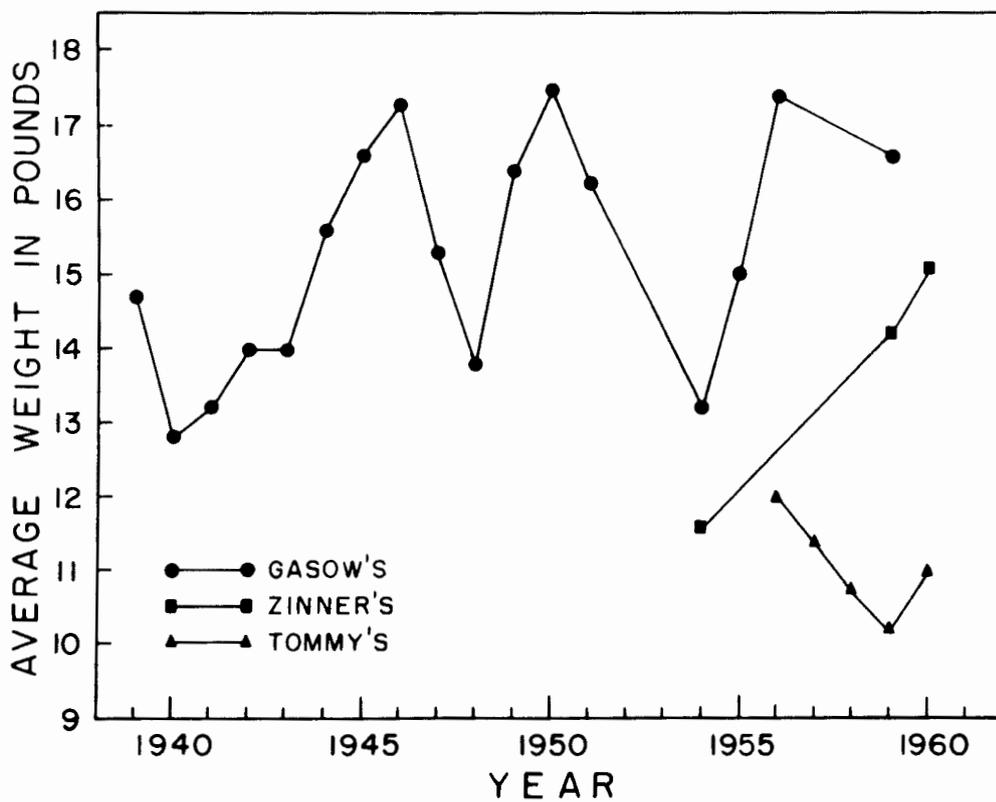


Figure 6

Fish entered in contests at Zinner's Boat Livery at Mt. Clemens, during 1954, 1959, and 1960, are also incorporated in Figures 5 and 6.

In 1955 a concentration of muskellunge in the southern part of Lake St. Clair during midsummer was "discovered" for the first time; at least it was a discovery for anglers on the United States side of the lake. From 1955 on, muskellunge fishing has been heavy on both sides of the international boundary in the southern part of the lake, mainly by anglers and guides from the Detroit Metropolitan Area. The most active "musky headquarters" has been Tommy's Boat Livery in Detroit, where records have been kept since 1955. These records (except for those of 1955 when length and weight data of the 406 muskellunge brought in was not recorded) are compiled in Table 2 and included in Figures 5 and 6.

Length-weight data are given in Table 3 for 3,382 angler-caught muskellunge from Lake St. Clair; 1,477 fish (including 80 known females and 63 known males) were taken by spring fishing in the northern part of the lake between 1939 and 1960, and 1,904 fish (recorded at Tommy's Boat Livery) were taken from the southern part of Lake St. Clair, mostly after mid-June, during 1956 to 1960 (locality of capture for one fish is not known). The length-frequency distributions of angler-caught muskellunge from the north and south parts of Lake St. Clair are given in Figure 7. The fish taken from the north end during the spawning season were mostly over 34 inches long and (Table 3) averaged 15 pounds in weight; those taken from the south end of the lake during summer and fall were of smaller average length and 11 pounds in average weight. Fish within the length range of 30-34

Table 2. --Number and average size of muskellunge recorded
at Tommy's Boat Livery, Detroit, 1956-1960

Year	Number	Average total length (inches)	Average weight (pounds)
1956	277	36.9	11.9
1957	356	36.4	11.4
1958	466	35.8	10.8
1959	452	35.5	10.2
1960	370	35.8	11.0
Total or average	1,921	36.0	10.9

Figure 7. --Length-frequency distribution of 3,365 muskellunge caught in Lake St. Clair by anglers, 1939-1960.

