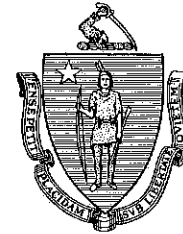


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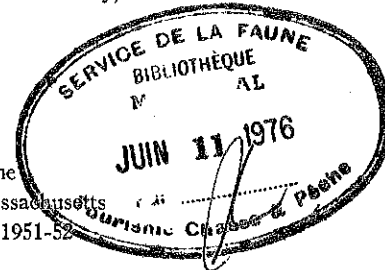
The Commonwealth of Massachusetts



Natural Hybrids Between Two Species of Pickerel (*Esox*) In Stearns Pond, Massachusetts

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SUPPLEMENT  
to  
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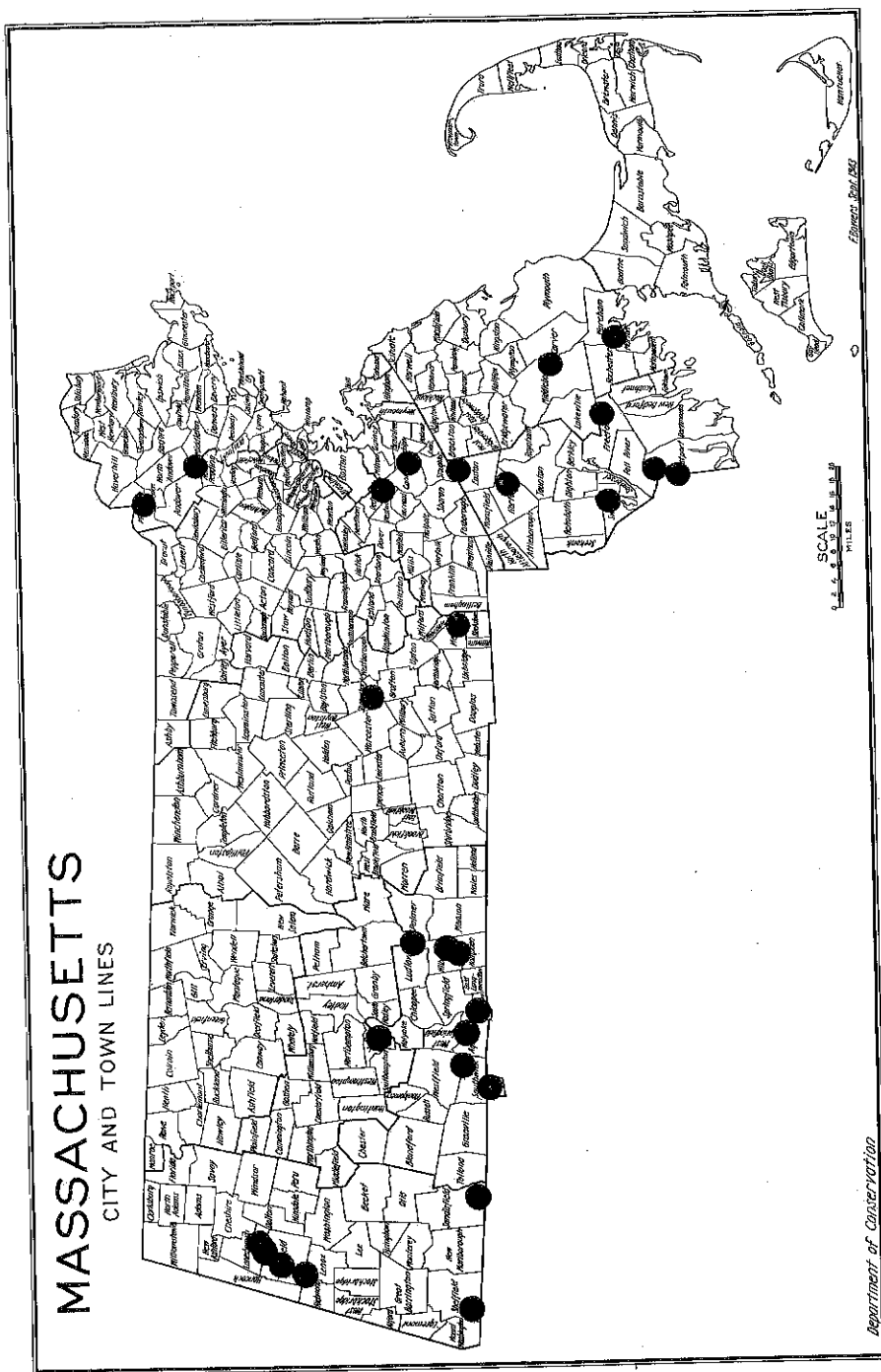
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In Massachusetts the chain pickerel, *Esox niger* LeSueur, is a widespread and important game fish. The redbfin pickerel, *Esox americanus* Gmelin, also known as bulldog, grass, banded, trout, and little pickerel is a small species which perhaps is more local in distribution (Map 1) and is of little value to the fisherman. Both pickerel are freshwater forms which range along the Atlantic Coast, and in general the chain pickerel seems to be more common in the North. They prefer warm, sluggish, weedy waters.

