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DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES

HUGH M. SMITH, Commissioner

THE PIKES:
THEIR GEOGRAPHICAL DISTRIBUTION, HABITS, CULTURE,
AND COMMERCIAL IMPORTANCE

By WILLIAM CONVERSE KENDALL
Scientific Assistant, U. S. Bureau of Fisheries

APPENDIX V TO THE REPORT OF THE U. S. COMMISSIONER
OF FISHERIES FOR 1917



Bureau of Fisheries Document No, 853

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Of what the peculiar virtues of each consist depends much upon the view point, as did the alleged bad qualities. For example, there have been waters in which some pike and other fishes have lived in reciprocal counterpoise from time immemorial, notwithstanding the condemned "characteristic voracity of the pike." Supposing that at some particular time the pike had been rendered less voracious, the tendency then would have been toward an undue increase of the natural objects of that voracity, which had probably been relatively as voracious on their own part in devouring the eggs and young of the pike. The increase of these forms might have resulted in the extermination of the pike, which would naturally have been reflected upon the other forms by depriving them of a part of their customary and requisite food supply, consisting of the eggs and young of the pike, and so have resulted in the decrease, deterioration, or extinction of those forms upon which the pike had exercised that quality which had been generally regarded as superlatively bad. The foregoing illustration is only a partial statement of the disturbances possible through extraneous or unusual agencies.

It is, however, a phenomenon that is usually manifested as a result of overfishing, which amounts to the same thing as depriving the pike of its voracity, and similar to what often happens when black bass are introduced into pickerel ponds, of which there are many instances, but the cause of which has not been fully recognized. For instance, it has been recognized that black bass have practically exterminated pickerel in certain waters, but why the black bass afterwards deteriorated in size and number did not seem explainable. These facts may be equally applied to other fields and fishes as respects their artificial distribution, and particularly to the members of the pike family itself, for it should be borne in mind that the reverse process of the foregoing is just as effective. If the pike should be rendered more voracious or, what amounts to the same thing, unduly increased in number, it would signify that sooner or later the food supply would be depleted, with the result that the pike would be forced to depend more and more upon its own young and would finally figuratively swallow itself.

The problem in the culture of the pikes, as well as in fish culture in general, is, or should be, how by artificial propagation to maintain a natural balance. Therefore, the common practice of placing several kinds of predacious fishes in one body of water should be abandoned. Attention should be paid to not over two species intended for cultivation and the food supply for them. Preferably, the fishes should be those natural to the waters to be stocked or, if not the natural forms, those nearest like them. In other words, species to which the waters are suited should be used, and when two species are introduced they should be of different habits, particularly the fishes that

are least likely to prey upon each other and which do not subsist upon exactly the same kind of food.^a Again, applying the foregoing to the members of the pike family, while many of the old balances of interrelations have been upset or seriously disturbed, if due caution is exercised they may be restored or new counterpoises established.

In the following pages citations to literature are by names of author and date of publication in parentheses, indicating the publication referred to in the appended bibliographical list.

CHARACTERISTICS OF THE PIKES.

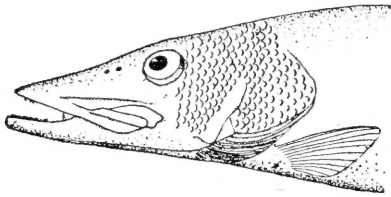
The muskellunge, pike, and pickerels are all pikes in a generic sense. There are other fishes belonging to entirely different families and, therefore, structurally different and distinct from the true pikes, which, unfortunately, have the local names of pike and pickerel. The most common species thus designated belong to the perch family. The spinous dorsal fin possessed by these fishes readily distinguishes them from the true pikes. They are more properly designated as pike perch, wall-eyed pike, sauger, etc. The "pike" part of these names, however, signifies only a resemblance, yet in certain localities the pike perch is called "pike" and in others "pickerel." This is altogether unfortunate, as it has caused regrettable confusion, particularly in compiling statistics of the fisheries.

The true pikes are characterized by having a rather long, broad, flattish snout; a large mouth extending about halfway the length of the head; the lower jaw the longer; and both jaws provided with broad bands of teeth, which are coarse and rough like wool cards and more or less movable. The dorsal and anal fins are situated near the tail and are similar and opposite. The ventral fins are abdominal.

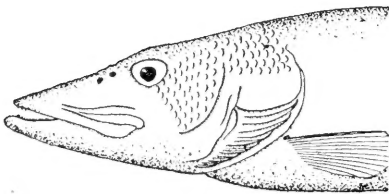
The preceding characters serve to distinguish the pikes from the pike perches, and the following will distinguish them from all other fishes having abdominal ventral fins: Body with ordinary scales; back without adipose fin but with a single dorsal fin made up of soft rays and not preceded by free spines; anal fin without distinct spines; tail forked; pectoral fin situated below the median line of the body from tip of snout to base of tail; head more or less scaly; gill membranes not attached to the prolongation of the body forward between the gill openings; no barbels; maxillaries distinct; upper jaw not protractile, that is, its forward end is firmly joined to the snout; both jaws provided with sharp teeth, varying in size and arranged in broad bands; snout somewhat prolonged and depressed.

^aJardine (1898) states that in artificial carp ponds in Germany it is the custom to keep a few pike, the carp culturist knowing just how many to introduce. A few act beneficially in destroying the smaller and weaker individuals of the carp stock, which would not attain a growth in three years commensurate to their consumption of food.

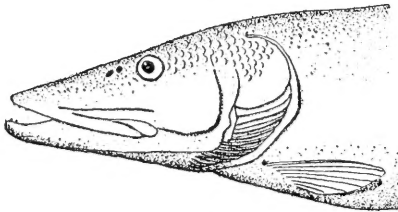
The pike family includes one genus only—*Esox*, the pikes—inhabitants of the fresh waters of the temperate parts of Europe, Asia, and America. The pike proper, *Esox lucius*, inhabits all three continents and is the only representative of the family in other than the North American continent. In North America there are now recognized five species, including the pike. These are the pike (*Esox lucius*), the muskellunge (*Esox masquinongy*), the eastern pickerel (*Esox reticulatus*), the banded pickerel (*Esox americanus*), and the little pickerel (*Esox vermiculatus*).



a



b



c

FIG. 1.—SQUAMATION OF HEAD OF PIKES.

a, Pickerel; b, pike; c, muskellunge.

The species vary in appearance among themselves according to locality, age, size, and sex, but it is only in muskellunge that subspecies have been designated, and these have been pronounced distinct species by some ichthyological authorities (Jordan and Evermann, 1902).^a

Owing to confusion of local names, mistaken identifications, and the scant knowledge of the fishes of some regions, it has not been easy to decide positively regarding the exact geographical distribution of the muskellunge and pike in America, but the ranges of the other species have been fairly well made out.

The following key should enable anyone to distinguish any member of the pike family. In

this key, however, and in the subsequent text the usual order of arrangement has not been followed, but the most important species are first considered.

The genus is divisible into three groups according to the squamation of the sides of the head, which easily separates the muskellunge, pike, and pickerels.

^a Pike and pickerel, particularly the latter, have had their original geographical range more or less extended by man with both good intentions and alleged malice aforethought. Also, places in which the fish was supposed not to occur have, at one time or another, been discovered to contain them.

Jardine wrote that it had often puzzled naturalists to explain how newly made lakes or streams known to have never contained pike should suddenly have been found to be stocked with them. He added that some naturalists, including the late Frank Buckland, considered that waterfowl, such as ducks, coots, moorhens, or dabchicks, after feeding among aquatic weeds where vivified spawn had been deposited, on taking flight to other waters, conveyed some of the spawn, which is glutinous, sticking among their feathers or to their feet.

KEY TO THE PIKES.

- a. No scales on lower half of gill cover (operculum).
- b. Cheek, as well as lower half of gill cover, without scales.....Muskellunge.
- bb. Cheeks entirely scaled, lower half of gill cover without scales.....Pike.
- aa. Gill cover and cheeks both entirely scaled.
- c. Branchiostegals ^a normally 14 to 16; dorsal rays 14; anal 13.... Eastern pickerel.
- cc. Branchiostegals normally 12 (11-13); dorsal rays 11 or 12; anal 11 or 12.....
.....Banded pickerel, little pickerel.^b

MUSKELLUNGE (*Esox masquinongy*).

The muskellunge comprises three more or less distinct color forms which have been variously regarded as subspecies or distinct species.^c These are the Great Lakes and St. Lawrence fish, with irregular blackish spots on a ground color or grayish silver (*Esox masquinongy*); the Ohio drainage fish, including some Pennsylvania and New York lakes, with dark crossbars which split up into diffuse spots (*Esox ohioensis*); and the fish of the Wisconsin and Minnesota lakes and

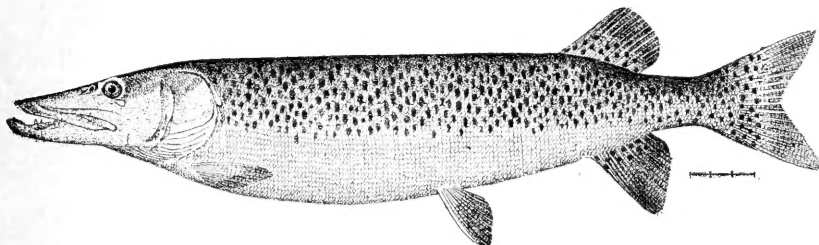


FIG. 2.—MUSKELLUNGE (*Esox masquinongy*).

rivers, with body unspotted or with vague dark cross shades (*Esox immaculatus*).

The spelling of the name muskellunge has been the subject of numerous modifications by various authors, with more or less etymological authority. Curiously enough the Cree Indian name sounds much like the French appellation (Henshall, 1892), but inasmuch as the orthographical representation of Indian sounds is somewhat a matter of individual interpretation, and as many North American French words have become greatly modified, if not wholly Anglicized, the spelling "muskellunge" is adopted here, as it is a phonetic representation of the common pronunciation whether by Cree or

^a The branchiostegals are the riblike rays under the lower edge of the gill cover.

^b Inasmuch as the distinguishing differences of these two species are very slight and the geographical distribution quite distinct, the easiest method of identifying them is by locality (see discussion of each). However, the following characters have been given in keys:

A. Head $3\frac{3}{4}$ in length of body, snout $2\frac{1}{2}$ in length of head, eye 5.....*americanus*.

AA. Head $3\frac{1}{2}$ in length of body, snout $2\frac{1}{2}$ in length of head, eye 6.....*vermiculatus*.

At least one student who has examined many specimens of each of these species maintains his belief that they are not distinct species, and are merely subject to local or geographical variations.

^c "The muskellunge of Chautauqua Lake and the Ohio Basin differs greatly in appearance from that of the Great Lakes. As the two forms are not known to intergrade and as their habits are entirely distinct, they are best regarded as distinct species." (Jordan and Evermann, 1902.)

Frenchman. In fact, the Cree name may have been an Indianized form derived from French sources or vice versa.

