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TROUT-PERCHES

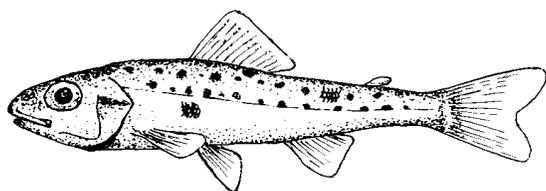
PERCOPSIDAE

Trout-perches get their name from the fact that they have both an adipose fin, like the trout, and true spines in the fins, like the perch. In fact, they are members of a separate group of fishes called the Paracanthopterygii, which includes the codfishes as well as the more closely related pirate perch.

Trout-perch are terete tapering fishes with a distinctive overhanging snout. In life, they have a characteristic transparent gray color with rows of spots. The only other species in the family is the sand roller, *Percopsis transmontana*, which occurs in Washington and Oregon. Trout-perch are sometimes abundant and are important as food for larger fishes.

Percopsis

Percopsis omiscomaycus is distinguished from the related *Percopsis transmontana* of the Columbia River basin by its slender spines, well-developed lateral line, weak (or no) teeth on the preopercle, and translucent body.



TROUT-PERCH

Percopsis omiscomaycus (Walbaum, 1792)

Identification

The trout-perch is a pale, terete fish with the unique combination of spines in the dorsal fin and an adipose fin. It has a conical snout overhanging the mouth, weakly ctenoid scales, and a forked tail. In life, it is nearly transparent with five rows of rounded spots, one in the dorsal midline and two on the upper and midsides. There is no other New York fish with which it is likely to be confused.

Description

Body elongate and terete, deepest behind the

head. Dorsal profile more arched than the ventral. Dorsal origin to snout 1.4 in dorsal origin to mid-base of the caudal fin. Dorsal retrogressive, its last ray about half the first ray. Dorsal margin slightly concave, its corners rounded. Adipose fin originating midway between end of dorsal base and mid-base of caudal. Caudal fin moderately forked, its middle rays less than two thirds its longest upper rays. Caudal lobes rounded. Anal origin behind end of dorsal base. Anal fin retrogressive, its last ray less than half the first, its corners rounded. Anal margin straight. Pelvic fin inserted below dorsal origin, retrogressive. Pectoral rounded, its base nearly vertical. Gill membranes separate. Mouth low and horizontal. Snout conical, frenum present. Predorsal, prepectoral, isthmus, and head naked, body fully scaled. Lateral line complete, straight. Counts and proportional measurements are given in Table 27.

Color: In life, the trout-perch is quite transparent, shading from grayish dorsally to white on the belly with dark flecks above the midline in addition to the rows of rounded spots on the midsides, upper sides, and dorsal midline. The number of the spots is variable, usually 9 to 12 in the midline, 7 to 12 on the upper side, and 10 to 12 on the midside. There is a dark bar on the operculum, sloping upward from the point of the opercle to the upper end of the preopercle. Below this, there is a silver area. Top of head and snout dusky gray. Dorsal, caudal, and pectoral rays outlined, as are the bases of the anal rays. In life, the upper sides often have a brownish wash.

Juveniles and breeding adults: The trout-perch does not develop any special breeding colors nor does it have tubercles. Juveniles are miniatures of the adults.

Size: Scott and Crossman report that this species reaches 6 inches total length in Lake Ontario. Our largest New York specimen is 108.5 mm standard length.

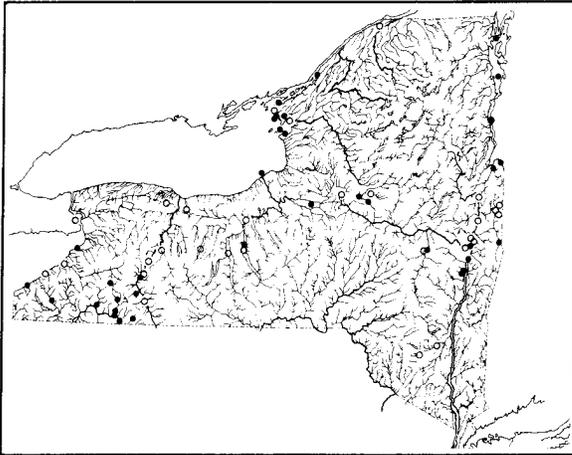
Habitat

The trout-perch occurs in both lakes and streams. We have collected it in a swift flume in the Hoosic River and in shallow parts of West Canada Creek. It also occurs in the Great Lakes and has been taken at depths as great as 200 feet in Lake Erie. Usually, it is found over sand or fine gravel and it appears to avoid rooted aquatic vegetation. It often moves into shallow water at night.

Distribution

The trout-perch ranges across North America from Alaska to Quebec, reaching southern Illinois and Kentucky in the Mississippi drainage, and the Potomac River on the Atlantic coast.

In New York, it occurs in the Great Lakes, the Allegheny and Genesee Rivers, the St. Lawrence and Lake Champlain, and in Canandaigua, Oneida, Seneca, and Cayuga Lakes, and in the Mohawk and Hudson drainages. The Survey collected it in Rondout Creek at two localities.



Life History

Spawning takes place in shallow water and the trout-perch make short migrations from their normal habitat in deeper water of lakes and streams to the spawning sites. In Minnesota, and probably in northern New York, the spawning begins in May and, with several peaks in June and early July, ends sometime in August.

Magnuson and Smith found that the spawning runs began after the air temperature had reached 50 F, or warmer, for about 44 days. Peak spawning occurred when the water temperature was 67 to 68 F.

Most of the spawning took place at night but, occasionally, spawning was seen during the day. There is a preponderance of males on the spawning grounds and the ratio of males to females varied from 1.8:1 early in the season to 9.5:1 near the end. In one stream tributary to the Red Lakes of Minnesota, spawning took place within 4 or 5 inches of the surface. Two, and sometimes more, males clustered around the females and the trio occasionally broke the surface as the eggs were released. The eggs were heavier than water, had a sticky surface, and adhered to the bottom wherever they settled.

The eggs are rather large, with a diameter of 1.2 to 1.75 mm, average 1.45. The number of eggs varies with the size of the females according to the formula:

$$\text{Log } N = -3.247 + 3.029 \text{ Log } L,$$

where N is the number of eggs and L is the length of the female. Some of the males matured at age I and some of the females matured at age II. The maximum age was IV +.

Males averaged 50.8 mm at age I, 88.2 mm at age II, 103.5 mm at age III. Females averaged 51.4 mm at age I, 92.2 mm at age II, 108.3 mm at age III, and 114.7 mm at age IV.

Food and Feeding

Greeley noted that the trout-perch feeds on midge larvae, *Cyclops*, adult flies, and blackfly larvae. Mayflies, amphipods, and small fishes have also been reported from its stomach.

Notes

Scott and Crossman noted that the arrangement of the pyloric caeca in two rows along the gut is distinctive and often makes it possible to identify trout-perch remains in the stomachs of predators even after the rest of the fish has become unrecognizable.

References

Magnuson and Smith, 1963 (life history). Kinney, 1950 (life history). Jordan, 1917 (names). Muth and Tartar, 1975 (reproductive biology). Lawler, 1954 (ecology). House and Wells, 1973 (age, growth, fecundity).

Names

The species name is probably an Algonquian Indian name. McPhail and Lindsey (1970) suggest that it includes the word for trout.

Salmo omiscomaycus Walbaum, 1792: 65 Hudson Bay

Percopsis guttatus Agassiz, 1850: 286-289 Lake Superior

Salmo perca pellucida Thompson, 1853: 33 Lake Champlain

Percopsis omiscomaycus, Greeley, 1927: 63 Genesee drainage

CODFISHES

GADIDAE

In spite of their importance in the world's food supply, the family of the codfishes is not a large one. Worldwide, there are about 25 genera and 60 species. Most are fishes of the continental shelves and deeper waters; only one species is truly a freshwater fish.