Note: Length measurements were grouped to the nearest whole inch; e. g., fish ranging from 30.5 to 31.4 inches were grouped under 31 inches.

The legal size limit was 30 inches, and the method of grouping used here would account, at least in part, for the low bar at 30 inches. Applies also to Table 3.

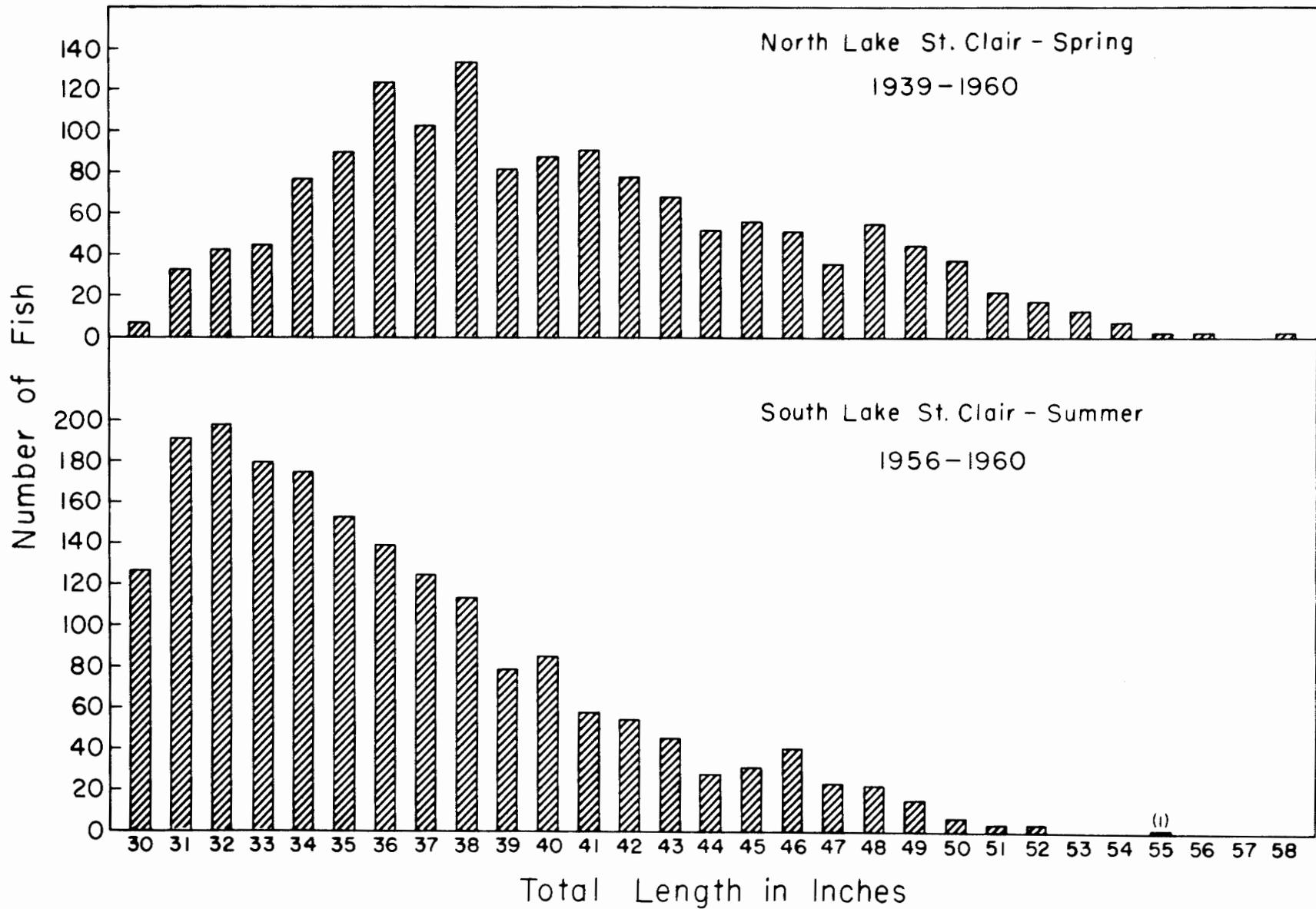


Figure 7

Table 3. --Length-weight relationship of the muskellunge in Lake St. Clair. The length-weight equations are given in the text and represented graphically in Figures 9 and 10