The most generally known form of the spotted muskellunge is native to all the Great Lakes, the upper St. Lawrence River, Lake Champlain, certain streams and lakes tributary to the Great Lakes, and a few lakes in the upper Mississippi Valley, also in Canada north of the Great Lakes. It does not seem to be at all abundant anywhere, as the number taken each year in any one of the lakes is small. It is, perhaps, most common in Lakes Michigan and Erie and among the Thousand Islands (Jordan and Evermann, 1896).

The barred muskellunge is best known from Chautauqua Lake, though specimens have been reported from a few places in the Ohio drainage—for instance, in Lakes Conneaut and La Boeuf, Pa.; the Mahoning River, and the Ohio, at Evansville—and a young individual 8 inches long was found in 1899 or 1900 by W. P. Hay in Decker Creek, above Morgantown, W. Va. (Bean, 1902a).

The spotless form is found in a number of small lakes in northern Wisconsin and Minnesota. The following waters in northern Wisconsin are stated to be inhabited by this pike: Pelican Lake, Tomahawk and adjoining lakes, Arbor Vitæ, St. Germain Lakes, Trout Lake, the Eagle waters—i. e., a chain of lakes through which Eagle River flows—Three Lakes and others connected therewith, Buckartcarbon Lake, Lac Vieux Desert, Big and Little Twin Lakes, Long Lake, Sand Lake, and various others, many of which have not been explored or named (Mosher, 1892, and Nevins, 1901).

SIZE.

The muskellunge has been stated to be the largest species of the pike family, but, if traditions and reports are true, in Europe the pike has attained a larger size than has ever been recorded for the muskellunge, and there are numerous records of pike in this country of fully as large size as the majority of large muskellunge. The average weight of the muskellunge and the usual range of the large pike perhaps are not much different except in some localities where the fish have become scarce and run large. In fact in the past there have arisen many disputes and discussions regarding fish which some anglers chose to call muskellunge and which others decided were pike. Sometimes the question was referred to the Sportsman's Journal and occasionally to the United States Fish Commission. Usually, however, the description of the fish was inadequate to permit of a positive identification.

The muskellunge has been said to reach a weight of 100 pounds or more (Jordan and Evermann, 1896), but the maximum weight is probably not often above 80 pounds and the average not over 25 or 30 pounds.

Bean (1902) stated that the muskellunge in Chautauqua Lake had been known to reach a weight of 50 pounds, and in the spring of 1895, when eggs were being collected for the Bemus Point hatchery, it was not unusual to take individuals weighing from 40 to 50 pounds and many weighing from 20 to 30 pounds.

At the Minocqua hatchery in Wisconsin James Nevins (1901) mentioned one of 40 pounds.

HABITAT AND HABITS.

Habitat.—Wherever the muskellunge occurs, its habits, so far as they are known, are essentially the same and generally similar to those of other members of the family.

The seasonal abode of the fish varies somewhat with the size of the fish. In any body of water it generally occurs in the vicinity of water plants at the edge of channels or streams or along the shores, where it lies concealed.

Referring to the Chautauqua Lake fish, Bean (1908) wrote that when the lake became very clear in February the fish go into deep water and that they live in deep water more or less all of the year, and in winter they frequent nearly the same localities as in summer, usually in the vicinity of water plants.

Mosher (1892) stated that the muskellunge delight to lurk among weeds or old tree tops that have fallen into the water. There they will lie for hours perfectly motionless.

Henshall (1892) stated that like all animals of prey it is solitary in its habits, lying concealed among the water plants and bullrushes at the edges of the streams or channels or along the shores.

Feeding.—The feeding habits of the muskellunge are essentially the same as of the other members of the family. As in the case of most predacious fishes, it subsists largely upon other fishes, for which it lies in wait under the concealment of water plants. Its size makes it a formidable engine of destruction, but not more so than other voracious species of like size.

Henshall (1892) stated of the muskellunge that, like all of the pike family, it is a typically piscivorous fish, having its large mouth, jaws, and tongue, armed with a terrible array of long, sharp, conical teeth of various sizes, which form veritable *chevaux-de-frise* from which there is no escape for the unlucky fish that is so unfortunate as to be seized by the cruel and relentless jaws. In another place he went on to say that the number of fishes destroyed by a mascalonge, as he called it, during a summer is almost incredible, and they are not small fry and young fishes, such as devoured by other predacious fishes, but those that have escaped the many dangers and vicissitudes of adolescence and have arrived at an age when they are capable of reproducing their kind.

Spawning.—In referring of the Wisconsin fish Nevins (1901) wrote: "The breeding places of the muskellunge are where the logs, stumps, and driftwood are thickest, in shallow water or flowage where dead limbs, logs, and brush have accumulated as results of flooding for logging purposes or otherwise."

Bean (1908) stated that the Chautauqua muskellunge begins to spawn a few days after the ice is out and continues until the latter part of April and that it spawns in comparatively shallow water from 10 to 15 feet deep. He said that the fish does not resort to gravelly bottoms like many other fish but to mud, usually going into bays.

The following communication ^a was reported in the proceedings of the Boston Society of Natural History in 1854:

Dr. Burnet (1854) stated on the authority of Prof. Ackley, of Cleveland, that the "muskalonge" (*Esox nobilior*) is known to perform an act of copulation in fecundating the eggs of the female. The female turning on her side offers her abdomen to the contact of the male, who, after taking a circuit, swims against her with considerable force. The female then retires and deposits her eggs in the sand, after which the process is repeated. Dr. Cabot thought that the object of the act in question might be to press the ova from the female just as they were about to be extruded. He has seen male and female suckers (*Catostomus bostoniensis*) side by side in close contact, during the breeding season, probably for a similar purpose. Dr. Durkee had noticed the same thing in the habits of the trout.

ARTIFICIAL CULTURE.

Only the State fish commissions of New York and Wisconsin seem to have made any determined effort to artificially propagate the muskellunge.

New York was first to undertake such operations, chiefly at Chautauqua Lake, and later Wisconsin carried on the work at the Minocqua hatchery.

In order to get the breeding fish, Bean (1908) stated, the pound nets are set at a number of places near Bemus Point as soon as the ice leaves the lake.

He stated that the males are smaller than the females and very little milt suffices to fertilize a large number of eggs. A female weighing 35 pounds yielded 255,000 eggs, and the eggs are about one-eleventh of an inch in diameter and 74,000 to the quart measure. They are semibuoyant and not adhesive.

Under favorable circumstances about 97 per cent of the impregnated eggs have been hatched. In the early experiments with artificial culture some eggs were hatched in 15 days with a water temperature of 55° F. The fry when first hatched are very small and quite helpless. The yolk sack is absorbed in about 15 days in water at 55° F.

^a Note the similarity of this description with Smitt's and Benecke's statement relating to the pike.

Formerly the eggs were hatched in boxes, but at present they are placed in glass jars and hatched like whitefish eggs in artesian-well water with a uniform temperature of about 48° F. The embryos are too heavy to swim out of the jars, and therefore they are transferred at the proper state of development to trays in boxes placed in the hatchery troughs. These boxes are fitted with wire at each end to insure a direct and uninterrupted flow of water, which prevents the banking up of the fry at the lower end of the tray. Eggs first taken on April 18 began to hatch on May 16. The shell of the egg was very dark, almost black.

Premature hatching occurred on some occasions, due to a difference of temperature between the lake and the artesian water, a difference of 7° or 8° F. when the eggs were transferred. Cold water was found very bad for hatching the eggs. They do not develop properly, some having no shell when hatched and the fry small and weak. On the other hand, if hatched in warm water the fry would be black and strong and almost twice as large. The best water to use is lake water, which should grow gradually warmer.

Mr. William Buller, of Corey, Pa., hatched muskellunge eggs on the finest wire trout trays in water at a temperature of 45° F., where they were stated to hatch in 62 days into fine and healthy fry.

Muskellunge fry can be kept very easily until they begin to swim up, but after that the losses through cannibalism are so serious that it has been found impossible to rear them.

It does not, however, swim up as soon as the young of most fishes and is much affected by the quality of the egg. Sudden changes of temperature of the water injure the egg seriously.

Young muskellunge kept in a small creek, at the hatchery grounds at Bemus Point, grew faster than those in artesian water in the hatchery troughs and ponds.

Many attempts have been made to rear the muskellunge to fingerling size, but none has succeeded on account of the cannibalism so characteristic of the young.

The young fry are usually ready for planting about the end of May or in June.

The Wisconsin commission began to propagate the muskellunge during the spring of 1899 in connection with the work of collecting wall-eyed pike ova (Nevins, 1901). The chief difficulty encountered was stated to be to catch the fish on the eve of spawning, as it was found that the large fish would not stand confinement, and in the beginning sufficient ripe male fish could not be secured.

Attempts were made to hold the fish in pens and in a large dummy pocket 20 by 22 feet and 10 feet deep, but in vain. The ova would be retained in the fish and would cake. Finally, a large pen was made in a thoroughfare between two lakes in a current of water, in which

unripe fish were successfully held until the ova matured and both spawn and milt were obtained. After spawning the fish were released. In catching the fish for breeding purposes the fyke net is usually employed, and it is not altogether an easy matter to collect a sufficient number for spawning purposes, as the spawning places to which the fish resort in pairs are scattered about the lake. In transporting the fish to the pens live boxes 16 feet long, 2 feet wide, and 10 inches deep, made "skow-shape" with bottom of slats 2 inches apart, giving an abundant circulation, are employed.

Unlike those of most other fish the eggs do not harden after being taken from the fish, but remain soft and flabby until hatched. With the water at a temperature of 52° F. the eggs hatch in about 10 days, and about 15 days are required to absorb the food sack.

Both boxes and Chase hatchery jars were tried, with the result greatly in favor of the jars. Just before the eggs began to hatch they were taken from the jars and placed on fine wire-cloth trays, in order that the young fish might not smother, being unable to make their way out of the jars unaided on account of the comparatively large umbilical sack.

One female weighing about 40 pounds produced not less than 225,000 ova, 80,000 filling a quart measure and 190 individuals averaged 6,315 eggs each.

The fry when first hatched are a light color and seem to adhere to the side of the tank, box, or tray, or any other object with which they come in contact. Those hatched were strong and healthy, grew rapidly, and in their development exhibited their wild nature and the instinct of self-preservation by quickly darting off to hide when alarmed by a person approaching the tank in which they were confined.

They were retained until they were 4 weeks old and 1½ inches long and were fed upon young pike, which seemed to be suitable as well as acceptable food.

CONSERVATION.

Nevins stated that for many years, since the wilderness of northern Wisconsin was opened by railways and by lumbering operations, with the advent of the comforts and conveniences which the railroad takes into a new country and the encroachment of the settler and summer hotels on the primitive banks of our northern lakes, the pursuit of the muskellunge has been constant and relentless. Its utter extermination has been well nigh accomplished in many of our lakes where it was indigenous; and nearly all of our waters have been cleared of this fish to such an extent that its future has become a matter of much concern to sportsmen, fish culturists, and others interested in keeping our waters well stocked with superior game fishes.

