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Two subspecies of *Esox masquinongy* have been recognized (Dymond, 1947) in Canadian waters namely, *E.m. masquinongy* Mitchill (St. Lawrence maskinonge) and *E.m. immaculatus* Garrard (northern maskinonge). They are distinguished by their pattern of markings, the typical subspecies having "round or squarish blackish spots of varying size" (Jordan and Evermann, 1896-1900), while the *immaculatus* form has spots, cross-bars or both, generally very indistinct except on the tail (Weed, 1927). Although some of the earlier workers (Mitchill, Garrard, Weed) appear to have considered these forms as separate species, most recent authors (Eddy and Surber, 1943; Hubbs and Lagler, 1947) refer to them as subspecies of *E. masquinongy*. All of these authors give a pattern of markings as the basis of distinction, but in some cases a scepticism of the value of classification on the basis of colour pattern is indicated (Eddy and Surber, 1943).

The problem of subspecific classifications in maskinonge is open to more thorough study and revision. The present study is designed to determine the nature and extent of the taxonomic differences between maskinonge from different parts of its Canadian range. Where practical, the level of identification of 75 per cent of a group has been set as the goal of comparison, as this level of difference is often used in describing subspecies. It is a generous expression of the requirement outlined by Hubbs (1943) that "much more than half of the given population be distinguishable; not necessarily at all times and places, but at least in one sex, at some given stage of development."

A taxonomic study of the maskinonge is further complicated by a form known locally as the "true tiger" maskinonge which is now known to be an infertile hybrid between *E. masquinongy* and *E. lucius* (Cameron, 1948). This hybrid has distinct dark cross-bars sloping forward and occasionally broken by distinct dark spots; the cheek and opercle are distinctly marked. It is found along with the northern maskinonge in Maskinonge Lake and Little Vermilion Lake near Sioux Lookout in the Kenora district of Ontario.

*The name of this fish has appeared in as many as forty-five different forms such as muskellunge, muscalonge, masquinonge, maskinonje, mosconongе, etc. However, the spelling maskinonge (or the French maskinongé) seems preferable since it is the one used in the statutes of the provinces of Ontario and Quebec. The derivation of the name is likewise disputed, but most authors seem to favour an Indian source. Chambers (1922) discusses this etymology and favours a derivation from the Chippewa *mis* or *mas* (large) *kenosha* (pike).

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MATERIALS AND METHODS

Locality of the Investigation

In Canada the maskinonge is found in bays of the Great Lakes, medium sized lakes and larger rivers from the St. Lawrence River to the upper reaches of the Winnipeg River (Dymond, 1947). Rather than attempting to gather specimens over the entire extent of the known range of the fish, an investigator was sent for one summer to each of three general areas in Canada where maskinonge have been reported to be relatively abundant. These areas are indicated in Figure 1, and may be outlined as follows:

(i) *Western.* This region, from which specimens were examined in 1946, comprises the Kenora and Rainy River districts in North-western Ontario. In the course of the study the following lakes were visited: Little Vermilion, Big Vermilion, Maskinonge, Eagle, Mud (Hooch), Cedarbough, Cedar, Clay, Class, Corner, Indian and Fluke. The Sabascong and Whitefish Bays on Lake of the Woods were also visited. All of these waters drain into Hudson Bay.

(ii) *Central.* This area was studied in 1947 and covers the Kawartha Lakes and Georgian Bay region of central and northern Ontario. The waters visited include Buckhorn, Lovesick, Pigeon, Rice, Scugog and Stony Lakes, Indian River, Deer Bay and Georgian Bay (at Sans Souci). These waters all drain into the Great Lakes. No specimens were taken from Lake Erie which has been reported to contain a spotted form quite different in appearance from the maskinonge of the Kawartha Lakes region (Hubbs, personal communication, 1949).

(iii) *Eastern.* In general, this district, which was sampled in 1948, includes the St. Lawrence River (and tributary waters) from the Ontario border to about eighty-five miles east of Montreal. The majority of fish examined were taken from Lake St. Francis, Lake St. Louis, and Lake of Two Mountains in the St. Lawrence River near Montreal.

Collection of Data

Since the maskinonge is a comparatively rare fish, the capture and collection of specimens by an individual investigator would not likely provide sufficient material for a study of this nature. By examining specimens taken by the numerous anglers fishing in the region under study it was possible to overcome this difficulty to a large extent. One of the drawbacks to this method was that it was sometimes impossible to gather complete data on each fish. It was easier to do so in the eastern region, where the Department of Fish and Game for the Province of Quebec offered a three dollar reward to any angler who caught a maskinonge and submitted it for a complete examination. In this manner data were collected on a relatively large number of specimens at a reasonable cost.

Mr. G.S. Cameron gathered the field data during 1946 and 1947 while the author and Mr. Cameron worked together in 1948. The original field data (body measurements in millimetres, fin and scale counts, photographs of each specimen, colour photographs of most of the specimens, and field notes) are permanently on file at the Royal Ontario Museum of Zoology and Palaeontology where they are available for examination and further analysis.

RESULTS

Comparison of Markings

Hitherto, the maskinonge has usually been divided into taxonomic categories mainly on the basis of the pattern of its markings. To test the reliability of this criterion and investigate it further, photographs were taken of each specimen examined. Colour photographs were also taken when conditions were suitable. From a study of enlargements made of these photographs and notes made when the fish were examined, the specimens from each region were classified according to their markings. The types of marking found included:

(i) *Spots.* – marks with their vertical height less than four times their horizontal width (Figures 2, 3).

(ii) *Bars.* – marks with their vertical height more than four times their horizontal width and with a definite "straight" shape and direction of slope (Figures 4, 6).

(iii) *Bars and Spots.* – a combination of the above two types of marks (Figure 7).

(iv) *Vermiculations.* – "wormlike" dark streaks with an irregular path and no definite shape (Figure 8).

(v) *Clear.* – without any dark marks or blotches imposed on the background except in the caudal region where indistinct marks were often visible (Figures 9-11).

Any fish whose markings could not be classified clearly under the above headings was listed as doubtful. This category included faded specimens on which the marks could be detected but were not distinct enough to be defined. These fish comprised 14.7 per cent of the total number examined and were excluded from the analysis. The classification according to markings is given for size groups of 200 mm. in Table I. All types of markings were found in every region except the spotted type in the central region. The tendency of spots to persist in the larger specimens, which has been considered characteristic of *E.m. masquinongy*, prevailed among maskinonge from the eastern region. The marking pattern characteristic of *E. m. immaculatus* (bars, fading with age) was shown by the fish from the western and central regions where the barred specimens are mainly in the smaller size groups and the larger fish show a greater tendency to be clear.