Total length*	North						South		Total					
	1954-1956						1939-1960		1956-1960		1939-1960			
	Female			Male			All fish		All fish		All fish			
	Num- ber	Weight Empirical average	Calcu- lated	Num- ber	Weight Empirical average	Calcu- lated	Num- ber	Average empirical weight	Num- ber	Average empirical weight	Num- ber	Weight Empirical average	Calcu- lated	Weight Empirical average
19.3	1	1.47	1.86	-	-	-	1	1.47	-	-	1	1.47	1.53	
25.4	-	-	-	-	-	-	1	3.44	-	-	1	3.44	3.49	
26.0	-	-	-	-	-	-	3	3.35	-	-	3	3.35	3.75	
26.6	-	-	-	1	3.69	3.99	1	3.69	-	-	1	3.69	4.01	
29.1	1	5.50	5.86	-	-	-	1	5.50	-	-	1	5.50	5.31	
30	-	-	-	-	-	-	7	5.96	127	5.90	134	5.90	5.75	
31	-	-	-	6	6.83	6.26	33	6.99	191	6.38	224	6.47	6.35	
32	-	-	-	2	7.00	6.86	43	7.27	198	7.15	241	7.17	6.98	
33	1	8.50	8.32	5	7.90	7.49	45	7.71	180	7.80	225	7.78	7.65	
34	2	9.25	9.06	9	8.14	8.16	77	8.41	175	8.56	252	8.51	8.37	
35	1	12.50	9.78	4	9.00	8.87	90	9.21	153	9.52	243	9.41	9.13	
36	3	10.83	10.63	12	9.52	9.61	124	10.07	139	10.36	263	10.22	9.94	
37	2	11.87	11.48	6	10.38	10.39	103	10.54	125	11.29	228	10.95	10.78	
38	5	13.40	12.37	9	10.72	11.22	134	11.87	114	12.29	248	12.06	11.68	
39	2	13.12	13.30	3	12.67	12.09	82	12.60	79	13.17	161	12.88	12.63	
40	5	13.90	14.28	2	12.50	13.00	88	13.60	85	14.38	173	13.98	13.63	
41	7	15.25	15.30	4	13.50	13.95	91	14.61	58	15.56	149	14.98	14.67	
42	4	15.69	16.37	-	-	-	78	16.01	55	16.72	133	16.30	15.77	
43	9	18.03	17.48	-	-	-	69	17.24	46	17.59	115	17.38	16.92	
44	9	19.50	18.65	-	-	-	53	18.56	28	19.17	81	18.77	18.12	
45	6	21.36	19.85	-	-	-	57	20.60	31	20.16	88	20.44	19.39	
46	4	22.75	21.12	-	-	-	52	21.30	41	21.39	93	21.34	20.72	
47	1	21.75	22.42	-	-	-	36	22.87	24	22.28	60	22.63	22.09	
48	5	24.30	23.77	-	-	-	56	24.83	23	23.69	79	24.50	23.52	
49	4	29.31	25.19	-	-	-	45	26.00	16	24.76	61	25.67	25.03	
50	2	30.00	26.67	-	-	-	38	27.28	7	24.84	45	26.90	26.59	
51	3	26.25	28.18	-	-	-	23	28.43	4	30.85	27	28.78	28.22	
52	1	36.00	29.75	-	-	-	18	29.91	4	25.62	22	29.13	29.91	
53	2	32.75	31.39	-	-	-	14	30.90	-	-	14	30.90	31.67	
54	1	30.00	33.07	-	-	-	8	31.10	-	-	8	31.10	33.49	
55	-	-	-	-	-	-	2	31.87	1	38.06	3	33.93	35.39	
56	-	-	-	-	-	-	2	33.75	-	-	2	33.75	37.35	
58	1	47.00	40.38	-	-	-	2	38.12	-	-	2	38.12	41.48	
59	-	-	-	-	-	-	-	-	-	-	1	62.50	43.65	
Total	82	-	-	63	-	-	1,477	-	1,904	-	3,382	-	-	
Average (legal fish only)		19.53	-	-	9.58	-	-	15.03	-	10.95	-	12.74	-	

* Lengths to the nearest inch, for fish 30 inches and longer.