Henshall (1892) stated that it is fortunate for the rest of the finny tribe that the "mascalonge" is comparatively a rare fish. The muskellunge, like others of the pike family, breeds in the spring, later, however, than the pike or pickerel. All of the pike family resort to overflowed marshes or shallow grassy streams to spawn—the pickerel during March and the muskellunge in May.

The pickerel thus has a start of about two months, and no doubt the young pickerel devour most of the muskellunge that hatch, for the spawn in May, in such shallow water, is exposed to the ravages of turtles, frogs, ducks, and coots, and most of it is doubtless destroyed. This seems to be a wise provision, for since the muskellunge spawns from 100,000 to 300,000 eggs, according to size, the result can be imagined were the same proportions of eggs to hatch and reach maturity as in the case of most other fishes.^a

It has not seemed advisable to introduce this fish into other waters than those in which it is indigenous.

For a number of years the Pennsylvania commission has distributed the young of this species, hatched from eggs derived from New York waters, into natural muskellunge waters in Pennsylvania. One of the State reports says, however, that the muskellunge attains a size of 12 inches in a very few months, but to attain that size eats an enormous amount of food, causing it to be a dangerous fish to place in ordinary waters.

FOOD QUALITIES.

As in the case of other species of the family, opinions vary regarding its quality as a food fish. Henshall wrote (1892) that in comparison with the rest of the family it is a valuable food fish, though it is much overrated and is inferior to the whitefish, lake trout, black bass, or brook trout for the table, but that it is, however, readily disposed of in the markets, and, while possessing no special or characteristic flavor, is firm, flaky, and is much admired by many, and adds "but chacun à son goût."

On the other hand, Nevins (1901) stated that from a gastronomic standpoint the muskellunge has few equals among fishes and by some is considered to rank in quality next to the salmon.

AS A GAME FISH.

Henshall (1892) stated that as a game fish the "mascalonge" is far superior to the rest of the family, and when weighing upward of 10 pounds its great vitality, weight, and power give it an endurance that

^a In this statement Henshall does not seem to recognize that homologous adaptations exist in other fishes. In natural economy the purpose of reproduction—i. e., the perpetuity of the species—is accomplished by the survival of one pair only to replace the parents when they are gone, and for which purpose one species is no better equipped than another. Every species is naturally adapted to meet both favorable and unfavorable conditions to which it is naturally subjected. The species which is subjected to the most adverse conditions has the most eggs, and vice versa.

is highly extolled by some, but can hardly be compared to the salmon, black bass, or brook trout for pure gameness per se; that is, it does not exhibit the finesse and élan of those superb game fishes.

Most "mascalonge," however, are taken with hand line and trolling spoon and hauled in hand over hand. With taut line and moving boat the "mascalonge" sometimes leaps above the water because it can not get very far beneath the surface. As a rule, however, when on the rod it does not leave the water and will not leap unless forced to do so, but will endeavor to keep near the bottom or to reach the cover of weeds or rushes.

With proper tackle the "mascalonge" affords good sport, for, being a powerful fish, it requires much skill and judgment on the part of the angler to keep it away from the moss and grass bottom or from the weeds and algæ of the shore and to successfully bring it to gaff within a reasonable time. The best bait is a large live minnow or frog, either for casting or trolling, though for the latter mode of fishing a large trolling spoon with single hook may be used.

Regarding the Ohio fish, Henshall said that in the Ohio and its tributaries the "mascalonge" is found in the summer and autumn in the deepest holes of the streams and are then taken by stillfishing, the bait being usually suckers of a half pound or more in weight. After taking the bait the fish is given time to gorge it before striking or hooking. He adds:

It is now, however, a rare occurrence to take a "pike," as it is called, in these waters, and the fact is talked of long afterwards and the head preserved as a trophy, while the fish itself, being esteemed a great delicacy on account of its great size and rarity, is made the piece de resistance of a formal dinner instead of being preserved for a piece justificative. For five years I have endeavored to procure a specimen of this rare fish in the Ohio Basin, but, beyond the head, my efforts have so far failed. No one who is so fortunate as to capture a "pike" seems willing to part with it for love of science or coin of the realm.

Regarding its game qualities, Mosher wrote that when lying basking in the sun they rarely take bait unless unusually attractive, but when lurking in the weeds or rushes, waiting for some living victim, they will take artificial bait voraciously. But, he stated, they do not seem to be so voracious as their smaller cousin the pickarel, and there are times when for days together no amount of coaxing will induce them to take bait of any kind.

PIKE (*Esox lucius*)

The pike, as previously mentioned, is the only species of the family which occurs outside of North America. Its geographical range, according to F. A. Smitt (1892), is from northeastern Siberia west to the east of North America. According to Pallas, it inhabits the River Amur, which falls into the Sea of Okhotsk, and the Rivers Indigirka and Chatauga, which discharge into the Arctic Ocean,

but is wanting in the Kamchatkan Peninsula. Brehm found it in the lower course of the River Obi; and in the great lakes of the Barbara steppes (the upper basin of the Obi and Irtish) it is extremely common, according to Pallas, and attains a considerable size. It occurs also in the Caspian Sea but not in Transcaucasia or in the Black Sea, though it is found in the Sea of Azov and the basin of the Danube. It is met with in rivers and lakes throughout Russia and north-central Europe, including Great Britain, Italy, and Sicily, but is said to be wanting in Greece and on the Pyrenean Peninsula. It inhabits all the waters of Scandinavia, with some exceptions in Norway.

In North America its range extends across the continent from the Labrador Peninsula to Alaska, northward to beyond the Arctic Circle, and southward to the St. Lawrence and Great Lakes Basin. It is found also in some waters in the United States south of the Great Lakes, as northern New York and the Mississippi and its tributaries, .

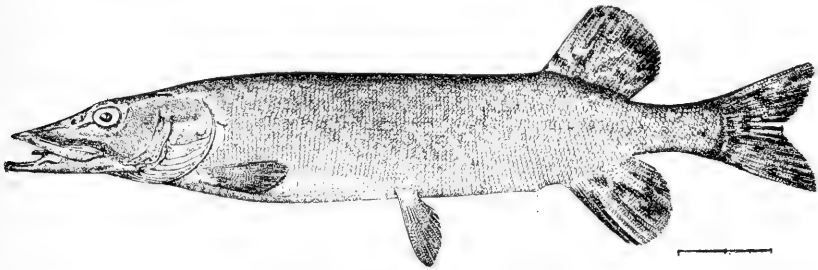


FIG. 3.—COMMON PIKE (*Esox lucius*).

but it does not occur in Nova Scotia, New Brunswick, or (except by introduction) in that part of New England east of the Green Mountains.

It is the common pike of northern New York and the States bordering on the Great Lakes.

Chambers (1896) stated that it occurs in Lake St. John and its tributary streams as well as in the large lakes adjacent to and beyond the height of land.

According to Low (1895), this fish is found abundantly throughout the interior of Labrador in the lakes and quick-flowing streams and is common in the rivers of the southern, eastern, and western watersheds, but not abundant in the Koksoak River.

Preble (1908) reported that it is abundant in the Mackenzie Valley in practically all the waters of the region and has given its name to scores of lakes and streams, but he was unable to ascertain its presence in the Ark-i-link, Great Fish, or Coppermine Rivers. However, it is an inhabitant of the Anderson.

Bean said that Townsend and others found it above the Arctic Circle in Alaska, and Dall and Nelson took it in abundance on the Yukon.

NAMES.

In America, as in Europe, this fish is known by various names according to locality and appearance. In the British Isles the young is called a "jack" or, sometimes, pickerel. In our own country, probably, the name pickerel is in as common use for this fish as pike, and, intentionally or unintentionally, when large it has sometimes been mistaken for muskellunge. It is the "grass pike" of Lake Erie and perhaps of other waters. In Canada it is referred to as pike and jack pike. According to Forbes (1908), in Illinois and elsewhere it is called pickerel. However, with a little scrutiny, at whatsoever size, it can hardly be mistaken for any other species. The presence of scales on the cheeks and absence of any on the lower half of the gill cover easily distinguish it.

While the color of the fish may vary considerably in some details of shade or markings, as usually observed it may be said to be greenish gray with yellow reflections and with many white or yellow spots arranged somewhat in rows, the dorsal and caudal fins bearing round or oblong black spots. The young are more or less crossbarred.

SIZE.

While the muskellunge is stated to be the largest of the pike family, in Europe, if traditions can be believed, the pike has far exceeded any muskellunge record. One taken at Bregenz in 1862 was said to weigh 145 pounds, and one caught in Scotland was reported as being 7 feet long and weighing 72 pounds.

Smitt (1892) said that the maximum authentic record is one of 57.2 pounds, but that pike of that size are of rare occurrence.

Jardine (1896) presented lists covering a period from 1869 to 1896, inclusive, of large pike taken by anglers in England, Scotland, and Ireland, comprising 51 examples ranging from 18 to 37 pounds, which are found to average $25\frac{1}{4}$ pounds. He mentions another found after draining Whittlesea Mere which weighed 49 pounds.

Coupled with the alleged great size to which the pike has attained in Europe are unauthentic accounts of instances in which individuals reached a great age, as high as 200 years in some cases.

In a large lake at the head of a tributary of the Nushigak River, Alaska, the Inuit natives believe that there are pike of fabulous size which they hold in a sort of superstitious awe or fear and concerning which they relate wonderful tales, believing that they attack men in their kyaks and devour them. They say they are longer than a kyak (Fassett).

In some waters of British America the pike reaches a considerable size. Preble (1908) stated that in the larger lakes it attains a weight of 35 pounds or more. In Labrador Low (1895) said that it varies in weight from 2 to 15 pounds.

According to Chambers (1896), in the Lake St. John region many of them far exceed in weight the generally accepted limit of size of the ordinary *Esox lucius*, sometimes attaining the weight of 20, 30, and even 40 pounds. One was taken in Lake Tschotagama in 1890 which weighed 49 pounds and another in 1891 of 47 pounds. In 1892 one was caught in the Peribonca River which weighed 35 pounds.

Herbert (1849), referring to the pike, said that specimens of the northern pickerel may be found which weigh as high as 16 or 17 pounds, but that weight is rarely exceeded.

Forbes (1908) stated that the average weight of the pike in Illinois waters is not over 5 pounds, but a specimen weighing 26½ pounds was reported by Dr. Jordan to have been caught in the Kankakee, and Tomlin (1892) wrote that specimens have been taken in Michigan and along the bays connecting with the north shore of Lake Superior which weighed as high as 20 pounds.

HABITAT AND HABITS.

Habitat.—The pike chooses its spring and summer haunts by preference in shallow inlets with weedy bottoms and shores overgrown with reeds and rushes. Toward autumn it betakes itself to precipitous, stony shores, which it again forsakes when winter is at hand and the inlets freeze. Most of the pike then return to their summer stations, but the larger ones seemingly follow the shoals of other fishes to the depths, being seldom caught during the winter in shallow water. For these a more plentiful supply of food is, no doubt, necessary than shallows afford in winter. When the pike has chosen its station for the season, it restricts its wanderings to the immediate neighborhood, leading a solitary life and never being seen in company except during the spawning. (Smitt, 1892.)