Considering only the types of markings used to identify *E. m. masquinongy* and *E. m. immaculatus*, (spots, and bars or clear), the percentage of each type has been tabulated below by region, with the number of specimens examined given in parentheses.

	Western	Central	Eastern
Spots	15 (5)	0 (0)	64 (90)
Bars, clear	85 (28)	100 (30)	36 (51)

Thus, well over three-quarters of the western and central fish are distinguished by the markings of bars or clear and nearly two-thirds of the eastern maskinonge may be distinguished by persistent spotted markings.

When all the types of markings found are included, the results do not differ appreciably.

	Western	Central	Eastern
Spots, bars and spots	23 (13)	6 (2)	61 (112)
Bars, vermiculations, clear	77 (44)	94 (31)	39 (71)

TABLE I

Frequency of Occurrence of the Various Types of Markings.

	Fork length mm.	TYPE OF MARKINGS						
		Bars	Bars and Spots	Spots	Vermiculations	Clear	Doubtful	Number in Class
301-500	eastern	1	—	—	—	—	—	1
501-700	eastern	2	2	5	—	1	—	10
	central	4	—	—	—	1	7	12
	western	1	—	—	—	—	—	1
701-900	eastern	8	11	47	8	10	10	94
	central	9	2	—	—	8	7	26
	western	19	6	4	7	5	3	44
901-1100	eastern	9	6	31	5	13	12	76
	central	—	—	—	1	6	1	8
	western	1	2	1	8	1	3	16
1101-1300	eastern	1	3	7	7	6	4	28
	central	1	—	—	—	1	—	2
	western	—	—	—	1	1	—	2
Total	eastern	21	22	90	20	30	26	209
	central	14	2	0	1	16	15	48
	western	21	8	5	16	7	6	63
Percentage	eastern	10.0	10.5	43.1	9.6	14.4	12.4	100.0
	central	29.2	4.2	0.0	2.1	33.3	31.2	100.0
	western	33.4	12.7	7.9	25.4	11.1	9.5	100.0

The inclusion of vermiculations in the *immaculatus*-like markings seems justified since the markings on the barred fish seem to break up with age into vermiculations, and even the "spotted" fish from the western region (Figure 3) show a rather vermiculated pattern with squarish irregular spots. On the other hand the fish with markings in the form of "bars and spots"tended to resemble the spotted fish more than the barred fish.

The classification "clear" may be open to some question as it is possible that the markings on some of these specimens faded subsequent to capture and that this had not been recognized. Thus, considering only actual marks, the results become:

	Western	Central	Eastern
Spots, bars and spots	26 (13)	12 (2)	73 (112)
Bars, vermiculations	74 (37)	88 (15)	27 (41)

On this basis, about three-fourths of the specimens are separable, but over 20 per cent of the specimens taken are not included. While a large portion of the latter may have had to be excluded because of technical difficulties, some of these fish must have been clear of markings in their natural state.

The general pattern of markings of the *immaculatus*-like form found in the western region has already been described by Cameron (1948) from the specimens taken during this study. His description, with appropriate changes in figures and figure numbers, states that: "Small specimens of the typical form (up to about 30 inches in length) are predominantly bluish green on the sides, with distinct dark vertical bars (Figure 12). Larger fish show a gradual darkening of colour, while the markings become gradually obscured (Figure 13). The back is often so dark a shade as to be almost black. This colour shades down through bronze to sides that have a ruddy ground colour. As a fish ages, the bars break up into obscure blotches which remain more distinct in the caudal region (Figure 14). In the largest specimens (over 40 inches) the sides are usually of a uniform, dirty brownish colour. The belly is usually white, although that of some young maskinonge is marked by faint dark patches. The fins are typically of a brownish colour with obscure darker blotches; the fins are often of a vivid red colour."

This general description may be applied also to maskinonge from the central region. In the east, however, the marking pattern typical of *E. m. masquinongy* predominates. Markings break up at an early stage (about 500 millimetres) into relatively small spots (Figure 15), and these spots tend to persist. They are found on specimens larger than 1150 millimetres (Figure 16). The general coloration is similar to that found in the west, the back being a dark olive-brown, almost black in many cases. This fades into a bluish or brownish green on the sides, sometimes marked with faint dark patches in the younger fish, which in turn fades into the white belly. The fins are similar to those described for the western form.

Comparison of Body Proportion Measurements, Fin Ray Counts, and Scale Counts

From each maskinonge examined, a set of 26 measurements and counts was taken. These included head length, depth of head, length of eye, snout length, least (bony) interorbital width, length of upper jaw, length from snout to occiput, body depth, body width, length of caudal peduncle, depth of caudal peduncle, length of longest ray, length of base and number of rays for dorsal, anal, pectoral and pelvic fins, lateral line scale count, branchiostegal rays and mandibular sen-

sory pores. Body measurements were made as outlined by Hubbs and Lagler (1947) with the exception that the opercular membrane was not included in the head length and that the length of the caudal peduncle was measured along the lateral line from a point directly above the insertion of the anal fin to the end of the vertebral column. The following additional measurements were employed.

1. Length of longest pelvic ray – measured as for the longest pectoral ray.
2. Length of pectoral and pelvic bases – measured as for the dorsal and anal fins.
3. Body width – the maximum width of the body.
4. Length from snout to occiput – defined as the distance from the anterior tip of the snout to the occiput.

Fork length was used as the measurement of body length. The number of specimens examined from each region is given for length groups of 200 mm. in Table II. This table also gives the mean fork length for each group and the conversion factor for changing fractions of fork length to fractions of standard length and natural tip length. The latter measurement was taken with the tail fin in its natural position, and was the distance from the snout to a perpendicular drawn from the longer lobe of the caudal fin, measured along the mid line of the body. The individual body proportion measurements and counts were plotted for indications of sexual dimorphism but no such differences were noted. The sexes were then lumped and the data compared by region and size group.

TABLE II

Number of specimens, mean fork length and conversion factors for changing fractions of fork length to fractions of standard length and natural tip length for maskinonge from each of the five length groups in the three regions studied.