What was thought to be nearly the entire pickerel population of Stearns Pond, North Andover, Essex County, Massachusetts, as well as other data on the pond, was received for study through Richard H. Stroud, formerly Chief Aquatic Biologist, Massachusetts Division of Fisheries and Game. In the field Mr. Stroud immediately realized the value of the specimens when, during the draining of the pond, he observed the presence of both chain and redbfin pickerel along with intermediate forms which he interpreted as possible hybrids. Upon study, this collection proved to contain both species of pickerel, hybrids, and backcrosses between the hybrids and each of the parent species. Also some specimens of the chain pickerel and the redbfin pickerel show characters which are evidently the result of introgressive hybridization which was defined by Anderson (1949) "as the gradual infiltration of the germplasm of one species into that of another". This was especially noticeable in the redbfin pickerel, the scarcer of the two species. An analysis of this pickerel population which consisted of 178 adult and 7 juvenile specimens (Table 1) is reported here.

Hybridization in nature in the pickerel family, Esocidae, has been reported several times and some hybrids have been produced artificially. Embody (1918: 253) gave notice of natural hybrids between the northern pike and chain pickerel, *Esox lucius* x *Esox niger*, in Cayuga Lake, New York. He also artificially crossed these two species and reared the hybrids to sufficient size to show the principal characters. Underhill (1939: 237) repeated the experimental cross, *Esox lucius* x *Esox niger*, and his results were substantially the same as those of Embody. Underhill (1948) illustrated hybrids of the same combination taken at the end of the first and second growing seasons. Eddy (1941: 41) and Eddy and Surber (1943: 190) reported on hybrids between northern pike and muskellunge, *Esox lucius* x *Esox masquinongy*. Black and Williamson (1947: 302) also studied this hybrid combination and gave detailed data on coloration and other characters of the hybrids which were produced by artificial propagation and raised in ponds. Weed (1927: 10) mentioned several hybrid combinations, including the cross between the chain pickerel and redbfin pickerel, *Esox niger* and *Esox americanus*, which he observed in the vicinity of Washington, D. C. Greeley and Bishop (1933: 99) noted several hybrids of the same combination from the upper Hudson River watershed, New York. Greeley (1939: 41) also reported hybrids of this combination from Valley Stream and Millburn Creek, Nassau County, Long Island. Bailey (1938: 151) studied hybrid pickerel, *Esox niger* x *Esox americanus* taken in the Merrimac River system, New Hampshire. The redbfin pickerel was common and often associated with the chain pickerel. Thirteen hybrids were taken in five different collections. Certain specimens among the hybrids were clearly intermediate in their characters between the parent species. The other individuals seemed to be variously close to one or the other parental types. Bailey interpreted this as suggesting backcrossing of first generation hybrids with both parent species, but pointed out that further study based on ample material and if possible utilizing experimental matings



Map 1

Distribution of the redbfin pickerel, *Esox americanus*, in Massachusetts based on the records of the Division of Fish and Game and B. C. McCabe, The distribution of fishes in the streams of western Massachusetts. Doctoral dissertation, Cornell Uni-

should be performed to achieve an acceptable solution of the problem. For references dealing with the subject of hybridization in fishes, see Hubbs (1955)

#### HABITAT AND ASSOCIATES

The pickerel were collected from Stearns Pond, a 41 acre artificial impoundment constructed in 1936 at North Andover, Essex County, Massachusetts, when it was drained on November 28, 1951. The depth averaged about 2½ feet with a maximum of 6 feet. The bottom was 80% muck and 20% sand. The scant emergent vegetation was composed of about 65% *Sparganium* and 35% *Typha*. Submerged vegetation was common and consisted mostly of *Utricularia* and *Nitella*. The water was warm (81.5° F. surface and 76.0° F. bottom) in midsummer and was well oxygenated (8.2 ppm). The transparency was five feet; the water was a dark brown. The pond drains a peat area. Propagation records reveal the pond was stocked with "pickerel" in 1940.

All fish present were captured with the exception of a relatively few small specimens which were lost in the muck. The number, weight and length of the fishes which were taken are given in tables 1 and 2. About 98% of all fishes examined were under 7 inches in total length, and about 95% were under 6 inches. The redbfin pickerel is a smaller, slower growing species than the chain pickerel and perhaps a few more may have been lost in the muck at the time of drainage. Probably few yearling pickerel were overlooked but few young-of-the-year were recovered. An indication that few pickerel of either species were missed seems evident from the large numbers of other species under seven inches in length which were recovered (Table 2). Only 185 pickerel were taken compared to a total of 44,096 specimens of brown bullhead, yellow perch, black crappie, bluegill, and golden shiner. It appears from the large number of bullheads (35,320) and other species which were present, that the relatively small pickerel population was unable to keep the bullhead and other fishes within reasonable "balance" under the angling pressure for pickerel which apparently was relatively low.