According to Preble (1908), in the far North it is much less common in the muddy rivers than in clear lakes, and the pools at the foot of falls or rapids are favorite haunts. Forbes (1908) said it prefers clean, clear, cool water with a sluggish current, in which it remains generally quiet by day.

Habits.—Tomlin (1892) wrote:

It is a powerful fish and is no coward; it will fight as viciously as a terrier. We have seen small pike with jaws locked and lashing the water around them like a boiling caldron. Occasionally letting go and backing out, they would rush at each other with open jaws and keep up the fight until one is beaten and driven away or until later on exhausted. Some years ago I found two dead, with both jaws fast set so that they could not be pulled open. Both of them were handsome male fish and must have fought fiercely, for their bodies were cut all along the sides and bellies.

Feeding.—The pike is undoubtedly the most voracious among the fresh-water fishes. It devours indiscriminately other fishes, young waterfowl, small mammals, and carrion. From the dense bed of grass or rushes, where it usually passes the day in stationary watch,

it pounces with the speed of an arrow on its unwary victim. It almost always seizes its prey crosswise and retains its hold until the latter is dead or so exhausted as to desist from all struggles. Then the pike turns the prize in its jaws till the head points toward the interior of its mouth and commences its meal. This operation is a protracted one when the victim is large, for the end first swallowed and received in the stomach must digest to make room for the remainder (Smitt, 1892).

On one occasion a pike of 7 or 8 pounds' weight was seen to dart forward and seize a salmon which was quite as large in its formidable jaws right across the body. The combat was fierce. The salmon leaped out of the water and made desperate but fruitless struggle to shake off its relentless captor. In a couple of hours' time the salmon was utterly exhausted, and the pike began to swallow it head first. The meal lasted three days before the whole body had disappeared. The process of digestion must have taken much longer, for all the following week the pike had a very swollen appearance and could hardly be induced to move by touching it with a long stick (Smitt, 1892).

The fishermen in general believe that at certain seasons of the year the pike entirely abstains from food and at others is excessively voracious. These seasons are said to be periodical and regular in occurrence, the observant fisherman being able to predict the time when the pike is "on its feed," as it is called. But these periods are said not to occur at the same time year after year, and according to some observations, they are determined by the spawning season, for the period of voracity begins in the same change of the moon (waxing or wane) as the pike finishes spawning. There is one exception, however, the pike being always "on its feed" throughout the dog days. This periodical voracity and moderation is said to depend on the circumstance that at certain times the points of the teeth hardly project above the flesh, some tenderness of the gums being thus the curb of the pike's usual rapacity. Perhaps we have here some observation on the manner in which the pike casts its teeth or we may find a more probable explanation in the fact that the fish requires some time to digest the great quantity of food which it devours during the period of voracity (Smitt, 1892).

According to Chambers (1896), in the Lake St. John the fish is so voracious that many of the settlers about the shores fear to bathe in the waters. Both dogs and waterfowl swimming upon the surface have been attacked.

Forbes (1908) stated that it is purely carnivorous, its food consisting of fishes, such as sunfish and black bass. Frogs, crayfish, large water insects, mice, reptiles, and young ducks have been reported by various authors to have been taken from the stomachs of pike.

Breeding.—Since, unfortunately, not much has been written concerning the breeding habits of the American pike, it is again necessary to rely for information mainly upon what has been published respecting the European fish. However, if the two are specifically identical, the general habits are probably much the same.

Smitt (1892) has quite fully described the spawning process of the Scandinavian pike, and his description essentially agrees with the account of the German fish given by Benecke.

In the spring before there is open water in the lakes the pike commences to approach the shores, and breeding individuals in particular repair to those parts of the shore having inlets. When the spring is so far advanced that the lakes are free of ice, the brooks clear, and the low-lying meadows about the shores are under water, the larger pike make their way to those inundated places and begin to spawn.

The spawning is of long duration, its season depending upon the age of the fish, the young spawning first. When they have finished, the middle-sized pike begin, and the oldest and largest spawn last of all. Generally there are laid about 100,000 yellowish eggs about 3 millimeters in diameter, out of which in the course of 14 days the young with their great umbilical sacs escape. The spawning time in eastern Prussia was given as during the months of February to April, and occasionally the spawning of the first pikes occurs before the departure of the ice. (Benecke, 1880 and 1885.) In Illinois the pike spawns in March, selecting shore water about a foot and a half in depth, and the young hatch in about 14 days (Forbes, 1908).

Benecke (1880 and 1885) stated that it lives a hermit life, consorting in pairs only during the spawning season, but Smitt said that the females, which are always larger, come to the spawning places each attended by two or three or, in rare cases, four males; also that the females swim so high in the water that when the weather is calm the surface is faintly rippled by their movements and the dorsal and caudal fins may be seen above the surface. As soon as the female halts the males approach and surround her, one on each side or, if more than two, one under the tail and perhaps one above the back. They rub themselves against her body, during which operation she keeps still, only moving the fins, after which she disperses the males with a sudden lash of her body and darts to another point, meanwhile having deposited in the grassy bottom the yellowish and coarse-grained roe which is impregnated by the milt. At the new location the operation is repeated. Benecke, however, states that the fish rub violently against each other and the spawn is deposited, accompanied by powerful blows of the tail.

The number of eggs yielded by a pike, of course, depends upon the size of the fish. Pennel (1886) stated that a pike produces about 80,000 eggs, while Jardine (1898) placed the number at 100,000. Bloch counted in a pike weighing a little over 6 pounds 136,500 ova,

and Buckland found in a female weighing 28 pounds 292,320 eggs and in another weighing 32 pounds 595,200 (Smitt, 1892).

According to Smitt (1892), the eggs, which at first are rather adhesive, lie free on the bottom and in the spring (April) require about three weeks to hatch. Jardine says that the period extends from one to three weeks according to the temperature of the water.

Notwithstanding the great fecundity of the pike, Smitt was of the opinion that a great portion of the deposited roe is probably destroyed, committed as it is to the open waters, where it is exposed to many dangers.

The newly hatched fry, wrote Sundevall (Smitt, 1892), is short and thick in shape with rather a large belly. The coloration is yellowish but quite transparent and densely punctated on the surface with black dots, a dark band running from the eyes along the sides of the belly.

At first the larva remains almost quiescent, lying close to the surface of the water beside plants and floating straws and the like, to which it seems, as it were, to hang, or else at the bottom in less than an inch of water. On being touched it swims rapidly about with hasty movements of the tail but soon resumes its former position. In about 10 or 11 days the yolk is absorbed and the belly much reduced in size but the head elongated and the mouth large. It now begins at once to swim more steadily, in the same manner as its elder, and goes in quest of prey. It soon abandons the habit of lying on the bottom or resting alongside floating objects, repairs to somewhat deeper water, remaining for the most part stationary, as if on the watch for prey. It seizes small fishes and other aquatic animals of a size considerable enough in comparison with its own, but only leaps for those which it sees moving, just as in the case of older pike (Smitt, 1892).

RATE OF GROWTH.

According to Smitt (1892), the external form in which the specific characters of the pike may be traced seems to be fully developed at an age of nearly 2 months and a length of about a Swedish inch (25 mm.). Subsequently the growth proceeds rapidly, as usual, at first, but with very considerable variations, depending on the different supply of food under circumstances favorable in all respects. According to some observations a 1-year pike is only 15 centimeters long, according to others 30 centimeters. Blanchere states the growth as follows:

MAXIMUM LENGTH OF THE PIKE.		Meters.
1 year old.....		0. 25-0. 30
2 years old.....		. 36- . 42
3 years old.....		. 55- . 60
6 years old.....		1. 00
12 years old.....		1. 35

How widely such computations may differ appear from Ekstrom's observations. He found that pike fry 37 to 49 millimeters (about 1.45 to 1.90 inches) long, kept in a spring with muddy bottom, only attained in 5 years the size of a common herring, but that a specimen 15 centimeters (about 5.88 inches) long, kept in another spring with smaller fish to feed on, attained in 5 years a length of 4 decimeters (about 15.70 inches).

Whitmark gave a number of statements from authorities in different parts of Germany showing the annual rate of growth of the pike, which appears to vary from 2 to 3 pounds, the maximum size attained being from 40 to 70 pounds. He cited one instance in which, in two summers, a few individuals liberated in a pond full of a species of carp grew from the weight of $1\frac{3}{4}$ to that of about 10 pounds.

Frank Buckland was of the opinion that pikes did not become egg-bearing under the weight of 3 pounds (Jardine, 1898).

CULTURE AND CONSERVATION.

Notwithstanding its growing scarcity, the idea of any need of culture or conservation appears not to have been generally entertained. Apparently no attempts at artificial propagation have been made.

In the words of Forbes (1908), this noble fish, completely and almost ideally equipped for the predatory life, has now nearly disappeared from the larger and muddier streams of Illinois, but it is still found in abundance in the headwaters of the Kankakee and in the small glacial lakes of the northeastern part of the State.

Chambers (1896) regarded it as fortunate that in many of the Lake St. John waters, where it has been systematically fished during recent years, the pike is very much less abundant than formerly.

In New England, about 1838, the fish, it seems, was transplanted from Lake Champlain into a pond connected with Black River, Windsor County, Vt., and thence carried by a freshet into the Connecticut River. In 1846 Dr. Storer (1848) reported the capture of this species in the Connecticut River, a specimen having been sent to him by Mr. William Henry, of Bellows Falls, Vt. Mr. Henry reported that he had known, in some seasons, 100 or more to be taken at Bellows Falls, weighing from 1 to 14 pounds each.

There are probably other instances of its having been transplanted, but its artificial propagation has not been encouraged in this country. However, regarding the British pike, Jardine (1898) wrote that inland lakes, ponds, and brooks were lying useless and pike would well repay cultivation in them, for they grow and fatten with great rapidity.

FOOD QUALITIES.

As a food fish the pike is of no small value. The flesh is white, firm, wholesome, and comparatively free from bones. Fresh pike is by no means a bad dish, and the flesh has advantage over that of

many other fishes. It may be kept for a long time, without deteriorating, in a salted or dried condition.

Herbert (1849) said that it is coarse, watery, and of small value on the table.

Preble said (1908) that in the Athabasca and Mackenzie region, a region of excellent food fishes, it is not highly esteemed, but being easily captured it is often a means of preventing much suffering from famine.

Benecke (1880 and 1885) stated that only the young rapidly growing pikes are edible, the old ones being dry and tasteless.

Jardine (1898) cited the "Analysis tables of the food collection" at Bethnal Green Museum in support of his statement that the pike is a nutritious food, containing more nitrogenous or muscle-forming qualities than meat, and he added that as an adjunct to the domestic bill of fare a small pike from 5 to 8 pounds' weight, caught during November or the next three months, when fat and nicely cooked, is a dish by no means to be despised.

AS A GAME FISH.