		Fork length in mm.				
		301-500	501-700	701-900	901-1100	1101-1300
Number of specimens	Eastern	1	10	98	76	28
	Central	1	18	36	10	2
	Western	–	2	52	20	2
Mean fork length	Eastern	426	617.8	814.3	979.9	1163.1
	Central	359	651.2	759.2	984.9	1159.0
	Western	–	680.0	801.9	971.9	1104.5
Conversion factor to thousandths of standard length	Eastern	1.1038	1.0841	1.0781	1.0740	1.0676
	Central	1.0977	1.0831	1.0893	1.0741	1.1186
	Western	–	1.0965	1.0892	1.0847	1.0893
Conversion factor to thousandths of natural tip length	Eastern	.9259	.9408	.9429	.9480	.9546
	Central	.9116	.9245	.9296	.9395	.9483
	Western	–	.9479	.9446	.9481	.9479

None of the counts showed an apparent difference between size ranges, and so their frequency distributions were compared by region. The western fish tended to have one less ray in their dorsal and anal fins while the eastern fish tended to have one more mandibular sensory pore than those from the other two regions. Neither of these differences were statistically significant. The large variation found in the lateral line scale count within the individual regions precluded significant comparisons of this character between regions. The other characters failed to differ in their regional modes.

The data on all measurements and counts were tabulated in the form of range, mean, standard deviation and dispersion of body measurements, expressed in thousandths of the fork length.

The dispersion is defined as 0.6745 times the standard deviation and the range of mean ± dispersion includes half of the observations in a normal frequency distribution, so that a quarter are excluded on either end. These tabulations are on file at the R.O.M.Z.P.; means and standard deviations of all characters are given in Table III.

A tendency to increase proportionately with an increase in body length was shown by the depth of head, least interorbital width, and length of upper jaw; whereas the length of eye, length of caudal peduncle, length of longest ray for all fins, and the length of anal base, all showed a tendency to decrease proportionately with increasing size. These differences were comparatively small in most cases but indicate the necessity of the size group breakdown as employed herein.

Each of the individual size ranges of the characters compared were tested for significant differences using the "t" test (Snedecor, 1937) in order to ensure that any distinctions found were statistically significant. The three populations differ significantly in respect to average size of the majority of the characters studied. In all, 98 out of 168 comparisons showed differences at the P= .01 level of significance, and 112 at the P= .05 level of significance. Since each of the groups includes fish from several populations, these represent regional differences in the character of the species.

Characters showing approximately 75 per cent distinction were length of longest pectoral ray (eastern from western and central regions), and depth of caudal peduncle, length of pectoral base, and length of pelvic base (western from central and eastern regions). This lack of overlap in the 75 per cent range was also noted for one size class of head length, least interorbital width, length of anal base, and lateral line scale count, but these differences were not considered to be sufficiently distinct for consideration at this level.

On the basis of the length of the longest pectoral ray, the eastern fish were distinct from those of the other two regions in four of the five comparisons made and nearly so in the fifth. On the other hand, the western and central fish show considerable overlap in their 75 per cent ranges for this character. Thus it would seem that the eastern fish may be distinguished from those in the western and central regions by the length of the longest pectoral ray.

The western fish tended to be distinct on the basis of caudal peduncle depth, (for three of the four comparisons), length of pectoral base (two of four comparisons), and length of pelvic base (for three of four comparisons). The 75 per cent

TABLE III.

CHARACTER	EASTERN REGION 301-500	501-700	701-900	901-1100	1101-1300
BODY PROPORTIONS					
Head Length	256	252.4	250.8	253.4	255.7
	(–)	(8.3)	(6.6)	(6.7)	(7.0)
Depth of Head	089	097.9	102.2	104.9	106.4
	(–)	(3.5)	(7.7)	(5.0)	(7.8)
Length of eye	031	028.7	026.0	024.4	023.3
	(–)	(1.7)	(1.6)	(1.7)	(1.3)
Snout Length	110	105.5	105.3	106.9	107.9
	(–)	(1.9)	(4.1)	(3.2)	(4.0)
Least (bony) inter-	059	057.5	060.4	062.4	064.7
orbital width	(–)	(2.0)	(3.2)	(2.6)	(2.7)
Length of upper jaw	122	118.8	122.1	126.3	129.2
	(–)	(3.5)	(4.0)	(4.5)	(3.8)
Length from snout	185	179.0	176.6	175.6	175.1
to occiput	(–)	(6.7)	(5.2)	(5.0)	(4.8)
Body depth	141	151.2	164.0	167.5	167.9
	(–)	(8.3)	(11.2)	(12.7)	(13.3)
Body width	077	087.9	090.9	091.2	093.3
	(–)	(6.0)	(5.1)	(7.6)	(5.1)
Length of caudal	101	107.3	107.8	105.3	104.8
peduncle	(–)	(7.1)	(6.1)	(5.8)	(4.1)
Depth of caudal	063	063.9	063.9	064.7	062.3
peduncle	(–)	(2.9)	(3.2)	(2.9)	(4.2)
Length of longest	131	113.4	103.6	096.9	091.3
dorsal ray	(–)	(6.0)	(5.7)	(6.5)	(6.1)
Length of dorsal	113	107.5	113.0	111.3	108.4
base	(–)	(8.2)	(5.2)	(5.9)	(6.7)
Length of longest	134	112.6	108.2	101.3	094.3
anal ray	(–)	(5.8)	(5.4)	(6.8)	(6.6)
Length of anal base	096	095.5	095.9	093.8	091.2
	(–)	(2.8)	(4.2)	(5.6)	(3.9)
Length of longest	108	091.0	093.1	092.7	088.7
pectoral ray	(–)	(7.4)	(8.6)	(5.4)	(6.3)
Length of pectoral	028	028.4	029.9	030.8	030.7
base	(–)	(2.3)	(2.0)	(2.4)	(2.7)
Length of longest	108	090.4	088.3	085.7	079.6
pelvic ray	(–)	(5.7)	(5.2)	(4.9)	(4.8)
Length of pelvic	028	028.1	029.7	030.6	030.7
base	(–)	(2.3)	(2.2)	(2.0)	(2.4)
COUNTS					
Lateral line scale	149	143.9	147.5	148.2	147.9
count	(–)	(4.6)	(5.5)	(4.8)	(6.4)
Branchiostegal rays	18	18.1	17.9	17.9	18.1
	(–)	(0.6)	(0.6)	(0.8)	(1.1)
Mandibular sensory	7	8.3	7.8	7.9	7.8
pores	(–)	(0.9)	(1.0)	(1.0)	(1.1)
Dorsal fin rays	22	21.9	22.5	22.7	22.2
	(–)	(1.2)	(0.8)	(0.9)	(0.9)
Anal fin rays	21	20.5	20.9	20.8	20.9
	(–)	(0.5)	(0.6)	(0.9)	(0.5)
Pectoral fin rays	17	17.4	17.4	17.5	17.3
	(–)	(1.1)	(0.8)	(0.7)	(1.1)
Pelvic fin rays	12	12.0	11.9	12.0	12.0
	(–)	(0.5)	(0.8)	(0.5)	(0.6)

ean and Standard Deviation (in parentheses) of Body Proportion Measure-
ents (expressed in thousandths of the fork length) and Counts, According
Region and Length Groups.