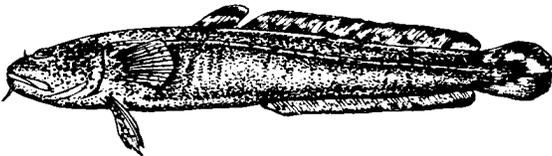
Several species of codfishes are occasionally taken in the Hudson Estuary and the tomcod, *Microgadus tomcod*, spawns there and probably spends its entire life in or near the estuary. In addition, the freshwater species, *Lota lota* (the burbot), occurs in lakes and a few streams of the Susquehanna River system.

Cods are soft-rayed fishes. They have a peculiar kind of scales with the circuli broken into short segments and their caudal fin is highly specialized. The tomcod, like several other species, has three dorsal and two anal fins but the burbot has only one anal and two dorsal fins. Most species have a distinctive barbel at the tip of the lower jaw.

A key to the species of cods that occur in the inland waters of New York State will be found in the section on marine species.

Lota

This genus contains only one species which is the only freshwater species in the family. It is placed in the subfamily Lotinae which also contains the hake genus, *Urophycis*, along with seven other genera.



BURBOT

Lota lota (Linnaeus, 1758)

Identification

The burbot is the only strictly freshwater codfish and there is no species in our state with which it can be confused. It has an elongated body, a conspicuous

single chin barbel, and two dorsal fins, the second of which is quite long as is the anal fin. The pelvic fins are inserted far forward and the tail is rounded, with its upper and lower rays short and extending forward on the body. The scales are small and deeply embedded, so the fish is quite slimy in life. Its colors are somber, predominantly dark mottlings on a slightly lighter background.

Description

Body elongate, terete, the head depressed and the caudal region compressed. First dorsal well behind the head, distance from the tip of the snout to its origin about 1.6 times in the distance from origin to the midbase of the caudal fin. First dorsal short and pointed, its middle rays longest. Second dorsal fin long and contiguous with the first dorsal, and with the caudal fin. Caudal base pointed, the caudal fin paddle shaped, its margin round, without definite corners. Anal fin slightly shorter than the second dorsal fin, its origin noticeably behind the origin of the second dorsal. Pelvic fins narrow, inserted well in advance of the pectoral base, between the gill openings. First and second pelvic rays produced into short filaments. Pectoral fin base nearly vertical. Pectoral asymmetrically rounded. Gill membranes slightly joined, free from the isthmus. Mouth subterminal, nearly horizontal, maxillary reaching to below the rear margin of the eye. Mental barbel single, median, and well developed. Anterior nostril with a low rim and a long posterior flap. Snout slightly overhanging the mouth. Eye rather small, lateral line complete. Scales embedded. Counts and proportional measurements are given in Table 27.

Color: Body generally grayish to tan, upper sides and dorsal surface marbled with darker gray, irregular marks; this pattern continued onto the fins. Margin of the vertical fins and the central part of the tail bright yellow or orange. Caudal, anal, and second dorsal with broad submarginal dark bands. Belly and head speckled but without dark marblings.

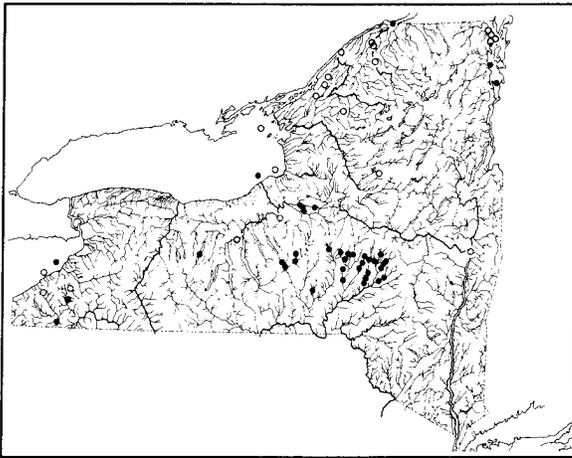
Juveniles and breeding adults: The coloration is extremely variable. Young fish are often uniformly dark and older fish lose their patterns and become uniformly light or uniformly dark.

Size: Trautman gives the maximum size of the burbot in Ohio waters of Lake Erie as 32.5 inches total length and 12 pounds 5 ounces. Ohio commercial fishermen report weights of 12 to 14 pounds. The IGFA record is 18 pounds 4 ounces

from Pickford, Michigan. Scott and Crossman mention literature reports of up to 75 pounds.

Habitat

The burbot occurs in lakes and streams and has been reported to enter brackish water. Robins and Deubler provide a summary of its habits. Although it generally lives in lakes, it has stream-dwelling populations, including one in the Upper Susquehanna where it lives in cool streams that have adequate shelter such as rock slabs, trees and tunnels large enough for the fish to hide completely. In larger streams, it sometimes lives among dense *Potamogeton* plants.



Distribution

The burbot is a circumpolar species ranging across Eurasia and North America.

In New York, it occurs sporadically in the Allegheny drainage and in Lakes Erie and Ontario and tributaries of the St. Lawrence River. The Survey reported it from the outlet of Bear Lake, and in May 1983 a specimen was taken in Conewango Creek between Jamestown and Frewsburg (Robert O. Woodward, pers. comm.). It also occurs in Canandaigua Lake, Cayuga Lake, Oneida Lake and Lake Champlain. It is absent from the Delaware, Hudson, and other coastal drainages. Stream populations occur in the Upper Susquehanna but not in the Chemung. It occurs in Canadarago and Otsego Lakes.

Robins and Deubler suggested that it invaded the Susquehanna drainage through glacial lakes and later invaded stream habitats.

Life History

Burbot are winter spawners. Robins and Deubler failed to find them in streams in December and suggested that they move downstream to larger waters in late fall and spawn between December and April. Scott and Crossman summarized life history data. Spawning occurs at temperatures of 33 to 35 F over sand and gravel shoals 1 to 4 feet deep. Some burbot may also spawn in deeper water. Spawning occurs in groups of 10 to 12 individuals moving over the bottom. Most spawning takes place at night.

The eggs are semipelagic and sink slowly in fresh water. Hatching takes 30 days at 43 F. Females produce 45,000 to more than 1 million eggs. Maturity is reached in the third or fourth year and the maximum age is about 16 years, although most of the Susquehanna stream burbot die before they reach age V, so they only spawn two or three times. In that population, the maximum age was 7 years.

Growth rates are variable. Lake fish grow faster than stream fish. In Lake Erie, they reach 616 mm standard length at age X. The Susquehanna stream fish reached 79 mm standard length at age I, 195.3 mm at age II, 234.7 mm at age III, 261 mm at age IV, and 341 mm at age VII.

Food and Feeding

Burbot less than 500 mm total length feed on insects, crayfishes, and mollusks. Young-of-the-year are almost entirely insect eaters. Larger burbot are primarily piscivores, although they will feed on invertebrates that are especially abundant, and on fish eggs. Sculpins, blacknose dace, darters, mad-toms, brook trout, other salmonids, and crayfishes were reported in the stomachs of stream burbot in New York. In the winter and spring, even the larger stream fish ate mostly invertebrates.

Notes

Pivnicka studied variation in the burbot and found that there are two recognizable forms: *Lota lota* ranges from the Volga River eastward across Siberia, Alaska, and northern Canada to the Mackenzie River, and occurs in the Elbe and Danube Rivers in Europe. The other form, *Lota lota lacustris*, ranges through southern Canada, northern United States, and western Europe.

Lota lota has a long, low, caudal peduncle, and high counts for the dorsal, anal, pectoral, and pelvic fins and vertebrae. *Lota l. lacustris* has a short, deep, caudal peduncle and low meristic values.

References

Pivnicka, 1970 (systematics). Robins and Deubler, 1955 (life history in Susquehanna River). Clemens, 1951a (food); 1951b (age and growth in Lake Erie). Fish, 1930 (life history). Lawler, 1963 (biology). McCrimmon and Devitt, 1954 (winter ecology). Cahn, 1936 (breeding).

Names

Lota is from the old French (800-1300 AD) *lote*, a name for the pout, probably *Lota lota*. *Lacustris* is the genitive form of the New Latin *lacus*, lake.