Go where pike can be found, fish for them with legitimate tackle, give them a fair chance, and they will afford as much pleasure as any royal smallmouth bass that ever swam (Tomlin, 1892). Cheney (1896) wrote that the pike and pickerel had not been hatched in this country, but that the pike was cultivated in Germany by artificial methods and is regarded more highly in Europe than in this country. He explained that the reason for this is that we have such a great number of so-called game fishes considerably superior to the pike that the latter has been relegated to an inferior position. However, the pike has its loyal adherents who regard it highly as a rod fish and as a table fish.

EASTERN PICKEREL (*Esox reticulatus*).

The eastern pickerel has a comparatively limited natural geographical distribution. It is believed originally to have been restricted to the fresh waters of the Atlantic seaboard, being commonly found everywhere east and south of the Allegheny Mountains from southwestern Maine to Florida.

Aided by man its range has been extended throughout the southern half of Maine and even farther north into the lower waters of the St. John River, into New Brunswick, and elsewhere. Thompson (1842 and 1850) did not record its being found in Lake Champlain, but stated that it was the common pickerel on the east side of the Green Mountains, as *Esox lucius* was on the other.

However, it has since been reported in Missisquoi Bay (Evermann and Kendall, 1902) and in the St. Lawrence as long ago as 1863

(Fortin, 1864). It has also been recorded in one locality in Lake Ontario (Evermann and Kendall, 1901).

Occurring as it does so commonly in the St. Lawrence, it is peculiar that it is not more common in the northern tributary waters, but Halkett (1913) does not definitely record it at all, and Nash (1908) states that he has not met with it elsewhere than in the neighborhood of Toronto, where he has taken a few specimens.

LOCAL NAMES.

A common book name given this pike is chain pickerel, but in New England it is almost if not quite invariably known as pickerel. It is, perhaps, the grass pike of the St. Lawrence and the green pike of some other localities. It is commonly called jack in the south, the term being probably an early importation from England, where small pike are often so denominated. Smith (1907) mentioned pike, red-

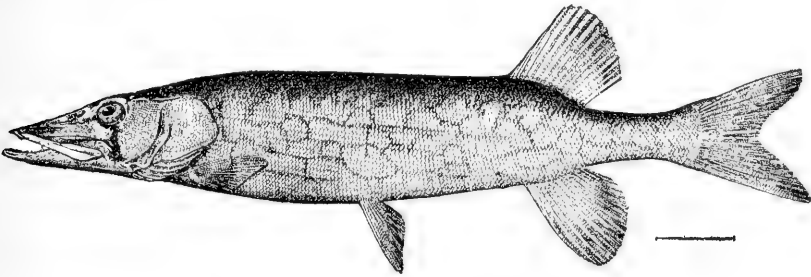


FIG. 4.—EASTERN PICKEREL (*Esox reticulatus*).

finned pike, black pike, duck-billed pike, and jack as names in common use in the Albemarle region of North Carolina. He explained that old specimens living in deep, shady water were designated as black pike by the commercial fishermen. Bean (1902) said it is the federation pike of Oneida Lake, N. Y.

CHARACTERISTICS.

The scales on the cheeks and opercles easily distinguish this fish from the muskellunge or pike, but not from the other two species of pickerel. From these the adult may be always distinguished by the reticulated black or brownish lines on the sides. Younger fish do not show these marks, but are also banded, the cross bands being wider and, consequently, fewer than in either of the others. The structural distinguishing characters have already been indicated. A well-conditioned pickerel, with its green and golden hues and dark markings, is a beautiful fish.

SIZE.

Ayres (1844) gave an account of phenomenally large examples. He said that on February 28, 1842, he examined a pickerel which had been caught in the Hoekanum River, about 2 miles east of Hartford,

Conn., which he claimed was "an undoubted *reticulatus* of Le Sueur." It was 38 inches in length and weighed 14 pounds. He stated that this was the largest example of the species which had ever come under his observation with one exception. The largest of which he had ever heard as occurring in the Eastern States was taken in the spring of 1842 near Greenfield, Mass., which weighed 20 pounds. These might be accepted as authentic records were it not for the fact that the introduced pike had become fairly common in the Connecticut River in 1846 in the vicinity of Bellows Falls, Vt., and had found its way down perhaps into these tributaries. This fact lends an element of doubt to the question, preventing acceptance of the records as authentic, although Dr. Ayres was an accomplished ichthyologist. However, ichthyologists have been known to make worse mistakes.

Storer (1853) said that the largest pickerel seen by him were specimens weighing 7 pounds brought from Brewster, Cape Cod. Even larger ones were reported to have been found there.

Pickerel weighing as high as 8 pounds have been authentically reported, but such size is uncommon and fishes accounted large will not usually exceed half that weight. Two and three pound pickerel are about the average in waters of ordinary suitability to the fish. However, bodies of water differ in respect to their suitability, and in some the largest fish will not exceed a pound and in others much larger fish are common.

HABITAT AND HABITS.

Habitat.—The usual haunts of the pickerel are weedy streams and bays or coves of lakes. In some lakes small and medium sized pickerel occur in the shallow coves, where they lurk under lily pads or amongst the rushes and sedges. Often larger fish occur along rocky shores contiguous to deep water, especially if there are fallen trees, brush, or bowlders to afford concealment. It has, also, been caught on the rocky shoals of an open lake.

In some streams, while it is most abundant in the sluggish, dead waters where aquatic vegetation is profuse, it is not infrequently found well up in quicker water if the character of the shores or growth there provides concealment.

In North Carolina, Smith (1907) stated that its favorite haunts are creeks, coves, and bayous containing grasses and broad-leaved water plants, under which it lurks.

Where natural or artificial obstructions do not exist, the pickerel will sometimes make its way to extreme headwaters. Adult pickerel a foot in length have been taken near the spring source of a stream where it was not over 2 feet wide and only a few inches deep, but full of pondweed. However, pickerel will not often traverse rapids or long extents of rips, and those found far upstream, as just de-

scribed, probably reached those places for self-protection while young fish. The very young, just as in the case of many other fishes, find their way into the shallowest waters and mouths of brooks entering the lake, probably from neighboring localities where they were born.

According to Mr. Frank Todd, of St. Stevens, New Brunswick,^a a few years after the introduction of pickerel into the St. Croix Lakes, for a number of years a good many individuals of large size were taken by weirs and by hook in salt water some 6 or 8 miles below the head of tidewater. At the time of writing, however, some 15 years since the introduction of the fish into that region, they had greatly decreased coincidentally with the pickerel of the fresh waters.

Food and feeding.—The principal subsistence of adult pickerel consists mainly of other fishes, although it includes many other animals in its bill of fare, such as frogs and other batrachians or, in fact, any living thing moving in the water within reach which it can capture and handle. According to Smith (1907), in the spring about Albermarle Sound, this fish feeds chiefly upon alewives.

Like other members of the family, this pickerel is accounted an extremely voracious and destructive fish, but it is seldom found gorged with food, as is the salmon and trout, although it sometimes proves itself successfully ambitious respecting the size of the object it swallows—swallowing, as it were, on the installment plan. When ravenous, it does not hesitate to seize a fish at least half as large as itself or so large that a portion of the fish may be seen protruding from the pickerel's mouth as the remainder is being digested in the stomach. In Umbagog Lake, of Maine and New Hampshire, of numerous pickerel examined, those that contained any food at all usually had small suckers. Three pickerel—11, 12, and 15½ inches long—caught in a stream in the vicinity of Freeport, Me., contained only aquatic insect larvæ. A 2-pound pickerel caught at the mouth of Sebois River, a tributary to the east branch of the Penobscot in Maine, contained a hornpout (*Ameiurus nebulosus*) about 4 inches long, and in one weighing 2½ pounds, taken in the Wissatoquoik Deadwater of the east branch, was found a smaller hornpout.

The character of the food of young and adolescent pickerel may be inferred from the following examples: At Sebago Lake two pickerel about 2½ inches long each, contained small insect larvæ and small crustaceans, and one about 5.8 inches in length had only a tiny fish in its stomach. One less than 2.5 inches long contained a young sucker, apparently partly digested, about one-half an inch in length. One about 3.2 inches in length contained one sunfish (*Lepomis gibbosus*) about nine-tenths of an inch long, swallowed head first, and one 4.7 inches in length had fed upon nothing but insect larvæ

^a Forest and Stream, vol. VIII, June 21, 1877, p. 320.

and amphipods, small crustaceans very common in the brook in which the fish were found. At Umbagog Lake many young pickerel ranging from 2 to 4 inches long were found to be feeding exclusively upon Entomostraca and insect larvæ.

Of eight examples, from 4.25 to 6.37 inches in length, caught at the same time and in the same place, six contained fishes, four of which were young pickerel. Of another lot a 4.25-inch fish had also a young pickerel 3 inches long in its alimentary tract; one 5.37 inches long also contained a pickerel 3 inches long; another 5.87 inches long, besides other things, had a pickerel 2.06 inches in length in its stomach; still another 5.62 inches in length contained two small minnows; one 6.37 inches long had in its stomach one pickerel 3 inches long and one shiner 2.5 inches in length; and another 7.5 inches long contained a 1.5 inch hornpout. Other instances were those in which one 7.5 inches long contained the head of a small chub and one 9½ inches long had a 2.3 inch pickerel in its stomach.

The foregoing suggests a cannibalistic tendency even in very young fish, which is maintained throughout life owing to the previously mentioned fact that, when feeding, the pickerel will attack any accessible moving object. Pickerel, however, are not always feeding, and apparently go without feeding for periods of days, or at least, during the time in such periods as they are under observation. Probably, its hunger having been satisfied, like many other fishes, it refrains from eating for a considerable period. When it takes its food it does so with a rush, and if the food is a fish the pickerel grasps it crosswise, then stops and works its victim around so that it is swallowed head first.

Breeding.—The breeding places of the pickerel are shallow coves, mouths of inlets, approaches to outlets, and sometimes in overflowed areas, in water from 3 to 10 feet deep, but not always in the same places each year. Sometimes the eggs are deposited among the roots of submerged tree stumps, the branches of fallen trees or bushes, water plants, and occasionally on gravel or in the crevices among rocks. Here, according to Tomlin (1892a), the fish are found in pairs, gently swimming to and fro, rubbing side by side until the female is ready to spawn. Similar to the perch, the eggs are laid in glutinous strings of a yellowish-white color, which often form large masses and have been seen clinging to submerged bushes in great mats or long strings. Strings of pickerel eggs observed by the collector of the Pennsylvania Fish Commission (1907) were said to average from 2 to 9 feet in length. Most published statements regarding the spawning time of pickerel are rather indefinite, as in "winter and spring." It is quite possible that southward it does spawn in late winter. However, the report of a commissioner of Massachusetts (1870) stated that Mr. Stone found

the pickerel ripe in the beginning of May. In Pennsylvania they were found to begin to spawn from the middle of April until the early part of May, depending upon the locality and season.

The female fish appear to preponderate over the males, according to observations cited by the Massachusetts Fish Commissioners (1870):

This fish, to its other disagreeable and contrary qualities, adds the tendency to multiply females, whereby the spawn crop is increased. Among many individuals examined last spring it was rare to find a male, not oftener, certainly, than 1 in 14.