CENTRAL REGION					WESTERN REGION			
301-500	501-700	701-900	901-1100	1101-1300	501-700	701-900	901-1100	1101-1300
BODY PROPORTIONS								
256	254.9	251.0	249.0	254.5	264.5	251.0	259.1	254.5
(–)	(6.3)	(9.0)	(6.5)	(–)	(–)	(5.7)	(7.9)	(–)
123	098.9	096.0	100.2	102.5	109.0	103.7	109.0	106.0
(–)	(6.6)	(5.6)	(6.3)	(–)	(–)	(8.6)	(7.6)	(–)
028	026.6	025.7	023.3	021.5	030.0	027.0	024.8	023.5
(–)	(1.6)	(1.5)	(1.1)	(–)	(–)	(1.6)	(1.5)	(–)
114	104.8	104.5	103.4	109.0	107.5	103.7	108.3	109.0
(–)	(2.9)	(3.0)	(5.1)	(–)	(–)	(2.9)	(3.9)	(–)
056	057.7	059.0	059.9	063.0	061.0	061.0	063.3	063.0
(–)	(3.3)	(1.5)	(2.1)	(–)	(–)	(2.4)	(2.3)	(–)
120	121.4	122.1	123.3	128.5	125.0	120.2	128.2	123.5
(–)	(4.8)	(3.6)	(4.6)	(–)	(–)	(6.6)	(4.3)	(–)
195	176.8	174.4	172.5	175.5	181.0	174.3	178.0	175
(–)	(5.3)	(4.0)	(7.6)	(–)	(–)	(4.4)	(6.1)	(–)
128	151.5	154.6	159.1	157.0	174.5	167.5	168.0	182.0
(–)	(10.7)	(10.8)	(13.7)	(–)	(–)	(11.6)	(12.8)	(–)
084	085.7	086.1	094.8	084.5	104.0	099.3	099.0	112.0
(–)	(6.3)	(6.7)	(5.8)	(–)	(–)	(6.1)	(5.6)	(–)
117	115.6	108.2	105.1	105.5	113.0	115.7	110.3	108.5
(–)	(5.9)	(6.8)	(6.1)	(–)	(–)	(8.1)	(7.5)	(–)
056	062.4	061.9	061.0	059.5	073.5	068.6	068.6	070.0
(–)	(2.6)	(2.6)	(3.9)	(–)	(–)	(3.3)	(4.5)	(–)
128	114.3	107.2	097.2	094.0	117.0	105.8	100.5	096.5
(–)	(3.8)	(5.2)	(3.6)	(–)	(–)	(5.1)	(5.4)	(–)
120	115.4	114.3	110.5	106.5	126.0	111.1	109.0	110.5
(–)	(3.6)	(4.9)	(4.2)	(–)	(–)	(6.7)	(4.4)	(–)
131	119.4	111.5	100.2	097.0	117.0	106.5	100.1	095.5
(–)	(4.6)	(5.4)	(4.9)	(–)	(–)	(6.0)	(5.0)	(–)
100	101.8	098.6	093.9	089.5	093.0	091.5	088.8	089.0
(–)	(5.5)	(5.2)	(5.1)	(–)	(–)	(4.9)	(4.4)	(–)
100	106.0	105.4	098.8	098.0	116.0	106.7	103.1	100.5
(–)	(7.4)	(3.7)	(4.1)	(–)	(–)	(5.5)	(6.7)	(–)
028	030.7	030.3	030.1	030.0	036.5	033.4	033.0	034.5
(–)	(1.6)	(2.4)	(1.8)	(–)	(–)	(2.6)	(2.3)	(–)
095	097.1	092.7	085.2	082.5	095.5	093.3	089.6	086.5
(–)	(4.5)	(3.9)	(4.6)	(–)	(–)	(4.9)	(4.8)	(–)
028	029.4	029.4	030.2	030.0	035.5	033.0	032.4	035.0
(–)	(1.8)	(1.3)	(1.3)	(–)	(–)	(1.8)	(1.6)	(–)
COUNTS								
151	151.1	151.0	150.4	149.0	148.5	148.7	149.7	151.5
(–)	(3.2)	(5.9)	(4.6)	(–)	(–)	(4.7)	(4.2)	(–)
17	17.6	17.8	17.7	16.5	17.0	17.8	17.8	18.5
(–)	(0.7)	(0.7)	(0.5)	(–)	(–)	(0.7)	(0.5)	(–)
8	7.4	7.3	7.2	7.0	8.0	7.6	7.4	7.5
(–)	(0.6)	(0.8)	(0.5)	(–)	(–)	(1.1)	(1.0)	(–)
23	22.1	22.5	22.7	22.5	21.5	21.7	22.0	22.5
(–)	(0.8)	(0.8)	(0.6)	(–)	(–)	(1.1)	(0.9)	(–)
20	20.7	20.9	20.8	20.9	21.0	20.3	20.1	21.0
(–)	(0.7)	(0.6)	(0.9)	(0.5)	(–)	(0.8)	(0.9)	(–)
18	17.4	17.5	17.7	17.5	18.0	17.7	18.2	18.5
(–)	(0.6)	(0.7)	(0.5)	(–)	(–)	(0.8)	(0.6)	(–)
12	12.0	11.9	12.1	12.0	13.0	12.3	12.3	12.5
(–)	(–)	(0.4)	(0.3)	(–)	(–)	(0.5)	(0.5)	(–)

TABLE IV

The 75 per cent range is given by region and length group for characters for which this range shows a lack of overlap between regions.

		Fork Length in mm.			
Character	Region	501-700	701-900	901-1100	1101-1300
Length of longest pectoral ray	Eastern	087-099	089-096	084-093	086-096
	Central	101-111	103-108	096-102	–
	Western	–	103-110	099-108	–
Depth of caudal peduncle	Eastern	062-066	062-066	063-067	060-065
	Central	061-064	060-064	058-064	–
	Western	–	066-071	066-072	–
Length of pectoral base	Eastern	027-030	029-031	029-032	029-032
	Central	030-032	029-032	029-031	–
	Western	–	032-035	031-035	–
Length of pelvic base	Eastern	026-030	028-031	029-032	028-033
	Central	028-031	028-030	030-031	–
	Western	–	032-034	031-034	–

range of these characters as calculated from the dispersion is given in Table IV. The 75 per cent range in the 901-1100 mm. length group showed an overlap for the eastern-western comparison, but these two groups of fish may be distinguished by the length of their longest pectoral ray and by the pattern of their markings. The western fish proved to be distinct in other comparisons of the three characters, except the 701-900 mm. length group in the central-western comparison of the length of the pectoral base and it was nearly so. It would thus seem that 75 per cent of the western fish may be distinguished from those of the other two regions; this difference is especially evident at the small size levels. These Lake of the Woods maskinonge have also been shown to differ from the Kawartha Lakes and St. Lawrence River fish in their length-weight relationship, the western fish being heavier for their length than those from the other two regions (Hourston, 1952).