Gadus lota Linnaeus, 1758: 1172 Europe
Mathemeg, Pennant, 1784: 191 Hudson Bay
Gadus lacustris Walbaum, 1792: 144 (after Pennant)

Lota lota lacustris, Speirs, 1952: 99-103 (names)
Gadus maculosus Lesueur, 1817b: 83-84 Lake Erie

Molva maculosa, Lesueur, 1819: 159-161 Lake Erie

Lota maculosa, Greeley, 1928: 102 Oswego drainage

Lota inornata DeKay, 1842: 283 Hudson River at Lansingburgh (doubtful locality)

Gadus compressus Lesueur, 1817b: 84

Lota compressa, DeKay, 1842: 285-286 (after Lesueur)

TABLE 27
AVERAGE PROPORTIONAL MEASUREMENTS AND COUNTS OF TROUT-PERCH, PIRATE PERCHES, AND BURBOT (*Percopsis*, *Aphredoderus*, and *Lota*)

All proportions are expressed in percentage of standard length.

	<i>Percopsis</i> <i>omiscomaycus</i>	<i>Aphredoderus</i> <i>s. sayanus</i>	<i>s. gibbosus</i>	<i>Lota</i> <i>lota</i>
ST. LENGTH (mm)	63.5	48.0	44.9	173.5
TOTAL LENGTH	127.5	130.9	124.4	106.2
FORK LENGTH	115.5	129.6	124.4	106.2
PREDORSAL	46.1	48.2	46.6	37.8
PREANAL	65.8	67.1	66.1	51.5
PREPELVIC	44.5	45.7	40.6	21.8
DORSAL BASE	18.9	24.3	27.6	53.8
ANAL BASE	8.7	12.6	13.7	40.7
BODY DEPTH	23.5	35.7	35.2	11.7
BODY WIDTH	17.3	20.5	18.0	12.0
C.PED. DEPTH	8.2	16.2	15.9	5.7
PECTORAL ALT.	16.4	21.2	21.2	5.7
HEAD LENGTH	31.0	36.7	38.0	22.1
SNOUT	12.3	11.5	11.9	6.5
EYE	7.6	9.0	6.7	3.0
MOUTH LENGTH	5.6	8.7	12.3	6.5
INTERORB	4.5	6.0	10.9	6.0
N (sample size)	5	5	4	4
COUNTS:				
DORSAL RAYS	II,10-11	IV,9-11	III,10-12	10 to 12-66 to 67
ANAL RAYS	I,6-7	III,5-6	II,6-7	65-71
PECTORAL RAYS	12-15	11-12	13-14	17-21
PELVIC RAYS	I,8-9	0-I,7-8 0-I,6-7	5-8	—
GILL RAKERS	8-13	11-14	11-12	23-25
VERTEBRAE	34-36	29	29	61-64
SCALES:				
ABOVE L.L.	5-7	8-9	8-9	Not counted
LATERAL LINE	43-60	41-48	46-50	counted
BELOW L.L.	7-8	9-10	9-10	

KILLIFISHES

CYPRINODONTIDAE

The killifishes are sometimes called topminnows or egg-laying toothcarps but they are not related to the true minnows. They are members of a group called the atherinomorpha which includes the silversides, the flyingfishes, the needlefishes, and their close relatives, the livebearers. Killifishes and their near relatives constitute a rather large group, with about 900 species in the warmer parts of the world. Many species are kept in home aquaria. Huver (1973) presented a bibliography of the genus *Fundulus*, and Lazara (1984) gives synonymies of all of the egg-laying killifishes.

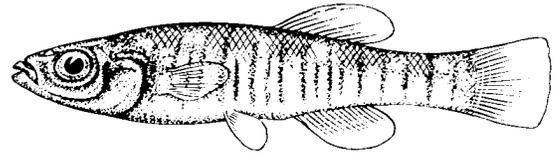
Killifishes are soft-rayed fishes with abdominal pelvics and the dorsal and anal fins set far back, the dorsal origin a little in advance of the anal fin. The mouth is usually directed upward and there are scales on the top of the head. As killifishes go, our five species tend to be rather drab but they are sexually dimorphic and moderately colorful during their breeding season.

In an extensive recent study, Parenti (1981) reclassified the various groups of killifishes, mainly on osteological characters, and placed the genera *Cyprinodon* and *Fundulus* in separate families. Here they are treated as subfamilies.

A key to the species occurring in the inland waters of New York State will be found in the section on marine species.

Fundulus

The genus *Fundulus* is considered by Parenti to be a close relative of *Lucania*. It is defined on the basis of the structure of the upper part of the gill arches.



BANDED KILLIFISH

Fundulus diaphanus
(Lesueur, 1817)

Identification

The banded killifish is a freshwater species but it also enters the brackish waters of the Lower Hudson and frequently lives with the mummichog. The banded killifish is more slender than the mummichog and has a longer snout. They also differ in counts: the mummichog has five branchiostegal rays and nine or more gill rakers whereas the banded killifish has six branchiostegal rays and five or six gill rakers. In the banded killifish, the dorsal fin originates midway between the middle of the eye and the middle of the caudal base; in the mummichog, the dorsal fin origin is midway between the caudal base and the rear edge of the gill cover. The banded killifish has a shorter snout than the striped killifish.

Description

Body elongate with flat sides. Profiles symmetrical. Dorsal fin inserted well back on the body. Dorsal fin margin convex. Tail square, with its margin slightly convex. Anal fin origin below the anterior rays of the dorsal fin. Anal margin slightly convex, its middle rays longest. Pelvic fins inserted well anterior to the dorsal origin, midway between the anal origin and the gill opening in the male, midway between the anal origin and the pelvic base in the female. Pelvic fin retrogressive, with its last ray connected to the body for about one-third of its length. Pectoral base nearly vertical. Pectoral asymmetrically rounded. Gill membranes separate, free from the isthmus. Mouth strongly oblique, superior. Lower jaw protruding. Maxillary ending well in front of the eye. Premaxillary protractile. Top of head scaled, body scaled. No lateral line. Counts and proportional measurements are given in Table 28.

Color: Generally olive green to tan dorsally with

the scales conspicuously outlined with a row of melanophores. Cheeks and sides of the body silvery white, belly clear white. Fins dusky with the rays of the dorsal, anal, caudal, and anterior pectoral rays conspicuously outlined. Pelvic fins clear. Sides with 11 to 20 narrow vertical bars. These bars are much wider in males. Dorsal surface with conspicuous spots in the western form but few or no spots in the eastern form. Iris golden brown. Body quite transparent in life.

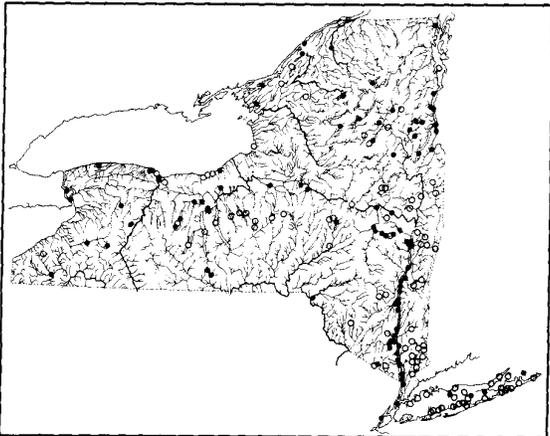
Juveniles and breeding adults: Breeding females develop a fleshy oviducal sheath around the base of the anal fin. Males become more brightly colored during the spawning season.

Size: The largest adults are about 4 inches total length. The eastern form tends to be larger than the western subspecies.

Habitat

The banded killifish lives in weedy shallows of lakes and ponds and in the slower moving parts of streams. It occurs over a variety of bottom types. Colgan noted that banded killifish burrow into sand or fine gravel when threatened. This happens less frequently in large groups. Different stocks showed different degrees of willingness to bury. Those from a quarry showed an increase in burying activities when tested in an aquarium with a sand bottom.

Melisky, Stauffer, and Hocutt reported that the final temperature preference for banded killifish from southeastern Pennsylvania was 28.6 C, whereas a population from Nova Scotia studied by Garside and Morrison had a final temperature preference of 21.0 C.