RATE OF GROWTH.

The rate of growth of the pickerel, like that of any fish, depends much upon the available food supply and to some extent upon the temperature of the water. Tomlin (1892a) said that as soon as they are able to take care of themselves they show the family likeness and begin their bold predacious attacks upon the fry of the silver chub and shiner family.

The Massachusetts Fish Commission reported (1870) that its rate of growth seems to vary with the temperature. In a pond fed by a large spring brook, when there was enough food but cold water their growth seemed slow. In support of the statement the following table was given:

Age.	Length.	Weight.
	<i>Inches.</i>	<i>Ounces.</i>
1 year.....	4.5	0.5
2 years.....	7	1.5
3 years.....	10	4
4 years.....	13.5-14.5	8-12
5 years.....	17.5	24
6 years.....	20	40

On the other hand, it was stated that in a large warm pond, covered with lily pads and full of young alewives, pickerel have reached 4 and 5 pounds in three years.

FOOD QUALITIES.

As a food fish it is variously esteemed, by some being regarded as an excellent fish and by others as decidedly inferior. In regard to this, it may be said that much depends upon conditions. A pickerel of moderate size from fresh cool water is not to be compared with one that has lain all day in the sun or a week or two in cold storage or a day or two on the market stand.

Storer (1853) said: "This fine species is the common pickerel of Massachusetts * * * and is everywhere valued."

Bean (1902 and 1902a) said that as a food fish not much can be said in praise of the chain pickerel, though it is eaten by some and

liked by a great many people, and, again, that in some parts of New York it is little esteemed, but in other portions of the State it is considered a fairly good fish and furnishes sport for the angler.

Whatever its food qualities, it is persistently sought throughout the year in localities where no restrictions are placed on the fishing and everywhere throughout the prescribed open season and is a common fish in some markets of the East and South. Smith (1907) stated that in North Carolina considerable quantities are marketed, but it does not rank high, the flesh being coarse and filled with minute bones.

In the writer's experience the pickerel has always been found to be an excellent fish when fresh from Maine waters and properly cooked. While small fish might be objected to on account of bones, he has not found them more troublesome in that respect than in many other small fishes.

PROPAGATION.

It appears that only the Fish Commission of Pennsylvania has ever considered the pickerel worthy of artificial propagation. Attempts were made in that direction as early as in 1901, but it was not until about 1905 that much success was attained. The reason for the attempt at artificial propagation of the pickerel is stated in the annual report of the commissioner (William E. Meehan) for 1905, pages 57-59 (1906) as follows:

Between 40 and 50 years ago nearly all the sluggish waters in eastern Pennsylvania teemed with pickerel, especially the streams near the border line of New Jersey. Three-fourths of the natural mountain lakes also contained large numbers of this fierce but excellent food fish. The pickerel in the streams were soon wiped out, so that 25 years ago it was rare to find a pickerel in any of this type of water, except occasional "strays." With very few exceptions there has been a rapidly diminishing supply in the mountain lakes. Destructive methods of fishing undoubtedly have been the one potent cause for this marked reduction, another was that no efforts were made to restock.

At first vain attempts were made to retain pickerel in ponds or pens until they became ripe and to retain them afterwards as breeders, but it was found impossible to supply them with the required living food. Therefore, they began to search for their eggs where the pickerel had deposited them naturally. These were collected and conveyed to the hatchery, where they were placed in hatching jars. At first the Downing jar was used, but later one devised by the commissioner himself, which was found to be more effective. The jars were arranged in the form of "batteries," as in the case of whitefish or perch.

It was stated to have been found to be remarkably easy to hatch pickerel eggs, as only a very small flow of water was required. However, constant vigilance day and night was necessary, for as soon as the

eggs began to eye they became semibuoyant and often bouyant, and unless prevented the eggs would have flowed out of the jars into the troughs and been lost. This the whole batch was liable to do in a few minutes. The flow of water through the jars must be barely enough to slightly move the eggs. It was in permitting this gentle flow that the Meehan jar was an improvement over the Downing jar, which required considerable force of the water to operate.

Although a strong flow of water was impracticable and a light flow necessary, the latter had to be augmented by some stirring of the eggs in order to prevent their smothering just before the hatching period. This was accomplished by occasionally rotating the glass tubes that supplied the water, thus producing better circulation and a change of position of the eggs.

The eggs were found to hatch in about a week or 10 days, varying somewhat with the temperature of the water, and were found to hatch equally well whether they came into the station clean or dirty. It was found that it was very injurious to attempt to wash the eggs when brought in. They had to be placed in the jars together with what sticks, weeds, etc., were clinging to them. At first in transporting the eggs from the lake to the hatchery cans were used, but later the eggs were retained in floating boxes until the conveyance came for them, when they were packed in egg cases and carried to the hatchery.

It seems that after 1910 pickerel propagation practically ceased in Pennsylvania. To indicate, however, the magnitude to which it had attained at that time, it may be said that in 1909 there were distributed 300,150,000 pickerel fry and the number in 1910 amounted to 226,100,000. In 1914 the only distribution of this species was 85 adult fish.

CONSERVATION.

In some States the pickerel has always had more or less nominal protection of the law. In some, perhaps it may be said in most, communities pickerel fishing has been a favorite pursuit of local residents, particularly in winter, both for the sport and for their tables. In the North pickerel was formerly caught to some extent for the market. However, in all localities there have been those who derogated the fish to the lowest degree. These were usually anglers who preferred other fish and fish culturists who believed that to all the allegations regarding its rapacity and destructiveness much more that had not been said could be added were their language adequate. Even to-day fish culturists have inherited the ancient beliefs and antipathies against the pickerel, which were based upon a small amount of truth and a great amount of fallacy.

But there have always been and still are those who want pickerel fishing and demand its protection and some who have wanted and those who now want the fishing without the protection. Some of

these facts are at the bottom of stated antagonistic beliefs and recommendations. The intricacies in politics involve even the fishes of the waters. One State fish commissioner's report calls attention to "much dissatisfaction regarding ice fishing. Many of our best sportsmen claim that the fishing for pickerel in waters that have been closed for a number of years is not as good to-day as before they were closed, different theories being advanced as to the cause."

Those interested in the pickerel and pickerel fishing have been forced to recognize that in a great many if not nearly all pickerel waters, where they once abounded and attained a large size, they have diminished in numbers and deteriorated in size. One or two examples will serve as illustration of facts well known, at least locally. As long ago as 1898 the writer made some observations and inquiries at Sebago Lake, Me. There an old resident fisherman informed him that pickerel were once abundant and of a much larger size in the lake and some of its tributary waters. By winter ice fishing they still caught some pickerel in the lake. Fish weighing 3 or 4 pounds each and the year before one of 7 pounds had been caught, but such fish were seldom seen in recent years. The lower part of the Songo River also harbored many large fish, but at this time one much over a pound in weight was a rarity. The pickerel observed by the writer in this place were small, poor, and often greatly emaciated, a fact that was surprising inasmuch as small minnows were very numerous in the so-called "bogs" or bayous where the pickerel were found. This latter fact is not easily explained, but the scarcity in both lake and Songo waters may be accredited to excessive fishing, particularly in the winter and in those days when market fishing was permitted. This was possible, notwithstanding the large size of the lake, owing to the fact that congenial pickerel waters in the lake were limited in number and restricted in area. The pickerel is supposed to have been indigenous to Sebago waters. Another lake in which pickerel were introduced may be cited as an example of deterioration. This is Umbagog Lake, the lowermost of the famous Rangeley chain of lakes. Umbagog is the only one inhabited by this fish, where they are reputed to have once been abundant and of large size, but as early as 1883 there were complaints of growing scarcity and the small size of the fish caught. To all appearances the conditions are ideally favorable for pickerel, which is supported by the fact of their former increase in number and size. Observations made there in 1905 by the present writer indicated that the claims of decrease and deterioration were true. Some remarkable explanations have now and then been offered.

There are two authentic reports of epidemic mortality among the pickerel due to unknown causes. One explanation was that pickerel had been suddenly frozen to death, but no explanation is offered

why other fish were not affected. A contributor to a sportsman's paper (Maine Woods, 1907) offered a decidedly striking explanation of the decrease of Umbagog Lake pickerel:

It is a well-known fact that the pickerel that inhabit Umbagog Lake are dying off rapidly. One man who is familiar with the lake advances the theory that they are being killed by hornpouts and this in a very peculiar way. This man says there are millions of hornpouts in Umbagog and that the pickerel devour them. He says: "The horns on the hornpout are always straightened out when the fish is in trouble, and this causes the death of the pickerel"—that they are "hooked to death."

It is doubtful if this hornpout is even a contributory factor in the death of the fish, and certainly there would not be epidemics of "hooking to death." The cause of such epidemics must be sought for by careful study of the fish and prevailing conditions, and even then it may not be revealed.

A gradual decrease in number and size of fish is more easily explained. The habits of the pickerel expose it to more dangers than are incurred by most other kinds of fresh-water fishes. To whatever extent it does or does not sustain its reputation for fierce and gluttonous voracity, those very qualities are its undoing. Whatever may have been its ability to maintain its existence in undisturbed natural conditions before man's attention was directed its way, the ease with which it is caught with any kind of lure, particularly in the winter and spring when congregated in restricted areas, have been decidedly adverse factors. Wholesale ice fishing has hastened its decrease by the destruction of practically every fish in the limited area and those larger fish which would have spawned that spring. Here, too, is the cause of decrease in size. The majority of large fish are caught, few succeed in spawning, and their progeny are in turn caught before they have had time to reach a large size. Consequently, there is a progressive decrease in number and size. While those that succeed in breeding deposit large numbers of eggs, doubtless but few survive. The character of the egg masses and their exposed situation in shallow water subject them to the ravages of other fishes, such as suckers, chubs, perch, etc., as well as reptiles and waterfowl.

A superintendent of one of the Pennsylvania hatcheries wrote that he estimated that fully 10 per cent of eggs deposited are devoured by other fishes before they are hatched and that storms sometimes sweep the eggs from where they are deposited and float them ashore, where they rot. He stated that he had seen hundreds of millions of eggs thus washed ashore and lost. But the reduction does not end there, for the fry from the time it is hatched is the common prey not only of various fishes, including its own kind, but also of reptiles, birds, and other animals. One would not suspect the common, toothless, innocent chub or so-called dace (*Semotilus bullaris*) of being a serious enemy of a fish that has been stated to

be able to take care of itself. Nevertheless, the present writer has observed chubs feeding upon young pickerel and has caught a dozen or so of these fish, of about one-half to 1 pound weight each, and found them gorged with pickerel 2 or 3 inches long. He has also seen a young pickerel chased and driven high and dry on a sand bar by a trout. The pickerel, a fish about 4 inches long, was secured and used as a bait by which the trout, which was about 10 inches long, was caught. The foregoing is sufficient to suggest that if the pickerel is to be saved several things are necessary. Constant increase or maintenance of numbers is possible only when adverse conditions are less or exactly equal to the favorable conditions. Maximum size is attained by any fish only when it is provided with sufficient food and room in which to grow and when it meets no check in its career. In other words, that means when favorable conditions preponderate over unfavorable.