The effect of sexual differences on the variations in these characters was checked by the "t" test (Snedecor, 1937). Length groups of 100 mm. were employed in order to minimize the effects of any variations with body length. The eastern fish showed dimorphism significant at the P = .01 level in the depth of the caudal peduncle between 32 males and 23 females in the 801-900 mm. length groups (t = 3.908) and between 21 males and 26 females in the 901-1000 mm. length group (t = 3.248). This dimorphism would not affect the conclusion drawn since the sexes are more or less evenly divided at this length range. In any case this character is used mainly to distinguish the western and central fish since the eastern fish may be distinguished from the others by other means. Differences significant at the P = .05 level were found in the length of the pelvic base for 11 males and 18 females in the 1001-1100 mm. size group from the eastern region (t = 2.058), and for 7 males and 12 females in the 701-900 mm. size group from the central region (t = 2.834). However;

since these are two of the most poorly sampled size ranges, and since the difference did not show up among other size ranges, their reality is not assured.

DISCUSSION

The results of this study might be taken to indicate the existence of subspecific differences between populations investigated. The population in the St. Lawrence River district in Quebec (eastern region) is distinguished from the central and western populations by its spotted markings and shorter pectoral fins. The Lake of the Woods (western) population may be distinguished from the Kawartha Lakes (central) population by a deeper caudal peduncle and longer pectoral and pelvic fin bases.

It has been suggested that some of the differences found may not be as significant as the data would indicate. The basis of this suggestion is that since each of the three populations was studied in a different year, the method of making measurements may have unconsciously varied from year to year. Indeed, the difference in the length of pectoral and pelvic fin bases was not reflected by a difference in fin ray counts. The possibility of later repeating the measurements made at different times was precluded by the fact that all specimens were measured in the field on fresh material. Also caudal peduncle depth could be affected to some extent by the nutritional condition of the fish. Finally, the degree of variation in markings and their tendency to fade after capture makes their quantitative assessment difficult. Nevertheless, the results of the study tend to confirm the assumption that there are significant differences between the eastern (St. Lawrence) and western (Lake of the Woods) populations of the maskinonge. They suggest, however, that the Kawartha lakes population cannot be regarded as belonging to a St. Lawrence River subspecies, which is also found in the Great Lakes (Hubbs and Lagler, 1947). The study emphasizes the difficulty in recognizing subspecies in the maskinonge.

SUMMARY

1. A total of 212 maskinonge from the St. Lawrence River (eastern region), 67 from the Kawartha Lakes and Georgian Bay (central region), and 76 from the Lake of the Woods district (western region) were compared for differences in their taxonomic characters. A series of 19 body proportion measurements, 7 sets of counts and the patterns of markings were employed in the comparisons, which were made in length of intervals of 200 mm.

2. Of the 168 comparisons made between regions, 98 showed differences at the $P = .01$ level of significance and 112 at the $P = .05$ level of significance, thus indicating that the three groups of fish were recognizably different.

3. The recognition of 75 per cent or more of a stock of fish is often accepted as a criterion for subspecific distinction. On this basis, fish in the St. Lawrence River were distinguished from the others by their spotted markings and their longest pectoral fin ray being shorter than that of the other fish. The Lake of the Woods maskinonge were distinguished from the Kawartha Lakes maskinonge by a deeper caudal peduncle and a longer base on their pectoral and pelvic fins. However, the possibility of variation in the methods of measuring body parts and the difficulty of interpreting marking patterns suggest that some of these differences may not be

as significant as the data would indicate.

4. The assumption that there are significant differences between maskinonge from the St. Lawrence River and Lake of the Woods region is supported by the results of this study. On the same basis, however, the Kawartha Lakes population cannot be regarded as belonging to a St. Lawrence River subspecies.

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PLATES

Figure 1. A map of the Province of Ontario showing the regions included in this study: 1 – Western region 4 – Eastern region
2, 3 – Central region

Figure 2. A 765 mm. maskinonge with spotted markings from Lake St. Francis in the eastern region.