K-45

inches comprised 8.7 percent of the fish from the north end and 36.6 percent of those from the south end. The apparent explanation for the larger size of fish in the north end is that the larger fish migrate from the south end to the north end to spawn.

The length-frequency distribution of 142 sexed muskies taken in the north area during May and June, 1954-1956 (Fig. 8) reveals a striking difference in average length of males and females among spawning fish. Most males were 34 to 38 inches in length, and none were over 41 inches. In contrast, there were few spawning females below 38 inches, and most were 40 to 48 inches in length. The maximum weight for males was about 15 pounds (Table 3).

The empirical length-weight relationship of 264 muskellunge from the northern part of Lake St. Clair, recorded at Gasow's Livery between 1939 and 1942, was plotted by Krumholz (1949). Records on Krumholz's fish, plus those recorded in later years from all parts of the lake, are combined in Table 3 and in the length-weight chart of Figure 9. In addition, the length-weight relationship of 145 sexed fish (82 females and 63 males) from the northern area in 1954-1956 is shown in Figure 10. The calculated length-weight relationships of the 145 sexed fish, determined by the method of Beckman (1948), are:

$$\text{Males: } \log W = 2.8661 \log L - 3.4778$$

$$\text{Females: } \log W = 2.7988 \log L - 3.3292$$

and for the total sample of 3,382 fish from Lake St. Clair:

$$\log W = 2.9969 \log L - 3.6669$$

Figure 8. --Length-frequency distribution
of 142 sexed muskellunge caught in Lake St.
Clair by anglers during May and June, 1954-
1956.