One of the most potent of unfavorable conditions is that of unrestricted fishing. The fish must be protected sufficiently to permit enough to breed to maintain the stock, and the eggs and young should also receive protection so far as possible. It doubtless has become evident that the writer's views regarding the pickerel are more favorable to it than are those of many. Yet he would not advise introducing the fish into waters which contain other desirable fishes, particularly if those waters are small. In fact, he would not recommend it for pond culture at all, owing to the fact that for it to reach the desired perfection in size and quality and in sufficient numbers to make it worth while a large body of water well supplied with natural food is necessary.

It is advised that good natural pickerel waters should be kept in that condition or, if deteriorated, restored to the normal state, for having been naturally favorable for pickerel they are better for that fish than for any other that could be introduced. In order, however, to meet these requirements, the waters must be more than little ponds. They must be good-sized lakes or streams unless the stock is to be kept up by artificial propagation of both the pickerel and its food.

This article would be incomplete without a reference to the alleged usurpation of trout waters by pickerel. The present writer has previously had occasion to comment on this matter. He wrote (1913) that there is scarcely a body of water in which trout once lived and where pickerel now occur that the depletion of the trout has not been ascribed to the pickerel. It undoubtedly eats other fishes, and there are few fishes that do not. But the habits of the pickerel are such that it is not nearly so detrimental to other fish life as some other species held in higher regard, and the pickerel in large bodies of water become still less harmful. It is not much of a wanderer.

It does not rush about in marauding bands seeking what it may devour. It lies in wait and siezes what comes its way when it is inclined to feed, yet often schools of tempting shiners have been seen swimming unharmed in apparently dangerous proximity to big pickerel heads. Again he wrote (1894) that during most of the year it resorts to waters uncongenial to trout, and at all times it prefers such waters. A warm, muddy^a pond or stream with profuse growth of aquatic vegetation is its favorite abode. Trout can not exist long in such surroundings. In weedy waters where trout manage to exist pickerel will also thrive, but trout will lie in the cooler, clear portions, while pickerel seek the water plants and shallow water. In most instances it would seem that the pickerel is not the whole, though possibly an accessory, cause of the disappearance of trout, and harm done by pickerel is overestimated. The injurious effect of pickerel upon trout and salmon is more often indirect than direct, especially when it appears in congenial waters where trout or salmon are barely maintaining themselves or decreasing. The indirect influence is upon the food supply, and this ultimately reverts upon the pickerel itself. It is an almost invariable rule that in time, after a period of increase in numbers and size, pickerel begin to decrease owing to diminution of the food supply.^b

Referring to the same subject a number of years ago, after expressing similar sentiments to the foregoing, the writer remarked that excessive and destructive methods of fishing (to which should have been added untimely fishing), pollution of the waters, and the destruction of forests are far more fatal to trout life than their natural enemies.

AS A GAME FISH.

If the pickerel is not on the list of honor as a game fish, it is entitled to the distinction of being an exceedingly good sport fish. As for its game qualities even, in its way, it possesses some characteristics that equal the much-lauded trout. In fact, the writer has more than once found to his surprise that a pickerel was on his hook instead of the expected trout. The actions are much the same. If the tackle consists of the customary long bamboo or stiff wooden pole, stout line, and large hook, and the fish is lifted from the water by main strength, it must be confessed that in this kind of fishing piscatorial poets would find little inspiration. But use a light casting rod, a slender bait rod, or even a fly rod with about the same weight of line as one would employ for trout of like size, and no disappointment will be experienced regarding the gameness of the fish.

^a The word "muddy" here does not refer to roily water, but to a muddy bottom, and "warm" is a comparative term meaning warmer than trout waters.

^b This discussion refers mainly to comparatively small lakes or streams into which the pickerel have been introduced.

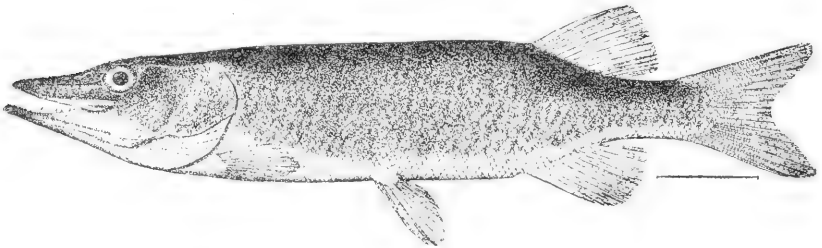
BANDED PICKEREL (*Esox americanus*).

GEOGRAPHICAL DISTRIBUTION.

This little fish has a somewhat more restricted geographical distribution than the eastern pickerel. Its stated range (Jordan and Evermann, 1896) is from Massachusetts to Florida in lowland streams and swamps. It is found only east of the Allegheny Mountains, the westernmost record being from Escambia River at Flomaton, Ala. It may be added, the northernmost locality from which it has been reported is Lake Bomessen, Vt. (Kendall, 1908). Whether it is indigenous there the writer is not informed.

NAMES.

Bean (1902) said that it is probably identical with the "mackerel pickerel" of Mitchill. Storer (1853) called it the "smaller pickerel," and it is referred to as the troutnose pickerel. Herbert (1849) and others mention it under the name of Long Island pickerel. Smith (1907) cited pike, red-finned pike, and jack as North Carolina names.

FIG. 5.—BANDED PICKEREL (*Esox americanus*).

SIZES.

Most references state that it rarely exceeds a foot in length or it rarely exceeds a pound in weight. Herbert (1849) said that a pound was greatly above the average weight, which was probably not more than one-half pound.

HABITAT AND HABITS.

Habitat.—The local habitat of this species is in general essentially the same as that of the eastern pickerel. It is found in shallow water amongst water plants, etc.

Bean (1902) said that it is especially plentiful in certain tidal creeks of Long Island, and Eugene Smith reports that it is often found in brackish water in the vicinity of New York, where it is brown in color.

Herbert (1849) described an individual which he stated was caught in a net in the salt water of Newark Bay. He wrote that it weighed something over a pound and a half and that it was in the finest condition. Its color, however, was remarkable, for the back and sides

down to the lateral line were of the richest and most lustrous copper color, paling on the sides into bright brazen yellow, with the belly of a silvery whiteness. The cheeks, gill covers, and fins all partook of the same coppery tone, and the whole fish was far more lucent and metallic than any of the family previously seen by him. There was not the slightest indication of any transverse bars or any mottlings nor was there any of that sea-green color which is so peculiar to the pike family.

Habits.—Its breeding or feeding habits have not been specifically described, but they are probably very similar to those of the eastern pickerel. Smith (1907), writing of the North Carolina fish, stated that its food is chiefly minnows, with which the stomach is often gorged.

FOOD AND GAME QUALITIES.

Bean (1902) wrote that the little banded pickerel is a fish seldom exceeding 10 inches in length, with flaky, white flesh, very few bones, and with delicious flavor, and that it is well worthy of the attention of fish culturists.

Smith (1907) said that in North Carolina it was of less importance as a food and game fish than *Esox reticulatus*.

Storer (1853) wrote that it was not infrequently noticed in Boston market, and that it was so similar to the *reticulatus* that it had previously been considered to be the young of that species.

LITTLE PICKEREL (*Esox vermiculatus*).

GEOGRAPHICAL DISTRIBUTION.

According to Bean (1902), its range is the valleys of the Ohio and Mississippi and streams flowing into the Great Lakes. He stated that Cope mentioned that it is also found in the Susquehanna, of which river it is probably not a native.

Forbes (1908) stated that its general range includes the tributaries of Lake Erie and Lake Michigan, extending thence southward to the Tennessee, Escambia,^a and White Rivers and, according to Evermann and Cox, to the Neuse River on the Atlantic slope.^a

It is stated (Evermann and Kendall, 1901 and 1902) to be rather common in all suitable waters of Lake Ontario and is recorded from Black Creek at Scriba Corner; Lake View, West Oswego; Wart Creek near Buena Vista; Great Sodus Bay; outlet of Long Pond near Charlotte; and Marsh Creek near Point Breeze, N. Y.

Cox does not record it from Minnesota, but Tomlin (1892a) wrote: "While fishing in a Minnesota lake one summer evening, I found a

^a It is a noticeable coincidence that the Escambia River is given as a locality for both *Esox americanus* and *Esox vermiculatus*, and it is remarkable that it should be recorded from the Neuse River east of the Alleghenies distinctly in the range of *Esox americanus*. These records support the idea advanced by a student of these fishes, to which reference was previously made, to the effect that the two are specifically identical.

school of trout-pickereel * * * common in this lake, and it was a handsome, clean fish."

NAMES.

Forbes (1908) referred to it as little pickereel and grass pike. This latter name appears also in many other publications. It is apparently the common name applied to it in the Pennsylvania Fish Commission's reports. Bean mentioned it also under the name of trout pickereel.

SIZE.

The general statements regarding its size are that it never attains a length of over 12 inches.

HABITAT AND HABITS.

Habitat.—According to Forbes (1908), it has a noticeable preference for quiet and muddy water, and a greater part of his collections

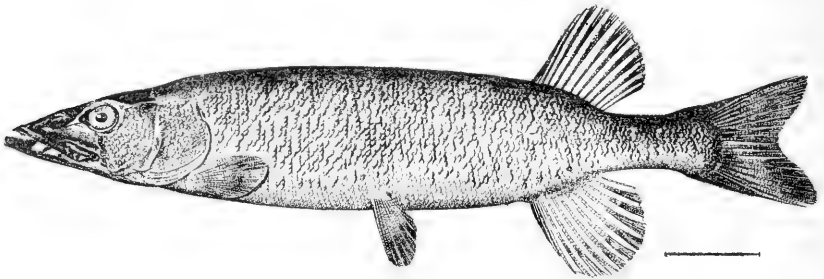


FIG. 6.—LITTLE PICKEREL (*Esox vermiculatus*).

were stated to have come from the weedy branches of the Embarras, Little Wabash, and Big Muddy in eastern and central Illinois. He wrote that it also occurred occasionally in the main stream of the Illinois or in the muddy overflow ponds of the bottoms. Indeed, large numbers of this fish are annually destroyed by the drying up of such ponds after the overflow.

Feeding.—Forbes (1908) stated that the feeding mechanism of this little species is a reduced copy of that of the destructive and voracious common pike, and its food, as illustrated by 18 specimens, seems to be of a purely animal nature. Two of these had eaten frog tadpoles and eight had taken fishes, one of which was a cyprinoid minnow, one a sunfish, and the other a common top minnow (*Gambusia*) of the southern part of the State. The remaining food was mostly composed of the larger aquatic insects. Amphipods and isopod crustaceans have been found in the stomachs of other specimens taken from Quiver Lake, near Havana.