Distribution

The western banded killifish, *Fundulus diaphanus menona*, ranges from the Dakotas and Minnesota east in a curving band through the lower Great Lakes and the Upper Ohio-Allegheny system. On the Atlantic coast, the eastern subspecies, *Fundulus d. diaphanus*, occurs in the Maritime Provinces and Newfoundland south to South Carolina. Intergrades between the Atlantic coast and western subspecies occur in the Lake Ontario and St. Lawrence systems. This is the only species with eastern and western forms that intergrade in New York.

Life History

The spawning of the eastern banded killifish was described by Richardson who made his observations in a small brook tributary to the Richelieu River, Quebec. Spawning took place in pools when the water temperature reached 21 C, near the end of May. Males selected territories and defended them against other males and other species. Each male pursued a female and, during the chase, she emitted a single egg which remained attached to her body by a fine thread. This stimulated the male to an even more vigorous pursuit and eventually the pair came together in a pocket in the vegetation where they locked fins and pressed close against each other and vibrated as the female released 5 to 10 more eggs, which also remained attached for a brief time, then broke loose and sank until the threads caught in the weeds. The spawning pair then separated and, as the female started to move away, the male gave chase once more. This process was repeated until about 50 eggs had been laid in a period of about 5 minutes. The parents exhibited no awareness of the eggs. Development to the eyed stage took 3 days. Other investigators have reported hatching after 11 days and 72 F.

In Ohio, the young reach 20 to 58 mm by the end of the first summer.

Food and Feeding

Keast and Webb reported that although the mouth position would seem to indicate that the banded killifish is a surface feeder, it also feeds in midwater and near the bottom. Midge larvae, cladocerans, ostracods, and flying insects were the chief items of diet of fish up to 60 mm total length. Larger fish ate odonates, mollusks, and flatworms as well.

Notes

The two subspecies can be distinguished by the following key:

A. Scales smaller, 45 to 49 in lateral series. Dorsal rays 13 or 14, pectoral rays 16 or 17. Bars on sides narrow and regular, those of the caudal peduncle not fused into a stripe. Nine to 15 anterior bars, some extending across the dorsal surface without breaking up into spots. Commonly reaching more than 70 mm standard length.

F.d. diaphanus

A'. Scales larger, 40 to 44 in lateral series. Dorsal rays 10 or 11, pectoral rays 14 or 15. Only 5 to 10 anterior bars which break into spots on the back. Bars on the caudal peduncle often fused into a median stripe. Seldom reaching lengths greater than 70 mm standard length.

F.d. menona

References

Richardson, 1939 (breeding). Keast and Webb, 1966 (feeding). Melisky, Stauffer, and Hocutt, 1980 (thermal preference). Garside and Morrison, 1977 (thermal preference). Colgan, 1974 (burying behavior). Colgan and Costeloe, 1980 (burying be-

havior). Baker-Dittus, 1978 (foraging patterns).
Arcement and Rachlin, 1976 (karyotypes).

Names

The species name is from the Greek *dia*, through, and *phaneros*, visible or open, hence transparent. The western form, *menona*, takes its name from the lake from which it was first described.

Hydrargyra diaphana Lesueur, 1817e: 130-131
Saratoga Lake

Hydrargyra multifasciata Lesueur, 1817e:131-132
Saratoga Lake

Fundulus diaphanus, Greeley, 1930: 83-84
Champlain drainage

Fundulus diaphanus diaphanus, Greeley and
Bishop, 1933: 99 Upper Hudson

Fundulus menona Jordan and Copeland, 1877:
68-69 Lake Menona, Wisconsin

Fundulus diaphanus menona, Greeley, 1927:
62-63 Genesee watershed

LIVEBEARERS

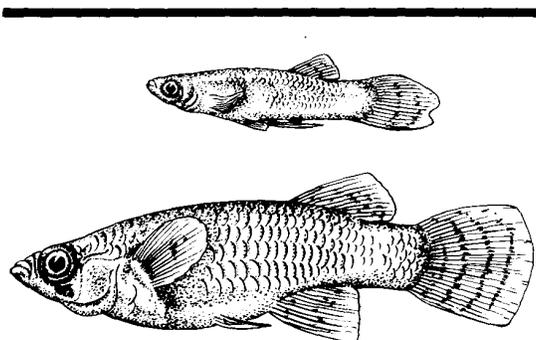
POECILIIDAE

The family Poeciliidae includes many of the favorite aquarium fishes such as the guppy and the mollies. They are generally confined to the warmer waters of the West Indies and tropical America with a few species in southern United States. As presently recognized, the family includes approximately 21 genera and at least 140 species. They are all small fishes and all but one bear their young alive. Their most conspicuous feature is the modification of the anterior part of the anal fin into an intromittent organ with which sperm is transferred to the females. Most species have the mouth superior, that is, directed upward. The origin of the dorsal fin is always behind the anal fin.

Although there are no poeciliids native to New York, a hardy strain of the western mosquitofish has been introduced on Long Island. From time to time, other species are encountered where their owners have released them. This was undoubtedly the source of a thriving population of guppies that we found in a pond in Central Park. It is unlikely that these populations, for all their abundance, could survive the winter and they are not considered here.

Gambusia

Gambusia contains more than 34 species which range from eastern United States to northern Columbia and the West Indies. Most of the distinguishing features are in the anal fin which is modified for transferring sperm to the female. Males also have the upper four to six rays of the pectoral fin thickened and curved forward.



MOSQUITOFISH

Gambusia affinis
(Baird and Girard, 1853)

Identification

With its terminal or superior mouth, small size, and rounded tail, the mosquitofish resembles its relatives, the killifishes. It is, however, a livebearer and the males have the anterior rays of the anal fin modified into an elaborate intromittent organ with which sperm are transferred to the female. Mosquitofish are rather somber in color, grayish with the upper scales conspicuously outlined with dark pigment. There is a dusky teardrop mark under the eye that varies in intensity, becoming darker when the fish is alarmed. Females have a black blotch on the side of the abdomen that becomes more intense when they are carrying young. Both sexes have the dorsal fin inserted behind the anal fin and the body has a distinctive humpbacked shape with the caudal peduncle abruptly slimmer than the belly.

At first glance, the mosquitofish might be mistaken for the rainwater killifish which is similar in size and color, and somewhat similar in shape, but the rainwater killifish has its dorsal inserted in front of the anal fin.

Description

Body rather stubby, with the dorsal profile rising to the dorsal origin which is behind the midpoint of the body. Ventral profile deepest just in front of the anal fin which is farther forward than the dorsal. Caudal convex, anal bluntly pointed in the female, highly specialized as an intromittent organ in the male. Pelvics small, inserted midway between the anal origin and a point below the pectoral insertion. Pectorals

asymmetrically pointed. Gill membranes separate, free from the isthmus. Mouth superior, tip of lower jaw a continuation of the dorsal profile. Top of head scaled. Counts and proportional measurements are given in Table 28.

Color: Scales of the sides and back conspicuously outlined in dark pigment. Belly uniform white. Upper part of body, and dorsal and caudal fins, sparsely peppered with small black spots which tend to form irregular rows on the fins, two on the dorsal and two or more on the caudal. Anal fin with some dark pigment on the middle rays. Margin of the dorsal dark in some individuals. A dark teardrop mark slopes backward from the eye to the suboperculum.

Juveniles and breeding adults: In addition to the size difference, males have the striking elongation and elaboration of the anal rays and females are fatter, especially when they are gravid.

Size: Females to slightly more than 2 inches, males about 1.5 inches.

Habitat

The mosquitofish is a near-surface dweller that lives in ponds and sluggish streams. It frequently becomes extremely abundant in tiny ditches and artificial ponds with few or no predators.



Distribution

Rosen and Bailey recognize two subspecies: *Gambusia affinis affinis* is the western form. It ranges from Veracruz in Mexico to southern Indiana and eastward to southern Alabama. It intergrades with *G. a. holbrooki*, which ranges from southern Alabama, Florida, and north on the Atlantic coast to southern New Jersey. In New York, there are introduced populations on Long Island which are apparently maintaining themselves at several locations. These are *G. a. affinis*, apparently a cold-hardy strain from the northern part of its range in the Midwest.