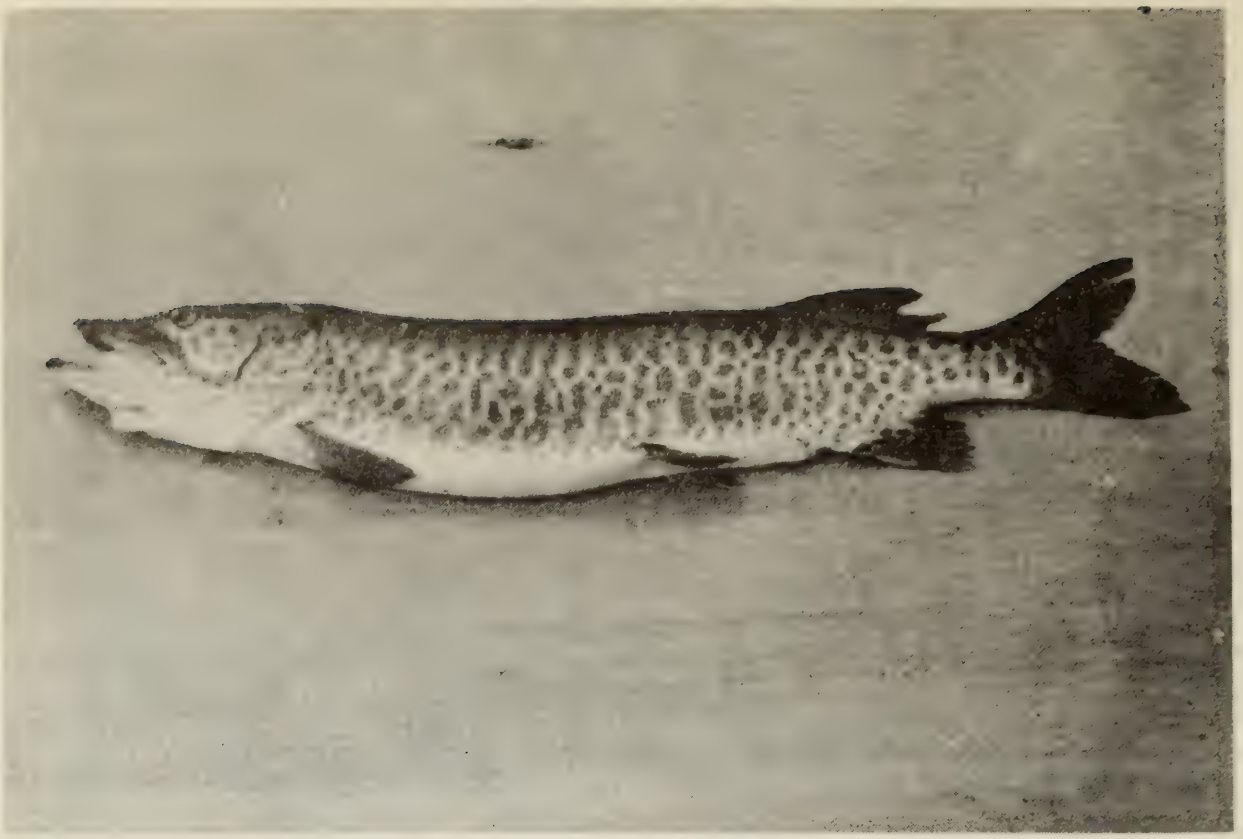

Figure 3. An 860 mm. maskinonge with spotted markings from Little Vermilion Lake in the western region.

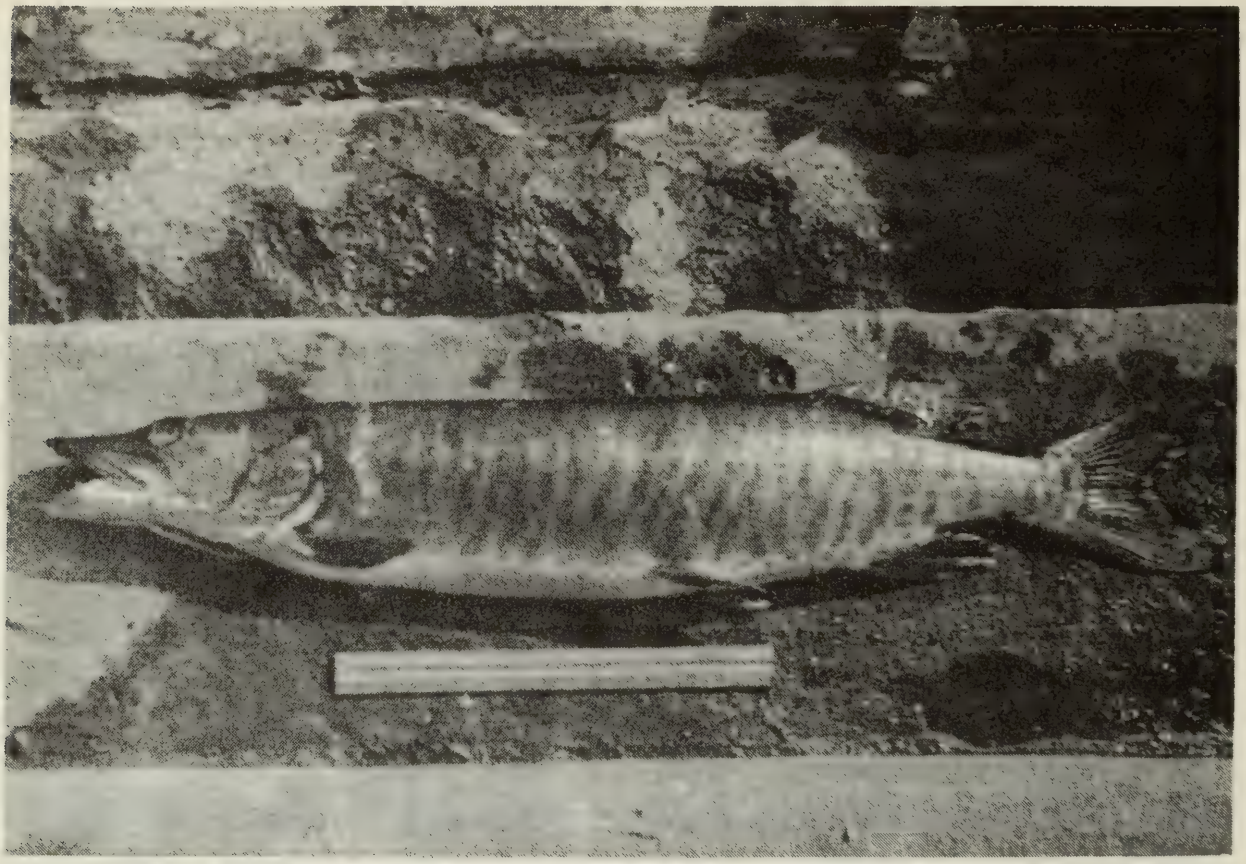

Figure 4. A 784 mm. maskinonge with barred markings from Lake St. Louis in the eastern region.

Figure 5. A 724 mm. maskinonge with barred markings from Buckhorn Lake in the central region.

Figure 6. A 751 mm. maskinonge with barred markings from Maskinonge Lake in the western region.

Figure 7. An 814 mm. maskinonge from Cedarbough Lake in the western region showing markings in the form of bars and spots.