#### METHODS OF MAKING COUNTS AND MEASUREMENTS

The pickerel were sorted into series which represented the two species, hybrids between the two, and backcrosses to each of the parents, by using color and other characters, such as snout length, head width at occiput, head length, and body length. There was little difficulty identifying the hybrids between *niger* and *americanus* but some designated as backcrosses and indeed a few labeled *niger* or *americanus* were somewhat in doubt since they obviously had some genes of the other species. The basic color patterns were studied and are described below. Since the pattern differences are for the most part striking (Plate 1) no attempt was made to treat them quantitatively.

After carefully comparing specimens of equal size of both species to determine which characters seemed to give the best separation, measurements to the nearest mm. were made, following the methods given by Hubbs and Lagler (1947: 13-15), of head length, head width at occiput, head depth at occiput, snout length, postorbital head length and length of upper jaw. These measurements were converted to thousandths of the standard length and, for each character, were then compared to standard length. Fin ray and branchiostegal ray counts were made. In counting the dorsal and anal fin rays, a slit was made at the base of the fin so that all rudiments were counted in the anterior portion of these fins. The last two basal elements of both the dorsal and anal fins were enumerated as one ray. In counting the rays of the pectoral and pelvic fins, each of the rays were counted and all branchiostegals, however rudimentary, were counted. Although there is supposedly a good difference in the number of scales possessed by these two species (see Bailey, 1938: 182), no counts were made in this study because of the difficulty of enumerating the lateral series of scale rows accurately.

#### RESULTS

When the several counts and measurements were tabulated the structural inter-  
mediacy of these characters confirmed the hybrid origin of specimens first indicated as such by color classification. Furthermore, in almost all counts the backcrosses to

a parent species were intermediate between the hybrid and the parent species. The actual coloration, measurements and counts are given in some detail below and in tables 3 to 6.

**COLORATION.** The chain and redbfin pickerels are easily separated by the basic body color pattern. An adequate description of living or freshly preserved hybrids (*niger* x *americanus*) is not available but there is some indication that the fins are red in the hybrid as well as in the redbfin pickerel. However, the percentage of hybrids and backcrosses which have red fins is unknown. Plate 1 illustrates the typical color pattern in both parent species and in the hybrids. The following color descriptions were made after specimens had been preserved for several months in alcohol.

**Chain Pickerel.**—The chain pickerel is much lighter in over-all color than is the redbfin pickerel. Laterally, the chain pickerel has light areas enclosed by dark chain-like markings which extend from just behind the opercular membrane to the base of the caudal fin. The chains are almost always completely enclosed on their ventral aspect and extend downward as far as the lower side of the body. The dark of the upper side of the body is interrupted by light vertical bars. The ventral side of the lower jaw, and the anterior isthmus are not strongly marked nor are they blotched. At times they are slightly darkened but if so the melanophores are small and rather evenly arranged. The rays of the dorsal and anal fins and to a lesser extent those of the pectoral and pelvic fins are dark, in contrast to the light interradiial membranes; more so than in the redbfin pickerel. The dark subocular bar in adults is prominent but changes in position with change in size. In young specimens it is directed obliquely forward, in those 250 to 275mm. in standard length the bar is almost vertical and in still larger specimens it may be slightly slanted posteriorly. This is an excellent character for separating small chain pickerel from redbfin pickerel. The latter always have the subocular bar pointing obliquely posteriorly.

**Redfin Pickerel.**—The general appearance of the redbfin pickerel is considerably darker than the chain pickerel. Laterally, from immediately behind the opercle to the base of the caudal fin, alternating dark and light bars extend obliquely forward. In some specimens on the rear half of the body these bars extend obliquely posteriorly. They extend ventrally to the lateral edge of the belly. The bars are somewhat irregular; the uppermost light bars are narrower than those of the chain pickerel. The under side of the lower jaw, and the anterior isthmus, to a lesser extent, are heavily blotched. The dorsal and anal fin rays and to a lesser extent those of the pectoral and pelvic fins are darkened but not as much as in the chain pickerel. The subocular bar is prominent and is slanted posteriorly. The rear end of the upper jaw extends to below the middle of the eye and appears to have the effect of forcing back the subocular bar. This holds for small specimens of 50 mm. or even less.