Life History

Mosquitofish have an extensive spawning season with each female producing two to four broods. The gestation period is 21 to 28 days. Females may

contain up to 315 embryos, usually about 40. Females mature in a matter of months when they reach 23 to 36 mm.

Food and Feeding

Mosquitofish have been introduced in many parts of the world as a method of controlling mosquitoes, which are a favorite food. They also feed on diatoms and other algae, zooplankton, and sometimes small fishes. Most of their feeding is at or near the surface.

References

Rosen and Bailey, 1963 (systematics). Krumholz, 1948 (reproduction). Harrington and Harrington, 1961 (ecology). Moyle, 1976 (California populations). Collier, 1936 (internal fertilization). Kuntz, 1914b (reproduction). Hildebrand, 1917 (life history). Rosen and Gordon, 1953 (functional anatomy).

Names

The name *affinis* is Latin for related to, a reference to its resemblance to *Heterandria holbrooki*, now called *Gambusia affinis holbrooki*, which was described later.

Heterandria affinis Baird and Girard, 1853: 390. San Antonio River drainage, Texas

Gambusia affinis affinis, Rosen and Bailey, 1963: 94-95 (systematics)

SILVERSIDES

ATHERINIDAE

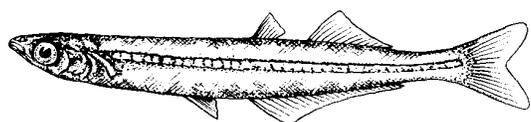
Silversides are mostly small, surface or midwater fishes with two well-separated dorsal fins. The first dorsal is inconspicuous, with four slender spines. The fishes in this family get their name from a bright silver streak along the side of the body; otherwise, they are pale, straw colored or almost transparent fishes, with little dark pigment. They have abdominal pelvic fins.

The family includes approximately 29 genera and 156 species. Most of the species live in temperate coastal waters although some live in fresh water. The famed grunion of California beaches belongs to this family.

In New York State, the brook silverside lives in fresh water and three other species enter the Hudson Estuary. A key to the species in the Lower Hudson will be found in the section on marine species.

Labidesthes

The fine scales and elongate jaws distinguish this freshwater species from other members of the Atherinidae.



BROOK SILVERSIDE

Labidesthes sicculus (Cope, 1865)

Identification

The brook silverside is the only truly freshwater silverside in our area although species of *Menidia* and *Membras martinica* occur in the Lower Hudson. The brook silverside is a slender, transparent fish with fine scales and rather long, almost beak-like jaws. Like other silversides, it has a tiny, inconspicuous first dorsal fin and a bright silver stripe along its midside. Its long anal fin is a good recognition character. The other silversides of New York have large scales that are faintly outlined with dark pigment above the lateral band, and their jaws are much less prolonged.

Description

Body very elongate and slender, slightly compressed. Dorsal profile nearly straight, the ventral evenly curved. Origin of the first dorsal midway between caudal base and the anterior edge of the pupil. First dorsal small, with only four spines, and well separated from the second dorsal, which originates over the middle of the long anal fin. Margin of the second dorsal nearly straight. Caudal forked, its middle rays about three-fourths the longest upper rays. Anal fin with anterior rays forming a low lobe. Pelvic fins abdominal, retrogressive. No pelvic axillary process. Pectoral retrogressive, slightly falcate or bluntly pointed, its base high on the side of the body and sloping at about 45 degrees. Gill membranes separate, free from the isthmus. Jaws curved, produced into a short beak. Maxillary ending in front of the eye. Upper jaw protractile. Lateral line incomplete. Counts and proportional measurements are given in Table 28.

Color: Body transparent pale green above, transparent below so that the peritoneum can be seen through the body wall. A narrow, quite even, silvery band, bounded above by black, is the most conspicuous color feature. Cheeks and prepectoral region silvery. Jaws and top of the head dusky. Scales of the dorsum faintly outlined by dark pigment but very small.

Juveniles and breeding adults: The brook silverside does not develop breeding tubercles nor does it have special breeding colors.

Size: Brook silversides are usually about 3 inches in total length and Trautman has reported that they reach 4.2 inches in Ohio. Nelson (1968a) reported a 109-mm fork length individual from Crooked Lake, Indiana. Our largest New York specimen is 74 mm standard length.

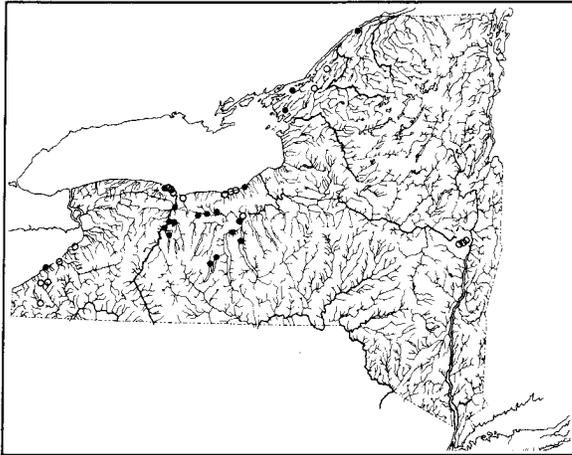
Habitat

This species is most abundant in weedy areas of streams and lakes. It stops feeding when the water becomes temporarily turbid and apparently cannot tolerate prolonged turbidity although we have often taken it in turbid water in the Barge Canal system.

Distribution

The brook silverside ranges from the St. Lawrence River through the southern Great Lakes to Minnesota and south to Texas and along the gulf coast to peninsular Florida. On the Atlantic coast, it ranges north to South Carolina.

In New York State, it occurs in the Lake Erie drainage, the western part of the Allegheny drainage, and the Finger Lakes. It is particularly common in the old Erie Canal east of the Genesee River. The Survey obtained several records at the eastern end of the Mohawk River but we have not duplicated them.



Life History

Hubbs studied the life history of the brook silverside in Portage Lake in southern Michigan. Spawning took place May to July over a washed gravel bottom where there was moderate current and the depth ranged from 1 to 3 feet. Males, which were more abundant, established rather ill-defined territories 2 to 4 meters long by 1 to 2 meters wide, driving off any invading males. When a female moved into the territory, one or more males pursued her and often she leapt clear of the water during the chase. Spawning occurred when the female allowed the male to catch her and the two glided downward, turning so their ventral surfaces were in contact. The eggs are of a special type with a long adhesive filament and several oil droplets. After being extruded well above the bottom, the egg sinks slowly and eventually the filament adheres to some object, the egg itself being nonadhesive.

Newly hatched young grow about 0.4 mm per day, reaching 70 to 80 percent of their adult size during their first summer. Ova begin to enlarge about one month after hatching indicating that the females approach maturity during their first summer, spawn when they are 1 year old, and die before the second winter. Nelson found that the annuli formed in early July.

At first, the young lived in open water and avoided shoals. Most of the time, they had their heads in contact with the surface film. They schooled only during the day. Adults, on the other hand, avoided open water and concentrated over shallows, near the surface or in midwater. They were active chiefly during the day and became quiescent at night.

Eggs and larvae: Brook silverside eggs were described by Rasmussen from the Peach River, Florida. Eggs ranged from 1.1 to 1.4 mm with two, rarely three, filaments about equal in length to the

diameter of the egg, and several oil droplets. Tide-water silversides have similar eggs but with four or more filaments. Newly hatched brook silverside larvae were 4.7 to 5.6 mm long.

Food and Feeding

Most of the diet consists of adult and larval insects and surface-dwelling entomostracans. Keast and Webb noted that in Lake Opinicon, Ontario, the diet was mostly cladocerans, small flying insects, and midge larvae. Nearly all food is taken from the surface or in midwater, although Hubbs noted that they sometimes leap out of the water to catch hovering insects.

References

Hubbs, 1921b (life history). Cahn, 1927a (ecology). Nelson, 1968a (life history). Rasmussen, 1980 (eggs and development). Keast and Webb, 1966 (ecology).