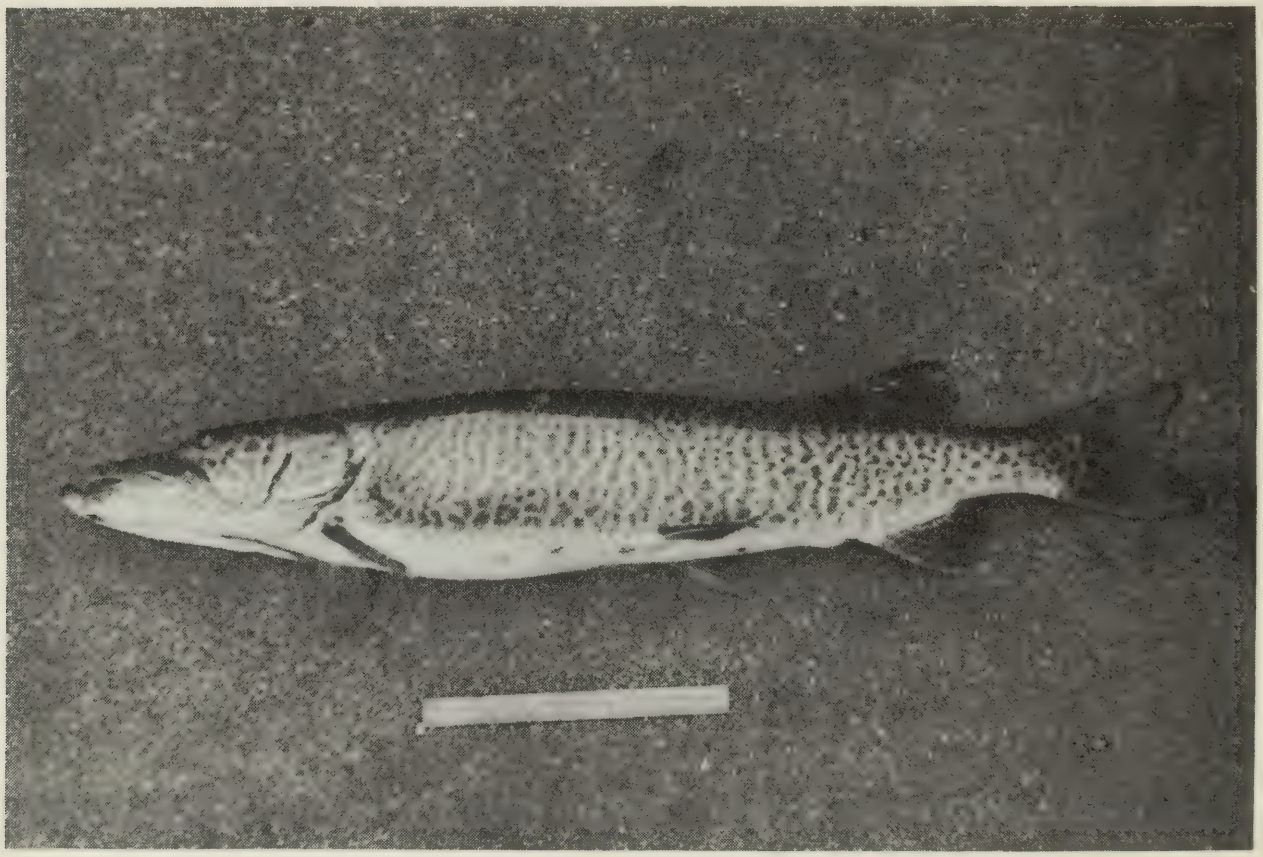

Figure 8. A 1110 mm. maskinonge from Lake St. Francis in the eastern region showing markings in the form of vermiculations.

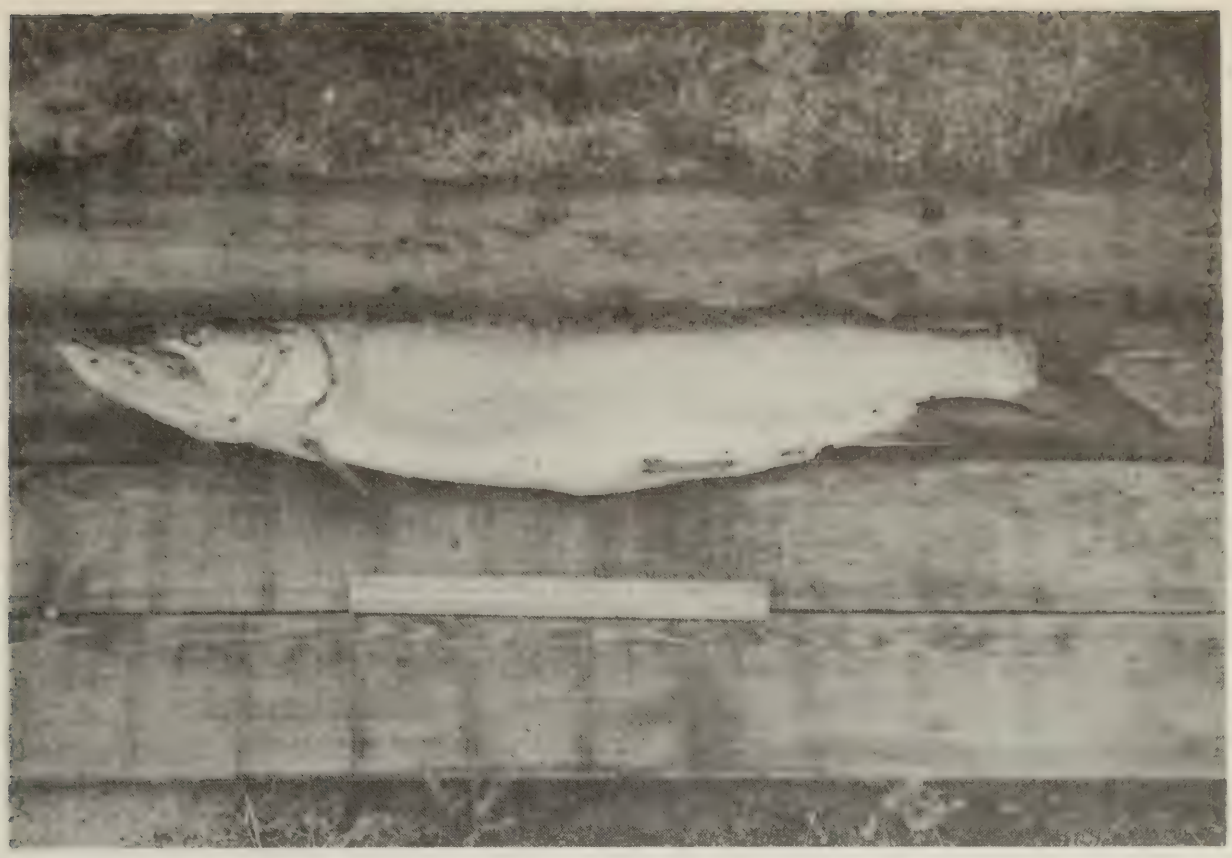

Figure 9. An 813 mm. maskinonge clear of markings from Indian Lake in the western region.

Figure 10. A 940 mm. maskinonge clear of markings from the Thousand Islands River in the eastern region.