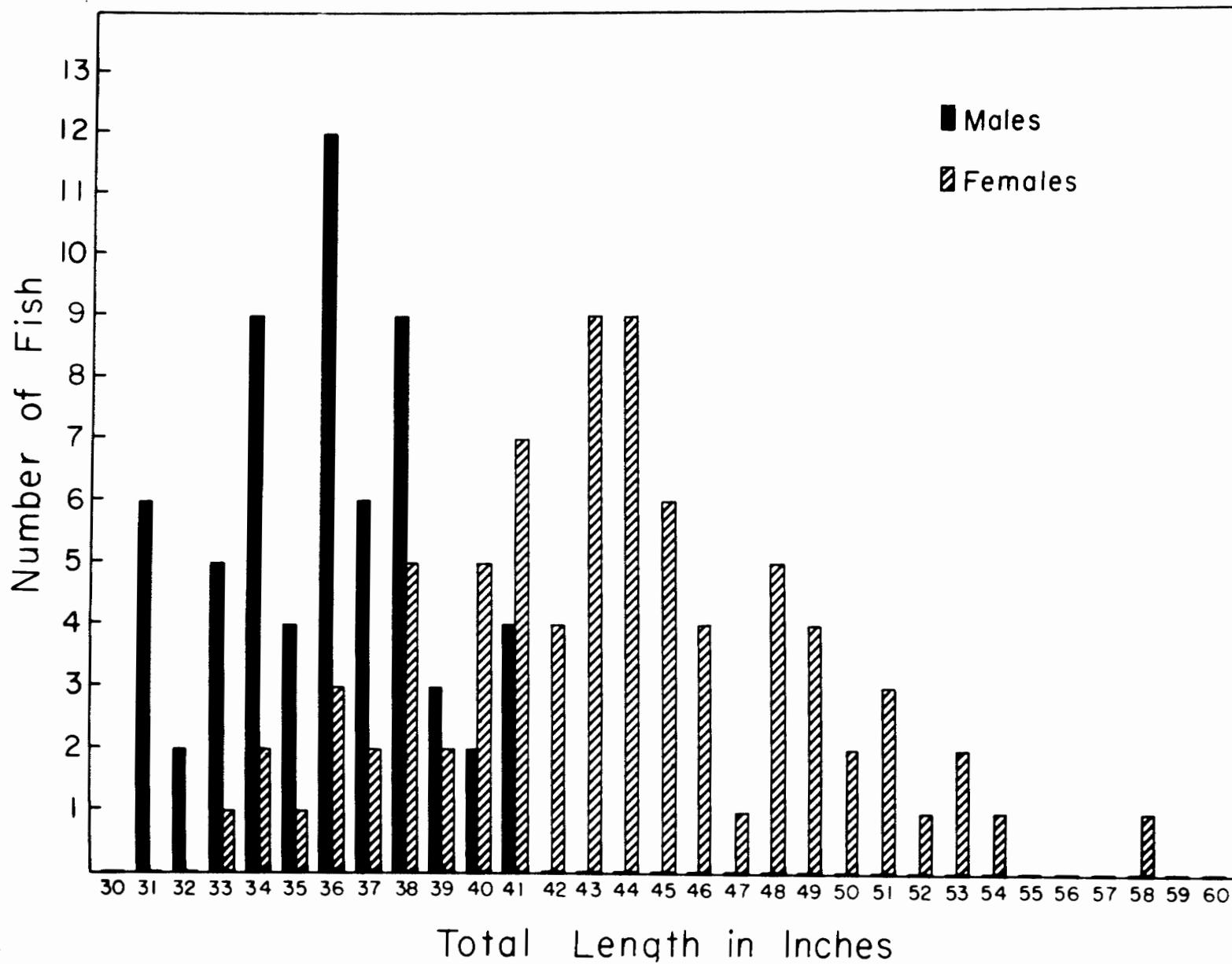


Figure 8

Figure 9. --Empirical (dots) and calculated (curve) length-weight relationship (by 1-inch groups) of 3,382 muskellunge caught in Lake St. Clair by anglers, 1939-1960.

Figure 10. --Empirical (plotted points) and calculated (curves) length-weight relationships (by 1-inch groups) of sexed muskellunge caught in northern Lake St. Clair by anglers, May and June, 1954-1956.