Breeding.—Nothing definite appears to have been published regarding the breeding habits of this species. Forbes (1908) stated that it apparently spawns early and ripe individuals of both sexes had been seen by him in March.

PROPAGATION.

The Pennsylvania Commission (1906) at one of its hatcheries undertook to hatch the eggs of the grass pike, and it was stated that no difficulty was found in taking the eggs but great difficulty was experienced in keeping them from sticking owing to their glutinous character. For some years more or less adult grass pike have been distributed by this commission.

FOOD AND GAME QUALITIES.

A Pennsylvania report (1906) states that it is a valuable fish. It is rather small to figure much as a game fish.

COMMERCIAL FISHERIES FOR THE PIKES.

The various early statistical reports afford but little definite data regarding any of these fishes, owing to confusion of local names and the combination of very different species under the common heading of "pike and pickerel," when very frequently one or the other refers to the pike perch. For this reason no general comparative statistics can be compiled. However, the three larger species have always been of some local commercial value.

Pike.—The U. S. census of 1908 gives four divisions in which "pike and pickerel" figure. The total catch for the United States, according to these figures, was 2,959,000 pounds, valued at \$194,000, excluding the Atlantic coast division, which can be regarded as including no pike.

From the other three divisions the figures were as follows, probably composed mostly of pike:

Divisions.	Quantity.	Value.
	<i>Pounds.</i>	
Great Lakes division.....	2,142,000	\$136,000
Mississippi River division.....	367,000	16,000
Gulf of Mexico division.....	305,000	11,000
Total.....	2,814,000	163,000

By States the figures appear as follows:

States. ^a	Quantity.	Value.
	<i>Pounds.</i>	
Illinois.....	14,000	\$1,100
Iowa.....	61,000	3,200
Michigan.....	478,000	32,000
Minnesota.....	351,000	11,000
Missouri.....	58,000	1,200
New York.....	99,000	9,600
Ohio.....	1,118,000	70,000
Tennessee.....	100	^(b)
Texas.....	305,000	11,000
Wisconsin.....	317,000	23,000

^a Other States not distinguished.

^b Less than \$100.

In the foregoing list Ohio appears to be the paramount State, yielding nearly 40 per cent of the entire catch of the country, all of which was from Lake Erie waters. In 1899 the recorded catch of pike and pickerel of Ohio in Lake Erie amounted to only 739 pounds, valued at \$38, showing the astonishing increase in nine years of over a million pounds, with very little increase in price per pound to fishermen (about 1 cent).

Pickerel.—In the census of 1908 only the Atlantic coast division includes any appreciable quantity of pickerel, unless possibly New York, which has been placed with the other divisions in this discussion upon the assumption that the bulk of the catch was of the Great Lakes fisheries (Lake Erie and Lake Ontario), although some *Esox reticulatus* are doubtless marketed from the St. Lawrence River and some of the smaller lakes.

In New England commercial fisheries for pickerel are permitted only locally, being more or less protected as a sport fish. In 1898 there were 200 pounds recorded for Rhode Island and 5,420 pounds for Connecticut. In 1899 Maine recorded 300 pounds. No statistics are given for later dates except in Connecticut, which in 1902 yielded 8,230 pounds, valued at \$530.

The Atlantic division yielded 145,000 pounds, valued at \$11,000, most of which probably were *Esox reticulatus*, although some *Esox americanus* may have been included.

By States the catch was recorded as follows:

States.	Quantity.	Value.
	Pounds.	
Delaware.....	140,000	\$1,100
Georgia.....	1,100	100
Maryland.....	35,000	3,800
North Carolina.....	69,000	3,100
Pennsylvania.....	14,000	1,600
Rhode Island.....	600	100
Virginia.....	12,000	1,000

Of the aforementioned States, statistics are available for Delaware and Maryland for the years 1887, 1888, 1901, 1904, and 1908.

The figures are given for pike, which, if they are not intended for pike perch, doubtless indicate pickerel (*Esox reticulatus*) and possibly *Esox americanus*. In these years, also, New Jersey, which in 1908 shows no yield at all, has a comparatively large catch. The following table is given for what it is worth:

Years.	New Jersey.		Delaware.		Maryland.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1887.....	27,625	\$1,850	26,268	\$2,073	521,146	\$33,496
1888.....	30,400	2,066	25,389	2,031	577,745	37,286
1901.....	2,560	210	16,310	654	67,530	5,590
1904.....	600	55	11,050	544	42,317	3,716
1908.....			14,000	1,100	35,000	3,800

Statistics are also available for North Carolina for the foregoing years, excepting those for 1904 and 1901, the latter being replaced by those of 1902. Also, Virginia and Georgia record small catches for 1901 and 1902, respectively. There may be some doubt regarding the pike of Virginia and North Carolina, as they possibly may comprise some pike perch.

Years.	Virginia.		North Carolina.		Georgia.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1887.....			22,402	\$1,056		
1888.....			27,161	1,303		
1901.....	32,103	\$2,848				
1902.....			30,850	1,487	350	\$18
1904.....	3,644	2,954				
1908.....	12,000	1,000	69,000	3,100	1,000	100

In the first table a decrease is shown in the catch in each State, New Jersey completely disappearing. In the Southern States the quantity caught appears to have increased considerably. North Carolina gained 46,588 pounds, or over 148 per cent, in the 21 years from 1887, but fell off slightly in price per pound to fishermen.

The foregoing figures, taken with what is known about the pickerel, suggest that it does not breed and grow fast enough to furnish a permanent supply for any extensive or intensive fishery. The first table shows almost progressive decreases in three Middle States in proximity to large markets. While in the South an increase is shown, it is probably ascribable to more extensive and perhaps more intensive fishing in later years. It is safe to predict that unless the fishing is regulated a canvass of the fisheries a few years hence will show a decrease.

Muskellunge.—Owing to its restricted distribution and its importance as a game fish, this fish has never attained to any very considerable commercial fishery. The report of the United States Census of 1908 gives 25,000 pounds, valued at \$1,700, for the Great Lakes division. Michigan furnished 4,000 pounds, New York 19,000 pounds, Wisconsin 1,900 pounds, and Ohio less than 100 pounds. In 1902 New York alone yielded 92,650 pounds, valued at \$13,890, of which 85,400 pounds were taken in Lake Chautauqua. In New York these foregoing figures show a falling off of 67,650 pounds in six years.

The question is: Are the pike fisheries worthy of protection and conservation? According to the writer's view, they merit protection as a conservative measure for other so-called "better" fishes and as an economic provision. Consideration of the question will show that such a reason is not so paradoxical as it seems at first sight. The ever-increasing demand by a growing population hastens the decrease

of the fisheries for those species most in popular favor, which, when accompanied by neglect or waste of other edible but less-favored kinds, results in a general depletion, with the result that the more highly esteemed fishes rise in price beyond the purchasing reach of the majority, who are forced to seek cheaper fish food, only to find that there is not enough remaining to supply the demand. This unsatisfied demand affects the price of the so-called inferior fish, and it, in turn or in consequence, also moves upward. The writer is radical enough to believe that there is not an edible fish that swims that should not be conserved. The people of these United States are going to need them sooner or later if they do not already.

It may be added that, as a rule, native species are naturally the easiest to conserve, and indiscriminate stocking of waters with new kinds is not to be recommended. The Biblical injunction about new cloth and old garments or new wine and old bottles is applicable to waters and fishes.

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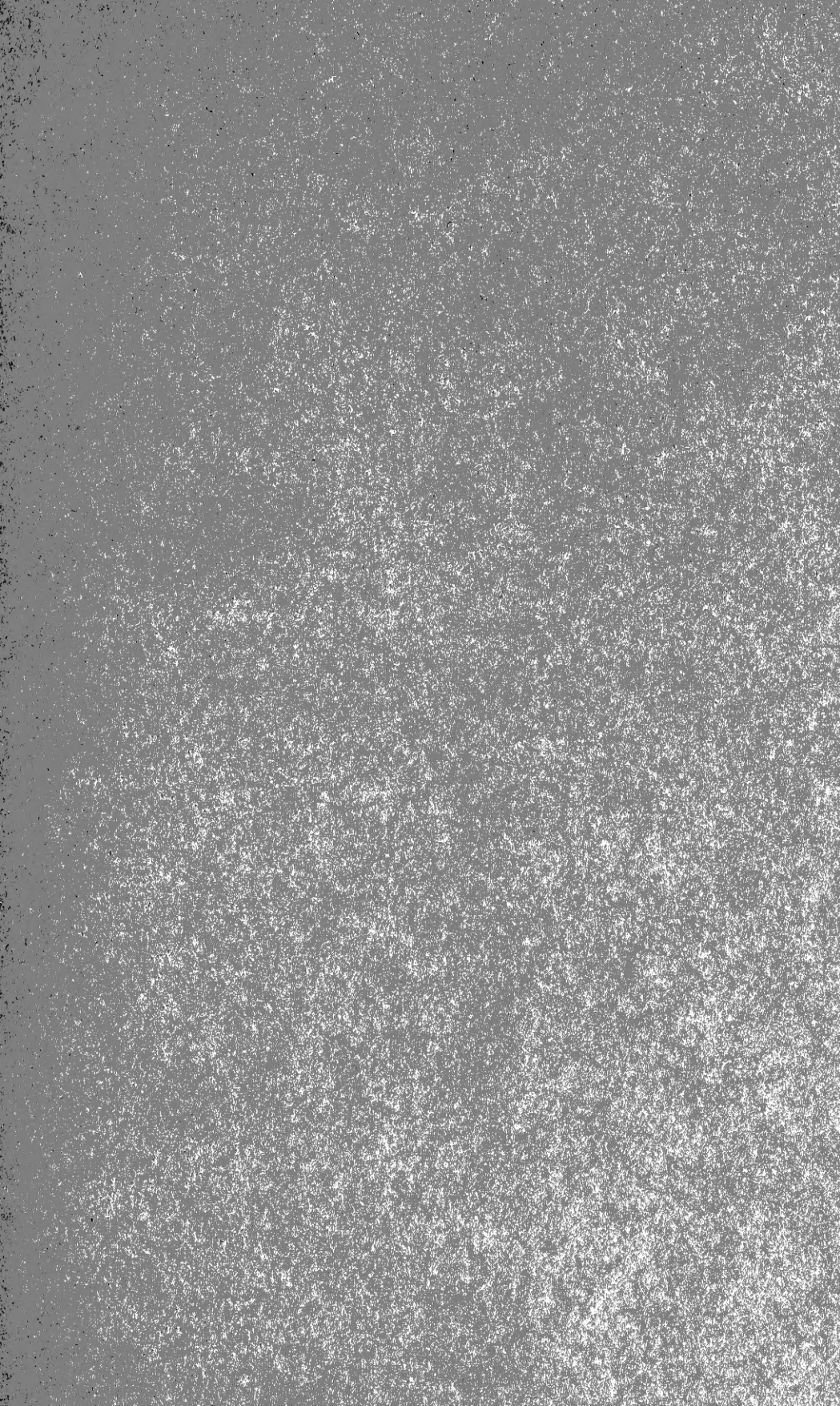
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