Names

The name *sicculus* is from the Latin word dried because it was found in half-dry pools.

Chirostoma sicculum Cope, 1865a: 81 Detroit River, Grosse Isle, Michigan

Labidesthes sicculus, Greeley, 1928 Oswego drainage

Labidesthes sicculus sicculus, Hubbs and Lagler, 1964: 115 Great Lakes

TABLE 28
AVERAGE PROPORTIONAL MEASUREMENTS AND COUNTS OF KILLIFISH,
MOSQUITOFISH, AND SILVERSIDES (*Fundulus*, *Gambusia*, and *Labidesthes*)

All proportions are expressed in percentage of standard length.

	<i>Fundulus diaphanus</i>	<i>Gambusia affinis</i>	<i>Labidesthes sicculus</i>
ST. LENGTH (mm)	51.4	23.2	60.6
TOTAL LENGTH	120.2	125.1	116.2
FORK LENGTH	120.2	125.1	111.4
PREDORSAL	55.9	63.5	53.6
PREANAL	61.1	52.5	52.5
PREPELVIC	45.8	43.8	40.3
DORSAL BASE	17.2	10.7	26.3
ANAL BASE	11.5	9.6	32.6
BODY DEPTH	18.1	25.5	11.5
BODY WIDTH	14.2	16.3	8.8
C.PED. DEPTH	10.2	14.4	6.0
PECTORAL ALT.	11.9	12.9	5.5
HEAD LENGTH	27.3	28.1	22.3
SNOUT	9.3	8.8	8.0
EYE	7.8	8.5	5.9
MOUTH LENGTH	8.0	8.6	8.6
INTERORB			
N (sample size)	5	5	5
COUNTS:			
DORSAL RAYS	12-15	6	IV-I,10-11
ANAL RAYS	10-13	7	25-26
PECTORAL RAYS	14-19	13	12-13
PELVIC RAYS	6	6	1,5
GILL RAKERS	4-7	11	24-29
VERTEBRAE	35-36	—	42-43
SCALES:			
TRANSVERSE	12-14	8	15
LATERAL SERIES	43-49	27	95

STICKLEBACKS

GASTEROSTEIDAE

Sticklebacks are delightful little fishes that live in weedy areas in both standing and flowing waters. With their tiny upturned mouths, slender caudal peduncles, and dorsal spines that are not connected by membrane, they can hardly be confused with any other fishes in our area.

Sticklebacks are related to the pipefishes and seahorses and are usually placed in the same order with them but recently some ichthyologists have challenged this because the evidence that both groups shared a common ancestor is weak. The family itself contains five genera and eight recog-

nized species although the threespine stickleback is exceedingly variable and is perhaps a complex of species.

These fishes have elaborate courtship and nest building habits and have been intensively studied by students of animal behavior.

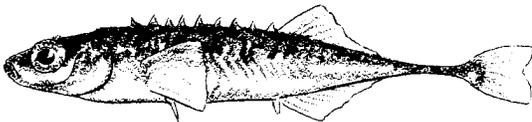
Many sticklebacks show a fine disregard for salinity. The threespine and ninespine sticklebacks occur in both salt and fresh water, the fourspine enters fresh water but is more common in salt water, and the brook stickleback is strictly a freshwater species.

KEY TO THE SPECIES OF STICKLEBACKS IN NEW YORK

A. First dorsal spines 8 to 10, usually 9. Body slender and elongated.

Pungitius pungitius

Ninespine stickleback, p. 277



A'. First dorsal spines fewer than six.

B. Free dorsal spines three. Gill membranes joined to isthmus. Some populations with large vertical plates along the sides, but these may not be present in some freshwater populations.

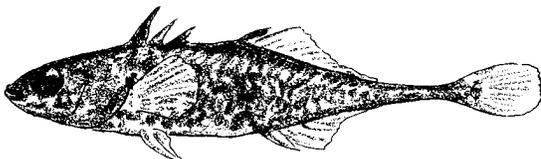
D.

B'. Free dorsal spines usually four or five.

C. Free dorsal spines usually four, graduated in size, the first (longest) spine about equal in length to the first soft ray. First three dorsal spines close together, then a wide space between the third and fourth. Caudal peduncle long and slender. Belly with a fleshy keel on each side. Brackish and fresh water.

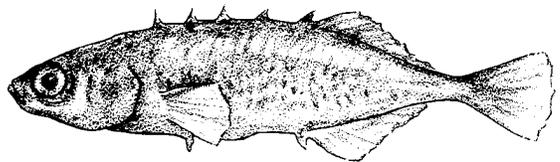
Apeltes quadracus

Fourspine stickleback, p. 273



C'. Free dorsal spines usually five, evenly spaced, short, and nearly equal in length. Caudal peduncle short. A single fleshy keel along midline of belly. Fresh water.

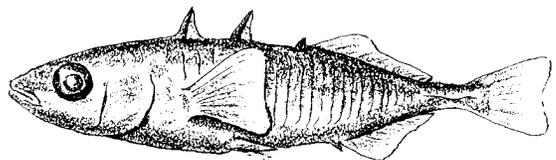
Culaea inconstans Brook stickleback, p. 274



D. (B. Free dorsal spines three.) Pelvic fin with one spine and one soft ray. Caudal peduncle with a lateral keel. Body variously colored but never with conspicuous, round, black spots.

Gasterosteus aculeatus

Threespine stickleback, p. 276



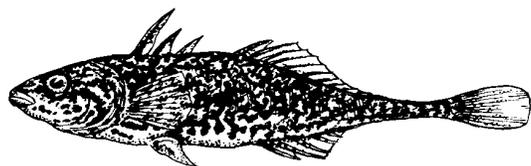
D'. Pelvic fin with two soft rays. No keel on caudal peduncle. Sides of body with conspicuous, round, black spots. Long Island; not reported from inland waters.

Gasterosteus wheatlandi

Blackspotted stickleback

Apeltes

This is a monotypic genus, characterized by four long dorsal spines, no lateral plates, and a long slender caudal peduncle without lateral keels. The pelvic skeleton has a lateral posterior process. The gill membranes are broadly united to the isthmus.



FOURSPINE STICKLEBACK

Apeltes quadracus (Mitchill, 1815)

Identification

The fourspine stickleback has four, occasionally five, rather long dorsal spines. The first and second dorsal spines and the pelvic spines are longer than the diameter of the eye. The fourspine has no bony plates on its sides and no keels on the side of the caudal peduncle. Its gill membranes are broadly joined to the isthmus. The pelvic skeleton has a lateral posterior process.

This species is probably most similar to the brook stickleback but it differs from that species in shape and in having much longer spines. This is a slender, tapering species whereas the brook stickleback tends to be more rectangular in shape.

Description

Body elongate, somewhat compressed. Caudal peduncle very slender, without lateral keels. Profiles symmetrical. Body deepest between the origins of the first and second dorsal fins. First three dorsal spines close together, graduated, each with a triangular membrane. Fourth spine separated by a greater distance and attached to the second dorsal fin by a deeply incised membrane. Caudal fin rounded. Anal origin slightly behind origin of second dorsal. Pelvics inserted below the second dorsal spine. Pelvic spine slightly serrated. Pectoral base rather high and nearly vertical. Pectoral symmetrical, its margin slightly convex or straight. Gill membranes broadly joined to the isthmus. Mouth small and terminal. No scales. Lateral line incomplete, ending below origin of second dorsal fin. Lateral posterior processes of the pelvic girdle form ventrolateral ridges on the abdomen. Counts and proportional measurements are given in Table 29.

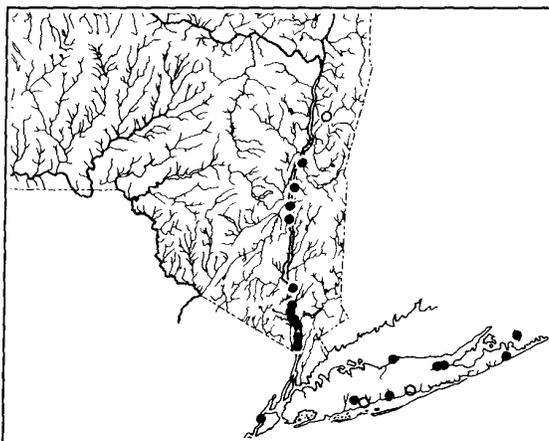
Color: Variable. Mottled brown on the back and sides. Lower sides blotched, belly silvery white. Fin rays conspicuously outlined against clear membranes. Iris brown.