**Hybrids.**—The hybrids between chain pickerel and redbfin pickerel are intermediate in general background coloration. The lateral coloration of the body is quite typical and consists of combinations of ovals and oblique bars which extend downward and forward. Typically every other or every third interspace between two dark bars is filled by chain-like markings as indicated in Plate 1. The chain-like markings are somewhat more rectangular and thicker than in the chain pickerel. The lowermost ovals between the pectoral and pelvic fins are usually not completely closed ventrally. The light areas on the upper side of the body are fairly large and resemble those of the chain pickerel. The ventral aspect of the lower jaw and the anterior part of the isthmus are blotched with dark like the redbfin pickerel. The fin color is more like that in the chain pickerel with relatively great contrast between the dark rays and the light fin membranes. The subocular bar is strongly slanted posteriorly much like the redbfin pickerel.

**Back Crosses.**—Those specimens which are interpreted as back crosses to chain pickerel are like the latter in being rather light in general coloration. The lateral pattern consists mostly of chain-like markings on the side of the body which is occasionally crossed by an oblique dark bar. Most specimens seem to be most strongly banded on the upper side and ovals are generally more common below. Most

of the ovals on the extreme lower side are open below. The ventral part of the lower jaw, and the anterior isthmus are blotched or marked with a broken dark line. The dark fin rays contrast with the clear interradiar membranes (like the chain pickerel). The subocular bar is wide and strongly slanted posteriorly.

Specimens which are considered as being back crosses to the redfin pickerel are relatively dark in general body color. The side of the body is marked by irregular dark oblique bars which extend forward and downward. Adjacent bars often are connected, especially on the lower side, and occasionally an oval mark is present on the side. Less often two dark oblique bars lie close together with several small ovals connecting them. No ovals were noted on the extreme lower side and here a space separates the light and dark bars. The ventral part of the lower jaw, and the anterior isthmus are either strongly blotched or lined. There is fairly strong contrast between the dark of the fin rays and the lighter interradiar membranes. The subocular bar is wide and is strongly oblique posteriorly.

Four out of the eight specimens which are considered redfin pickerel have pigmentary irregularities which suggest effects of chain pickerel genes. These are a marked contrast to the rather uniform coloration shown by a number of large series of redfin pickerel captured at localities where chain pickerel were apparently absent. A few specimens of chain pickerel from Stearns Pond show some evidence of color irregularities which were probably due to introgressive hybridization.

**MEASUREMENTS.** Besides differences in color the best way to separate the chain pickerel from the redfin pickerel is by proportional body measurements. Snout length, head length and length of upper jaw, when considered as thousandths of standard length, are greater in the chain pickerel than in the redfin pickerel while the reverse is true of head width at occiput, head depth at occiput, and the postorbital length of the head. The longer and more acute yet narrow snout of the chain pickerel contrasts with the shorter, bluntish, and wider snout of the redfin pickerel. These relationships are clearly shown by plotting a scatter diagram snout length vs. head width at occiput (represented as thousandths of standard length), such as has been done in Figure 1. The hybrids (*niger* x *americanus*) are intermediate in position and each of the back crosses falls between the hybrid and the respective parent species.

The snout length alone when expressed in thousandths of standard length gives an excellent separation between the two species. In the redfin pickerel the values range from 96 to 116, in the chain pickerel from 130 to 160, and the hybrids occupy an intermediate position and range from 118 to 136. As expected, the back crosses are intermediate between the hybrid and the parent species but overlap considerably. The other proportional measurements give similar results but no single character among those investigated gives as good a separation as does snout length.

**RAY COUNTS.** The fin (caudal excepted) and branchiostegal rays were counted in the redfin pickerel, hybrids and back crosses, and in an adequate sample of chain pickerel. The results are shown in tables 3 and 4. The numbers are high for anal, dorsal, pelvic, and branchiostegals and low for pectoral rays in the chain pickerel. In all cases those specimens interpreted as hybrids are intermediate in value and in all but one case, and here the values were close, the back crosses were intermediate between hybrid and the parent species. Of the single characters mentioned here the branchiostegals rays give the best separation between the two species (Table 4).

Since the parent species differ in the same direction in anal, dorsal, pelvic and branchiostegal ray counts, a character index made by adding the above characters for each specimen gives the interesting picture shown in Table 5. Here again the hybrids and back crosses are intermediate as expected. Another character index (Table 6) was constructed by subtracting total pectoral rays (which show a reverse trend) from the sum of the anal, dorsal, pelvic and branchiostegal ray counts. This index gives an excellent separation for the countable characters. The intermediate position of the hybrids and back crosses is the same shown by the character index shown in Table 5.

The data for length presented in Table 1 indicates that hybrids and backcrosses are somewhat larger than an intermediate length which might be expected. However,

no attempt was made to age the specimens. It is also to be noted that the sex ratio for the several categories is approximately a 1:1 ratio.