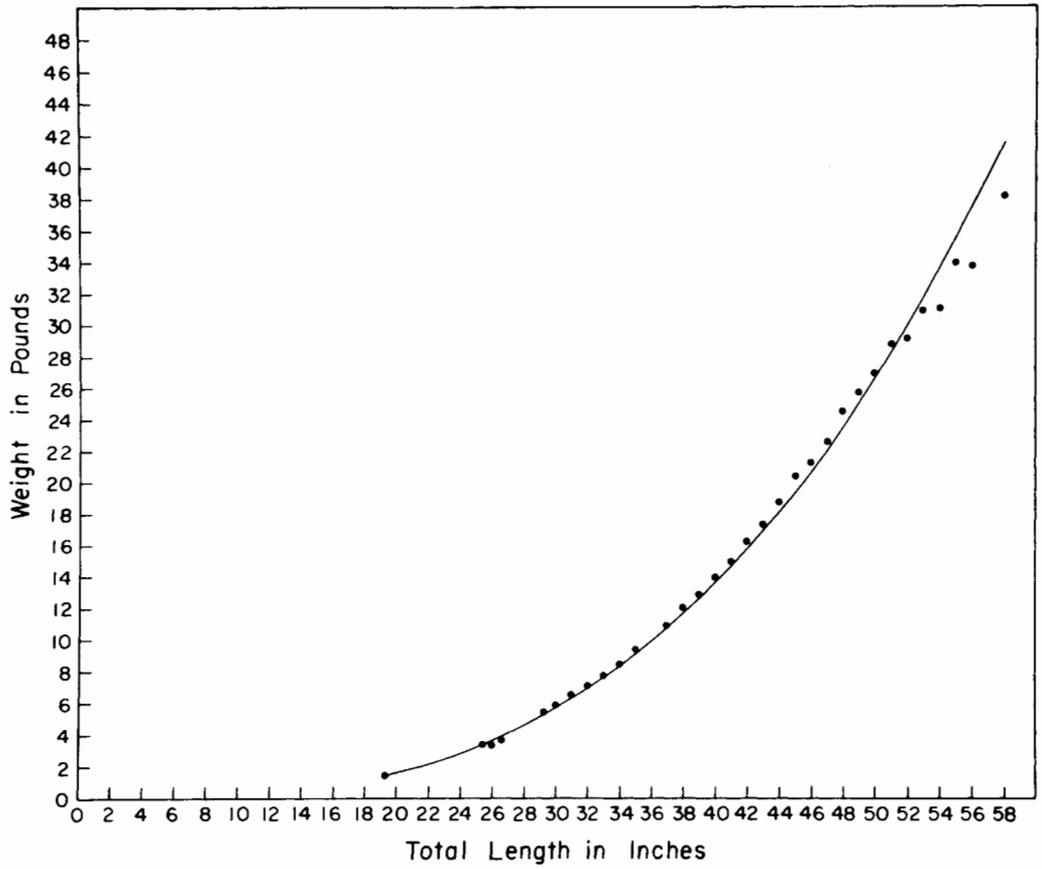


Figure 9

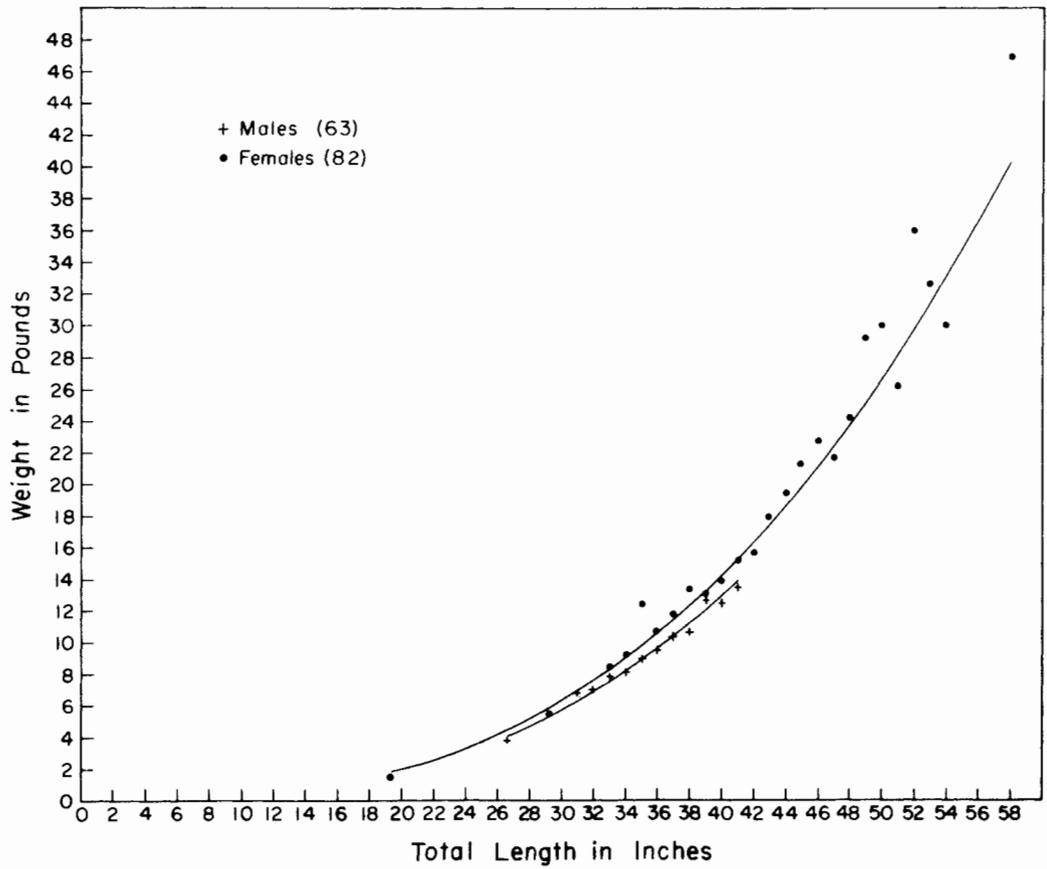


Figure 10

Hourston (1952), using fork length instead of total length, determined that the length-weight relationship of muskellunge from the central region of Ontario could be expressed by:

$$\text{Log W} = 3.204 \text{ Log L} - 3.883$$

and Muir (1960), reporting on the slow growth rate of hatchery-reared muskellunge after planting in Nogies Creek, Ontario, as compared with native stock, found the relationship of the 2 groups (also using fork length) to be:

$$\text{Hatchery reared:} \quad \text{Log W} = 3.074 \text{ Log L} - 3.702$$

$$\text{Native stock:} \quad \text{Log W} = 3.285 \text{ Log L} - 3.875$$

Conversion rates between fork length and total length for fresh specimens of the muskellunge are not at hand, but measurements on small preserved specimens indicate that fork length equals about 0.93 total length. Studies on other species of fish have shown that the tail makes up relatively less of the total length on large specimens than it does on small ones. However, using the above conversion figure (0.93) for an adjustment in the length-weight curves, it appears that muskies from the inland lakes of Ontario are in somewhat better condition than those from Lake St. Clair. The spawning fish in the north end of Lake St. Clair have a better condition factor than those taken later in the summer, although the higher proportion of smaller fish in the summer catch may be partially responsible for this difference. Not only do female muskies grow to a greater length than the males, but they are also considerably heavier at the same length (after maturity), at least during the spawning period.