Juveniles and breeding adults: Breeding males are blotched or variegated tan to olive dorsally, creamy silvery white below and have bright red pelvic fins. The females are darker and do not have red pelvics.

Size: This is a rather small species, usually 2.0 to 2.5 inches total length.

Habitat

The fourspine is basically a nearshore marine species, but in the Lower Hudson it occurs well into freshwaters of the estuary and its tributaries. Like other sticklebacks, it is usually found in well-vegetated areas.



Distribution

This species ranges from Newfoundland and eastern Quebec south to Virginia. Scott and Crossman report that it is established in lakes in Nova Scotia.

Life History

The fourspine stickleback was studied by Rowland. While its courtship is generally similar to that of other sticklebacks, it differs in building a cup-shaped nest rather than a barrel-shaped one and in ventilating the nest by pumping water through the nest using its gill covers.

Males establish territories and defend them against other males. When an intruder approaches, he is greeted with a warning display in which the defender raises the pelvic spines and meets the intruder head on in a nose-down attitude. Sometimes, there is a lateral display with the defender maintaining his position with the flank exposed as the intruder moves. If the intruder enters the territory, the defender will attack, ramming and nipping until the territorial boundary is crossed.

Males build the nests by pushing and carrying bits of plant material to the base of a plant where it is cemented in place by wrapping it with an adhesive strand extruded from the ventral pore. As more material is cemented into place, the male tamps it into a cup shape. Nest building, if not interrupted, takes 2 to 4 hours. Toward the end of the nest building, the male begins fanning that will continue until the eggs hatch or even afterward.

When a female enters the territory, the male begins a display by first erecting his pelvic fins and then butting her, finally swimming in a spiral path in the horizontal plane, and ending between her and the nest. She then signals her receptiveness by assuming a head-up position and swims toward the male. She swims under his erect pelvic fins and he

leads her into the nest. The male noses the nest as if to show it to her and she forces her way into the nest through the upper rim. When she is in the nest and in a head-up position, the male takes her caudal fin or peduncle in his mouth and begins to quiver. After a few seconds, the female deposits a cluster of 20 to 50 eggs, then squirms out through the other side of the nest. The male squirms through the nest, vibrating as he passes over the eggs, and fertilizes them. In a few seconds, he leaves the nest and resumes guarding the territory.

The male then proceeds to add more material to the nest, extending its sides upward and covering the eggs. The male then courts another female and this may be repeated until the nest contains as many as five clutches of eggs.

Once the nest has received eggs, the male spends more time fanning the eggs by inserting his snout into a hole in the side of the nest and drawing water over the eggs by pumping with his opercula and gill membranes. At least two holes are made for each level of eggs and the male fans each level in turn once every 10 to 30 seconds. Fanning frequency increases as the development proceeds. Hatching begins in about 6 days at 21 to 22 C. By the end of the ninth day, all of the eggs are hatched and the male ceases to care for the nest. Males may complete two nesting cycles a season.

The males usually have a 1-year life span and some females may live to spawn again at age II.

Food and Feeding

The fourspine, like other sticklebacks, feeds on plankton, cropping individual organisms with a pipping action.

References

Rowland, 1974 (reproductive behavior). Baker, 1971 (habitat selection). Breder, 1936a (nesting). Nelson, 1968b (salinity tolerance). Reisman, 1963 (reproductive behavior). Schwartz, 1965 (life history).

Names

The name *quadracus* is from the Latin *quadr-*, fourfold, and *acus*, a needle.

Gasterosteus quadracus Mitchill, 1815: 430 New York

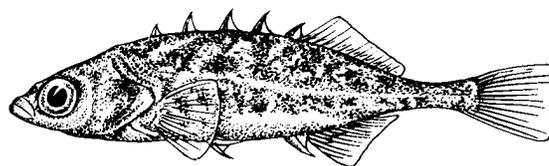
Apeltes quadracus, DeKay, 1842: 67 New York

Apeltes quadracus, Greeley, 1935: 101 Mohawk-Hudson drainage

Gasterosteus millipunctatus Ayres, 1842: 294 Old Man's Harbor, Long Island

Culaea

This is the only genus of sticklebacks not found in salt water. It is monotypic. It has no scales, four to six short dorsal spines, a rather short caudal peduncle, and the gill membranes are united to each other but free from the isthmus. The pelvic girdle has a narrow median posterior process.



BROOK STICKLEBACK

Culaea inconstans (Kirtland, 1840)

Identification

The brook stickleback is a rectangular little fish tapering abruptly at the second dorsal fin to a very slender caudal peduncle. It has four, five, or six dorsal spines and they are rather short, usually shorter than the diameter of the eye. There are no plates along the sides of the body and the caudal peduncle is deeper than long; it is without lateral keels. There is a narrow median process on the pelvic skeleton. The gill membranes are connected to each other and form a fold across the isthmus but they are not attached to the isthmus.

Description

Body rather deep, somewhat compressed, caudal peduncle not as long and slender as in the fourspine stickleback. Dorsal profile slightly more curved than the ventral or the profiles nearly symmetrical. Dorsal spines I to IV separate, each with a triangular membrane behind it. Last dorsal spine attached to the second dorsal fin. Margin of the second dorsal straight or slightly concave. Caudal fin square or slightly lunate, its corners rounded. Anal inserted below and similar in shape to the second dorsal. Pelvics inserted below second dorsal spine. Pectoral rather high on the body, its base nearly vertical. Pectoral square, nearly symmetrical, its margin slightly convex. Gill membranes joined to each other but free from the isthmus. Mouth small, terminal, oblique. Lateral line complete. No scales. Counts and proportional measurements are given in Table 29.

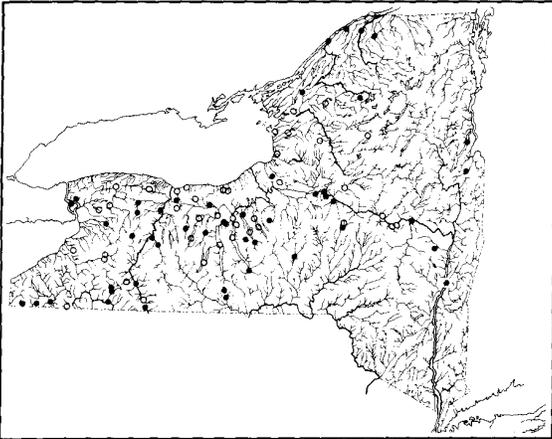
Color: Extremely variable but generally olive green above with pale flecks and darker mottlings. Sometimes nearly black. Cheek, lower sides, and belly sometimes silvery white. Often, there is a suggestion of vertical bars and a pale longitudinal midlateral stripe. Fin membranes hyaline, the rays conspicuously outlined.

Juveniles and breeding adults: The breeding males are very dark, sometimes with a coppery hue above and slightly paler below. Breeding females darker than usual but not as dark as the males.

Size: Usually around 2 inches. The largest Ohio specimen was 2.7 inches total length.

Habitat

The brook stickleback inhabits clear, cool, weedy areas of lakes and ponds and the slower parts of streams wherever there is dense vegetation and a bottom of muck or organic debris. Beds of waterweed in cold creeks seem to be an ideal habitat.



Distribution

The brook stickleback occupies a broad band across southern Canada and the northern United States from Nova Scotia, across New York, Pennsylvania, and northern Ohio to Iowa, Montana, and the southern part of the Northwest Territories. Relict populations occur in northeastern New Mexico.

Life History

The brook stickleback spawns in April or May in New York and into June or July farther north. Winn described the reproductive behavior of this species in Michigan. Water temperatures of at least 40 to 50 F and no higher than 70 F are required. Males move into shallow water before the females, establish territories, and begin to build nests. The nests are barrel-shaped or globular and constructed of bits of algae and plant debris. The nests are usually close to the bottom but sometimes on the bottom and sometimes as much as a foot above it. The nests were attached to plant stalks or sticks and both vertical and horizontal structures were used for nest sites.