## EVIDENCE FOR HYBRIDIZATION

The evidence for hybridization is circumstantial but adequate when considered in the light of our knowledge of the morphology, distribution and life histories of the two species. Each species and structurally intermediate types were taken together in Stearns Pond and elsewhere. Over a wide natural range they are in large part sympatric although often one occurs in the absence of the other. Although they are known to spawn in early spring at about the same time, no details are available such as have been observed for northern pike and muskellunge by Black and Williamson (1947: 300). However one species undoubtedly occasionally takes part in the spawning activities of the other. Whether this is more likely to happen when one species (*niger*) is much more common than the other (*americanus*) as they were in Stearns Pond seems likely but is a matter for future investigation.

The specimens were collected November 28 and being early spring spawners, the gonads of both species were well developed. No gross differences could be found in the size of the gonads or of the developing ova in the two species, the hybrids and the backcrosses. Histological examinations were not made. The only individuals which obviously would not have spawned the following spring were 7 specimens of (*niger*), two males 130 and 148 mm. S.L. and 5 females 103, 127, 136, 150 and 159 mm. S.L. It seems that the parents species, and hybrids are capable of spawning readily and apparently fertile. Presumably in nature the species normally breed at somewhat different times in different microhabitats. Perhaps the spawning habitat was limited in Stearns Pond. Detailed field observations on the precise requirements of each species are needed.

The findings on the intermediacy of structural characters is in line with results gleaned from artificial propagation and laboratory findings on hybrids for this and other families of fishes.

## HYBRIDIZATION AND MANAGEMENT PROBLEMS

The apparent relative scarcity of the redfin pickerel in Massachusetts ponds makes it less of a problem than it is in many places. In many places in the North, it appears to be a creek species and if found at all in larger bodies of water, it is normally located in weedy coves. Here it is often overlooked when using conventional collecting methods except for rotenone sampling. The chain pickerel is quite general in its distribution in creeks, ponds and lakes of Massachusetts. Indeed, few ponds seem to lack this game fish.

That both forms are carnivorous, has been pointed out by Hunter and Rankin (1939: 194) and by Raney (1940: 58). They stand at the top of the food chain and it has been rather generally assumed that it might be desirable to protect large chain pickerel so as to cut down large stunted fish populations such as were present in Stearns Pond. The redfin pickerel is small and seldom reaches a length of more than 12 inches. Although carnivorous it seems to eat larger quantities of crustaceans, insects and amphibians than does the chain pickerel. Where both species occur together, a size limit usually causes a drain on the chain pickerel which grows more rapidly and reaches a larger size. Underhill (1949: 386) reports it to reach 28-30 inches and 6½ pounds. Thus the smaller redfin pickerel may be almost entirely protected and at the expense of the chain pickerel. This adds to the number of small competitors present and perhaps helps make for "poor balance". It has been noted that the redfin pickerel is frequently present in coastal trout streams and under such conditions a size limit usually gives it a virtual immunity and therefore freedom to prey upon small trout.

The data shown in Table 1 indicate that where chain pickerel and redfin pickerel occur together and hybridize, the hybrids are intermediate in size and are therefore somewhat larger than the redfin pickerel. Although this seems to minimize the problem it might make for better angling if the smaller redfin pickerel were not present and it should be reduced or eliminated where possible.

Several possible management policies may be considered for situations where both these species occur together. An open season with no size limit may be declared on redbfin pickerel. Unfortunately, most fishermen would probably not readily distinguish the redbfin. Another possibility would be to remove the size limit on all pickerel found in waters where the redbfin pickerel is known to occur. Perhaps under these conditions a better balance between the two pickerel would occur since presumably both species would be taken by the angler. Where conditions permit it is probably better to reduce the redbfin pickerel population by partial or complete rotenone treatment in favor of the chain pickerel alone. The best decision will probably be that which is decided after a thorough study of the local problem under consideration.