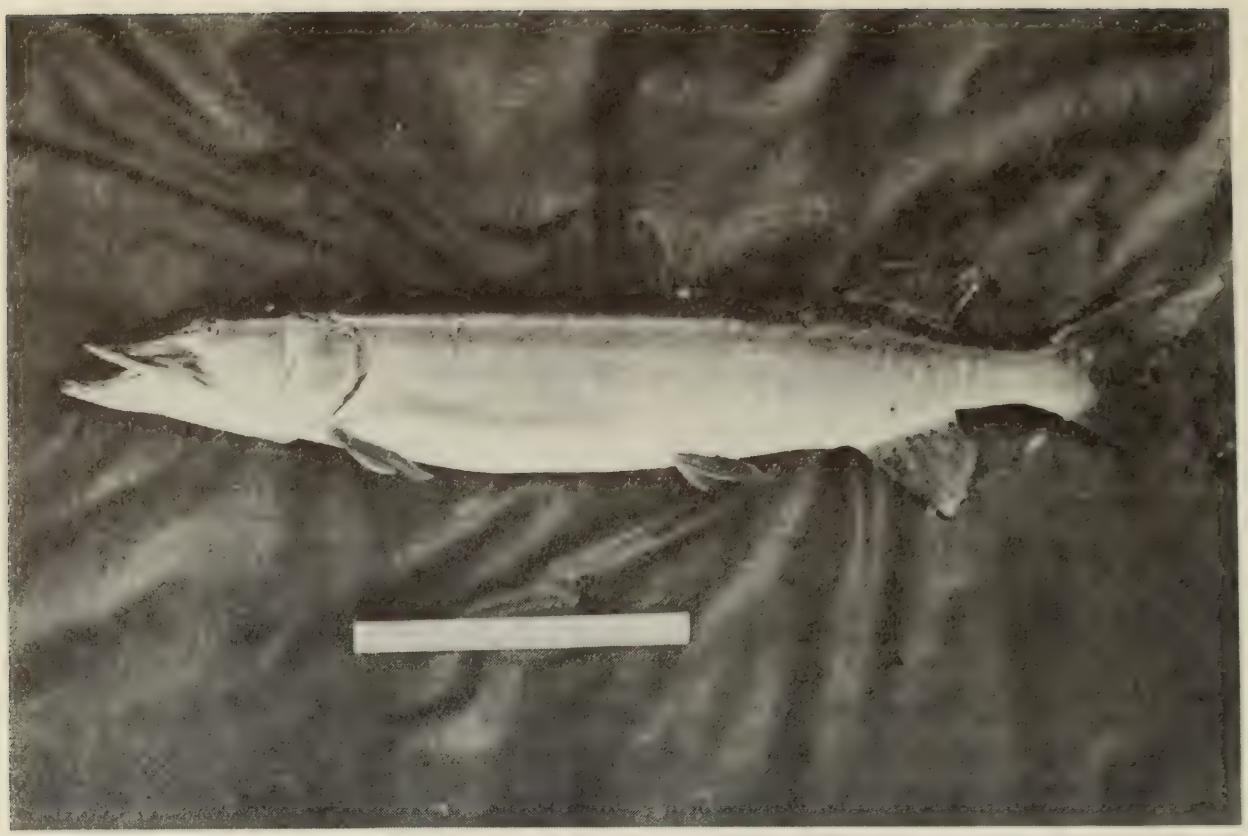

Figure 11. A 978 mm. maskinonge clear of markings from Buckhorn Lake in the central region.

Figure 12. A 687 mm. maskinonge from Little Vermilion Lake in the western region showing distinct dark vertical bars.

Figure 13. A 929 mm. maskinonge from Little Vermilion Lake in the western region showing the remains of dark vertical bars.

Figure 14. A 1106 mm. maskinonge from Little Vermilion Lake in the western region showing only traces of dark vertical bars.

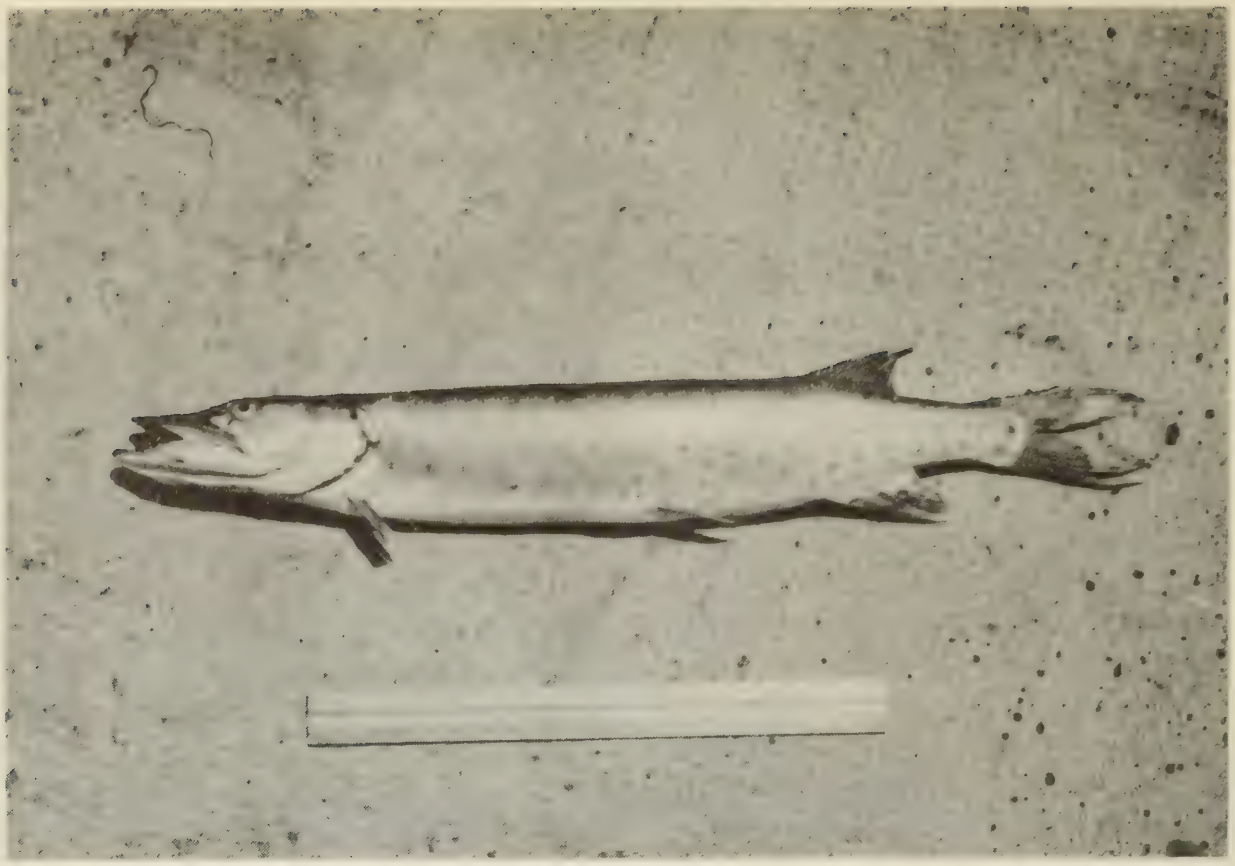

Figure 15. A 508 mm. maskinonge from Lake St. Francis in the eastern region showing distinct roundish spots.

Figure 16. A 1153 mm. maskinonge from Lake St. Louis in the eastern region showing the persistence of roundish spots in large specimens.