During the last 10 years of the present study, scale samples were secured from 126 muskellunge from Lake St. Clair, including 34 which were under the legal size of 30 inches. Samples from sublegal fish were secured either by guides from fish which were then released, or by conservation officers from fish confiscated during patrol activities. I am not yet confident that these scales can be read, and further study on this problem is being deferred until known-age material from Lake St. Clair is available. Tentative aging of the samples, however, indicates that muskellunge here may reach legal size in their fourth or fifth year. Males were found mature as young as 3 years of age and as small as 26.5 inches in length (same fish), whereas the youngest and smallest mature female musky was possibly 5 years old and 34 inches in length. As demonstrated by the length-frequency information (Table 3), males seldom exceed 41 inches in length and 15 pounds in weight; they are also apparently somewhat slower growing and shorter lived than females. The latter commonly reach 52 inches in length and 30 pounds in weight. Nearly every year at least one fish over 35 pounds in weight is caught in Lake St. Clair, but fish over 40 pounds are apparently rarer here than in other parts of Michigan and North America. In the last 21 years only 2 muskellunge over 40 pounds in weight have been reported from Lake St. Clair, including the 62 1/2-pound, former world-record fish taken here in 1940.

For the 1955 and 1956 muskellunge fishing seasons (mostly during May and June) in northern Lake St. Clair, creel census sheets were given to 4 guide-boat operators who were anxious to cooperate in a census of

muskellunge fishing. The guides kept records on the number of lines fished each day, the number of hours fished each day and the number of muskellunge caught. Thus, the hours fished are actual angler hours and not guide-boat hours. For 1955, guides returned forms stating that 46 legal muskellunge had been caught in 1,117 hours (24 hours per fish). For 1956, guide records included 26 muskellunge caught in 781 hours (30 hours per fish). Also, during 1955 and 1956, biologists obtained records on muskellunge fishermen who rented boats on weekends at Gasow's Boat Livery in Mt. Clemens. In 1955, a total of 113 anglers were checked who had fished 664 hours and caught 2 muskellunge (332 hours per fish). In 1956, anglers numbered 98 and the catch was 3 muskellunge in 466 hours (155 hours per fish). Thus, during the 2 seasons combined, anglers using guides averaged 1 muskellunge in 26 hours of fishing, but inexperienced anglers (or those using small boats) averaged only 1 muskellunge in 226 hours. Records kept by one angler (apparently an expert) in the southern part of Lake St. Clair in 1956 revealed 7 muskellunge taken in 186 hours (27 hours per fish), plus 4 sublegal fish caught and released. It is apparent that muskellunge anglers who employ guides are many times more successful in catching muskellunge than are those who rent small boats.

There is considerable discrepancy between the Michigan and Ontario sport-fishing regulations on the muskellunge in Lake St. Clair and the St. Clair and Detroit rivers. Ontario has a closed season between December 16 and June 24, whereas Michigan has no closed season. Michigan allows winter spearing on Lake St. Clair, but Ontario does not. Ontario has a

creel limit of 2 per day; Michigan has no creel limit. Ontario has a 28-inch size limit; Michigan has a 30-inch limit.

No information is available to indicate whether or not the muskellunge population(s) in Lake St. Clair is being overexploited. From boat livery records it seems obvious that at least 1,000 muskellunge are being taken by hook and line each year. Guides, livery operators and others believe the yearly Michigan take may be several thousand fish, especially in years when winter spearing is highly successful. At the present time Ontario apparently has no concrete evidence to justify their more restrictive regulations in Lake St. Clair. Naturally, however, they feel that the spearing and heavy spring fishing practiced in Michigan waters may be hurting the muskellunge population, particularly if only one discrete population is involved and if most of the fish spawn in the northern part of the lake.

In a discussion between Michigan and Ontario biologists in 1960, there was general agreement that research should be initiated to determine the number of muskellunge in the Lake St. Clair population, whether there are discrete subpopulations, and the degree of harvest being made by both Michigan and Ontario. There should be co-operative research by biologists from Michigan and Ontario and this should include the tagging of as many muskellunge as possible, followed by an intensive creel census and population study. Accurate records maintained by reliable guides and livery operators after the tagging is begun could be of material assistance in both census and exploitation estimates.

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INSTITUTE FOR FISHERIES RESEARCH

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