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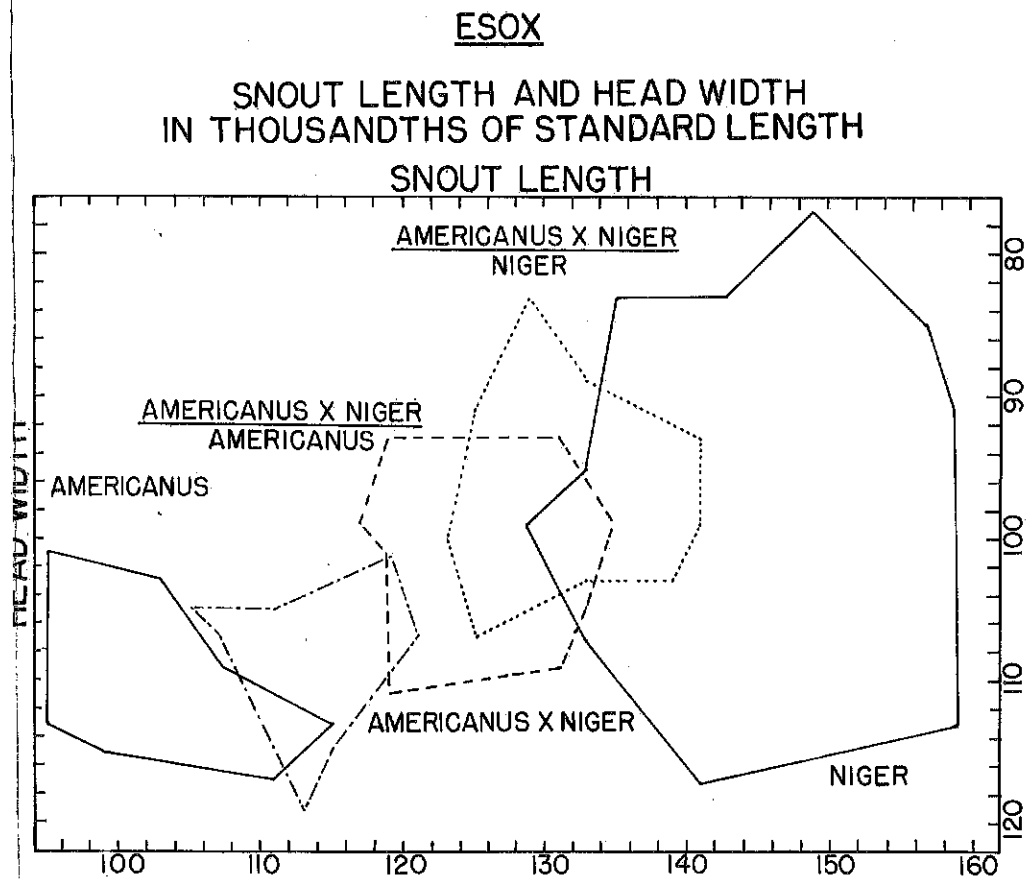


Figure 1

A scatter diagram showing snout length and head width, expressed in thousandths of standard length, for the chain pickerel (*niger*), the redbfin pickerel (*americanus*), hybrids (*niger x americanus*) and back crosses. The boundary lines for each species or hybrid connect (and surround) actual plotted points for all specimens available from Stearns Pond.

TABLE 1. NUMBER, SEX AND STANDARD LENGTH IN MM. OF 185 (178 ADULTS AND 7 JUVENILES) *Esox niger*, *Esox americanus* AND HYBRIDS FROM STEARNS POND, NORTH ANDOVER, MASS.

	<i>niger</i>	backcross to <i>niger</i>	<i>niger</i> x <i>americanus</i>	hybrid and backcrosses	backcross to <i>americanus</i>	<i>americanus</i>
No. of specimens	123	19	22	54	13	8
Percentage of total	66.5	10.3	11.9	29.2	7.0	4.3
No. of adults	116	19	22	54	13	8
male	56	9	14	29	6	6
female	60	10	8	25	7	2
No. of juveniles	7	—	—	—	—	—
Length of all specimens)	273	265	267	262	247	207
mean and range	(103-415)	(166-386)	(175-336)	(166-386)	(169-380)	(179-256)
Length of adults:						
male	274 (207-390)	245 (166-314)	249 (175-324)	245 (166-324)	234 (185-269)	192 (179-209)
female	289 (200-415)	283 (212-386)	299 (270-336)	281 (169-386)	258 (169-380)	250 (244-256)
Length of juveniles	136 (103-159)	—	—	—	—	—
male	139 (103-148)	—	—	—	—	—
female	135 (103-159)	—	—	—	—	—

TABLE 2. DATA ON FISHES (EXCLUDING PICKEREL, *Esox*) OBTAINED UPON DRAINING STEARNS POND, NORTH ANDOVER, MASSACHUSETTS, ON NOVEMBER 28, 1951.

Species	Number of Specimens	Weight in Pounds	Range of total length in inches
Brown bullhead, <i>Ameiurus nebulosus</i>	35,320	3,220	3.0-8.4
Yellow perch, <i>Perca flavescens</i>	6,520	549	2.1-7.0
Bluegill, <i>Lepomis macrochirus</i>	1,320	132	2.6-5.5
Black crappie, <i>Pomoxis nigromaculatus</i>	666	75	4.6-10.0
Golden shiner, <i>Notemigonus crysoleucas</i>	270	18	3.0-5.0

TABLE 3. DORSAL, ANAL AND PELVIC (BOTH SIDES) RAY COUNTS OF *Esox niger*, *Esox americanus* AND HYBRIDS FROM STEARNS POND, NORTH ANDOVER, MASSACHUSETTS.

	Dorsal rays											No.	Mean
	14	15	16	17	18	19	20	21	22				
<i>niger</i>	—	—	—	3	13	19	8	—	—	—	—	43	18.74
back cross to <i>niger</i>	—	—	—	—	7	8	4	—	—	—	—	19	18.84
<i>niger</i> x <i>americanus</i>	—	—	—	1	11	9	1	—	—	—	—	22	18.45
back cross to <i>americanus</i>	—	—	—	2	7	3	1	—	—	—	—	13	18.23
<i>americanus</i>	—	—	1	3	4	—	—	—	—	—	—	8	17.37
<i>niger</i>	—	2	6	22	13	—	—	—	—	—	—	43	17.07
back cross to <i>niger</i>	—	—	5	10	4	—	—	—	—	—	—	19	16.95
<i>niger</i> x <i>americanus</i>	—	1	12	6	3	—	—	—	—	—	—	22	16.50
back cross to <i>americanus</i>	—	1	7	4	1	—	—	—	—	—	—	13	16.38
<i>americanus</i>	1	3	4	—	—	—	—	—	—	—	—	8	15.37
<i>niger</i>	—	—	—	—	4	—	—	—	—	—	—	43	19.84
back cross to <i>niger</i>	—	—	—	—	4	3	10	1	1	—	—	19	19.58
<i>niger</i> x <i>americanus</i>	—	—	—	—	3	2	15	1	1	—	—	22	19.77
back cross to <i>americanus</i>	—	—	—	—	2	1	10	—	—	—	—	13	19.62
<i>americanus</i>	—	—	—	—	2	3	3	—	—	—	—	8	19.12

TABLE 4. TOTAL PECTORAL FIN AND BRANCHIOSTEGAL RAY COUNTS OF *Esox niger*, *Esox americanus* AND HYBRIDS FROM STEARNS POND, NORTH ANDOVER, MASSACHUSETTS.

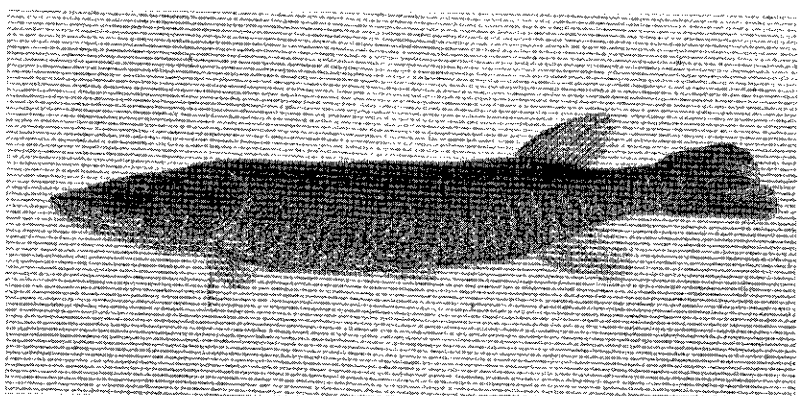
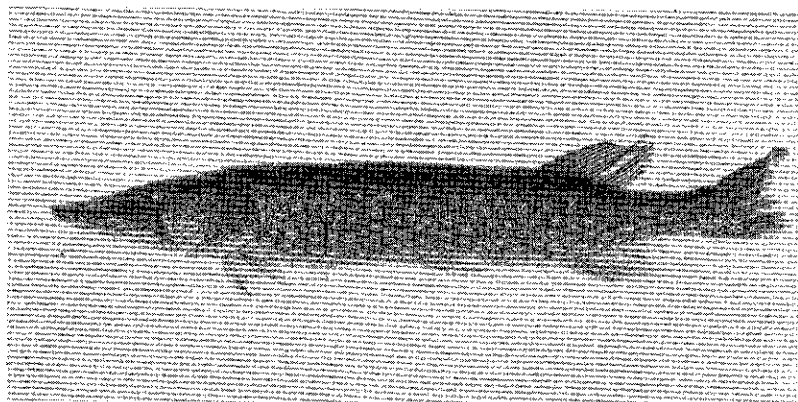
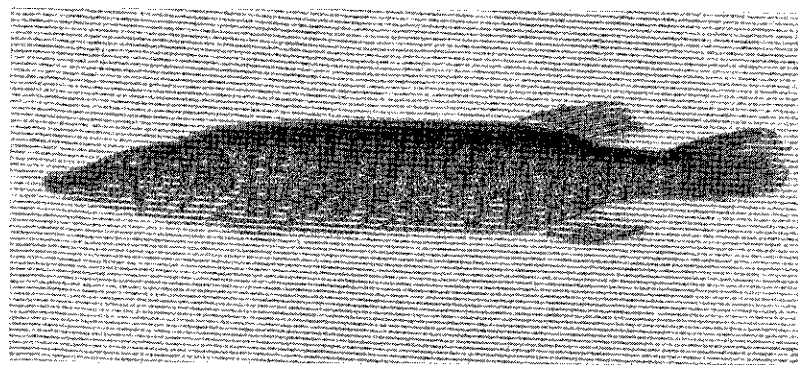
	23	24	25	26	Pectoral rays (both sides)										No.	Mean		
<i>niger</i>	—	—	1	6	6	6	22	6	2	—	—	—	—	—	—	—	43	27.67
back cross to <i>niger</i>	—	—	—	2	2	2	9	—	6	—	—	—	—	—	—	—	19	28.31
<i>niger</i> x <i>americanus</i>	—	—	—	—	2	2	7	3	8	2	—	—	—	—	—	—	22	29.14
back cross to <i>americanus</i>	—	—	—	—	—	—	5	1	6	—	—	—	—	—	—	—	13	29.31
<i>americanus</i>	—	—	—	—	—	—	3	1	3	—	—	—	—	—	—	—	8	29.37
							Branchiostegal rays (both sides)											
<i>niger</i>	—	—	—	—	1	—	4	5	14	8	9	2	—	—	—	—	43	30.35
back cross to <i>niger</i>	—	—	—	—	1	3	7	1	4	2	1	—	—	—	—	—	19	28.53
<i>niger</i> x <i>americanus</i>	—	—	1	2	4	4	9	2	3	—	1	—	—	—	—	—	22	28.05
back cross to <i>americanus</i>	—	—	2	3	2	2	4	2	—	—	—	—	—	—	—	—	13	27.08
<i>americanus</i>	1	2	2	1	2	—	—	—	—	—	—	—	—	—	—	—	8	25.12

TABLE 5. CHARACTER INDEX CONSISTING OF THE SUM OF ANAL, DORSAL, PELVIC AND BRANCHIOSTEGAL RAYS OF *Esox niger*, *Esox americanus* AND HYBRIDS FROM STEARNS POND, NORTH ANDOVER, MASS.

Index	<i>niger</i>	backcross to <i>niger</i>	<i>niger</i> x <i>americanus</i>	hybrids and backcrosses	backcross to <i>americanus</i>	<i>americanus</i>
90	3	—	—	—	—	—
89	5	—	—	—	—	—
88	5	2	1	3	—	—
87	8	1	1	2	—	—
86	3	2	1	3	—	—
85	6	2	3	5	—	—
84	7	5	3	8	—	—
83	2	4	—	8	4	—
82	2	1	6	10	3	—
81	1	1	4	6	1	1
80	—	—	1	3	2	1
79	—	1	1	4	2	1
78	1	—	1	2	1	—
77	—	—	—	—	—	1
76	—	—	—	—	—	1
75	—	—	—	—	—	2
74	—	—	—	—	—	2
No.	43	19	22	54	13	8
Mean	85.95	84.16	83.77	82.87	81.15	77.00
S. D.	2.45	2.27	2.54	2.52	1.77	2.73
S. E.	0.37	0.52	0.54	0.34	0.49	0.96

TABLE 6. CHARACTER INDEX CONSISTING OF TOTAL PECTORAL RAYS SUBTRACTED FROM THE SUM OF RAY COUNTS OF ANAL, DORSAL, AND PELVIC FINS (BOTH SIDES) AND BRANCHIOSTEGALS (BOTH SIDES) OF *Esox niger*, *Esox americanus* AND HYBRIDS FROM STEARNS POND, NORTH ANDOVER, MASSACHUSETTS.

Index	<i>niger</i>	backcross to <i>niger</i>	<i>niger</i> x <i>americanus</i>	hybrids and backcrosses	backcross to <i>americanus</i>	<i>americanus</i>
63	1	—	—	—	—	—
62	3	—	—	—	—	—
61	6	—	—	—	—	—
60	6	—	—	1	—	—
59	5	1	—	1	—	—
58	3	2	—	2	—	—
57	6	2	1	3	—	—
56	7	4	2	6	—	—
55	3	5	5	10	—	—
54	1	2	5	9	2	—
53	2	1	4	9	4	1
52	—	1	2	5	2	—
51	—	—	1	4	3	—
50	—	—	1	1	—	1
49	—	—	1	2	1	1
48	—	—	—	1	1	1
47	—	—	—	—	—	1
46	—	—	—	—	—	2
45	—	—	—	—	—	—
44	—	—	—	—	—	—
43	—	—	—	—	—	—
42	—	—	—	—	—	1
No.	43	19	22	54	13	8
Mean	54.21	55.84	53.64	53.98	50.85	47.62
S. D.	2.59	2.01	1.96	2.46	1.82	3.25
S. E.	0.39	0.46	0.42	0.33	0.50	1.15



[Legend for Plate 1]

All specimens were taken on November 28, 1951 in Stearns Pond, North Andover, Massachusetts.

Upper Figure. Chain pickerel, *Esox niger*, an adult female, 278 mm. in standard length.

Middle Figure. A hybrid pickerel, *Esox niger* x *Esox americanus*, an adult male, 217 mm. in standard length.

Lower Figure. Redfin pickerel, *Esox americanus*, an adult female, 256 mm. in standard length.