A female ready to spawn became darker with a more variegated pattern. She entered the male's territory and was attacked and nipped or butted. If she remained motionless or went to the bottom, the male would move to the opening of the nest. If she did not follow, he would return and nip or butt her again until she eventually followed him to the nest and entered it. There she remained, with her head and tail protruding, while the male prodded her vent region and caudal peduncle until she responded by laying eggs, vibrating as she did so. After several spawning episodes, she moved out of the nest and the male chased her from his territory. Two or more females may spawn in one nest, each laying about 250 eggs. After the female left, the

male rearranged the nest, presumably fertilizing the eggs as he did so, then remained with the nest, fanning the eggs and repairing the nest and driving off intruders that entered his territory. After the young hatched, the male herded them around the nest until they began to swim so well that he could not retrieve them.

Eggs were 1 mm in diameter, pale yellow, and adhesive. Hatching took place after 203 to 232 hours at 16 to 17 C. Newly hatched young appeared to be attached to the nest but Winn found that they hold their position by swimming against the nest, using their pectoral and caudal fins.

Brook sticklebacks mature in 1 year, some live into the second summer, and a few may survive to the third summer.

Food and Feeding

The brook stickleback feeds on aquatic insect larvae, crustaceans, snails, water mites, algae, fish eggs, and oligochaetes. Fish eggs are only a small part of their diet.

References

Winn, 1960 (life history). Jacobs, 1948 (nesting). Reisman and Cade, 1967 (reproduction). McKenzie, 1969a; 1969b (behavior). MacLean and Gee, 1971 (temperature relationships). Nelson, 1968b (salinity tolerance). Nelson, 1969 (geographic variation). Smith, 1970 (food and behavior). Thomas, 1962 (behavior).

Names

The name *inconstans* is the Latin word for inconstant, probably in reference to the variable coloration of this species.

Gasterosteus inconstans Kirtland, 1840: 273-274 Trumbull County, Ohio

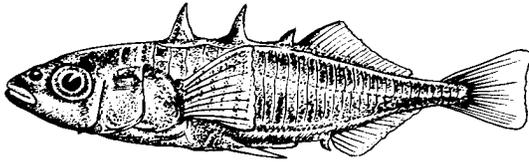
Eucalia inconstans cayuga Jordan, 1876: 249 Cayuga Lake at Ithaca

Eucalia inconstans, Greeley, 1927: 63 Genesee drainage

Culaea inconstans, Bailey and Allum, 1962: 93 (nomenclature)

Gasterosteus

This genus has two species, the threespine and the blackspotted sticklebacks. Both have lateral plates (absent in some freshwater populations of the threespine), three dorsal spines, and a wide median posterior pelvic process. The gill membranes are united to the isthmus.



THREESPINE STICKLEBACK

Gasterosteus aculeatus
Linnaeus, 1758

Identification

The threespine stickleback usually has three spines in its dorsal fin and a few vertical bony plates along its sides. There are fewer plates in fresh water, and some freshwater populations lack the plates altogether. There are keels along side of the caudal peduncle, and gill membranes are broadly joined to the isthmus. The pelvic fin consists of one spine and one soft ray and the spine has a single pointed cusp at its base. The threespine is similar to the blackspotted stickleback, *Gasterosteus wheatlandi*, but that species has two soft rays in each pelvic fin and two cusps at the base of the pelvic spine. The blackspotted stickleback also has black spots on its lower sides and no keels on the caudal peduncle.

Description

Body rather stubby, deep and compressed. Profiles symmetrical. Caudal peduncle depressed with well-developed lateral keels. Dorsal spines well separated with triangular membranes, the first dorsal spine inserted over the pectoral base, which is a short distance behind the head. Third dorsal spine short, with its membrane connected to the base of the first dorsal soft ray. Margin of the soft dorsal straight. Caudal fin square or slightly emarginate. Anal origin inserted below fourth or fifth dorsal soft ray, similar in shape to the second dorsal fin. Pelvic spine inserted below or slightly ahead of second dorsal spine. Pectoral fin well behind head, its base vertical. Pectoral truncate, symmetrical, its margin straight. Gill membranes broadly joined to the isthmus. Mouth short and terminal, slightly oblique. Sides of body with narrow vertical plates, about 23 in Hudson River fish but absent in some populations. Lateral line high, incomplete. All spines with a locking mechanism. Counts and proportional measurements are given in Table 29.

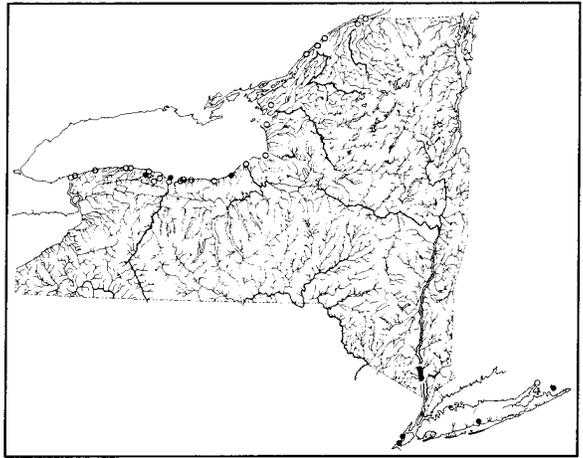
Color: The upper sides are green to brownish with some darker mottlings, shading to silvery on the belly. The fins are pale or have a slightly reddish tint.

Juveniles and breeding adults: Breeding males become bright red on the lower sides and belly and develop bright blue eyes. The females become pinkish on the belly and throat.

Size: Our largest Hudson River specimen is 51 mm standard length.

Habitat

The threespine stickleback occurs in fresh, brackish and salt water. In the Lower Hudson, it occurs in Bowline Pond in the fall and winter but apparently moves offshore in the spring and summer. It is said to be fairly common in Lake Ontario. Weedy areas over sand or flocculent bottom are preferred.



Distribution

The threespine stickleback occurs throughout Europe from Scandinavia and the Iberian Peninsula east to the Black Sea. It also occurs in Iceland, Greenland, and both coasts of North America as far south as Chesapeake Bay on the Atlantic coast and as far south as lower California on the Pacific coast. It also ranges from Korea and Japan to the Bering Strait but not on the Arctic coast of Siberia or North America.

In the Great Lakes, this species was confined to the waters below Niagara Falls until recently when it was collected in Georgian Bay of Lake Huron. In the summer of 1982, J. Nyckel discovered it in a tributary to the Straits of Mackinac. Apparently, it was able to move through the Nipissing Canal from the Ottawa River and is now spreading rapidly through the upper Great Lakes.

In New York, it occurs in Lake Ontario as well as the Lower Hudson and Long Island.

Life History

The behavior of the threespine stickleback has been studied intensively and will be reviewed only briefly here. The male establishes a territory in shallow water and builds a barrel-shaped nest on the bottom. He then entices a female by performing a ritualized courtship dance to which she responds in stylized way. Eventually, she enters the nest, deposits her eggs, and leaves. The male fertilizes the eggs and remains to guard the nest and the eggs, and later the young. Several females may deposit eggs in one nest. The adhesive eggs are yellow and opaque and

about 1.5 to 1.7 mm in diameter.

Sexual maturity is reached the first summer and they first spawn at age 1+. Few fish live through the third summer.

Food and Feeding

This species, like other sticklebacks, is a pipette feeder and eats a variety of small animals including crustaceans, aquatic and terrestrial insects, and fish eggs and fry.

Notes

The threespine stickleback exhibits great variation and may actually be a complex of several species or subspecies.

References

Hynes, 1950 (food). Lewis, Walkey, and Dartsall, 1972 (effects of low oxygen tension). Manzer, 1976 (food). Perlmutter, 1963 (Long Island). Li and Owings, 1978 (sexual selection).

Names

Aculeatus is the Latin word meaning furnished with spines or prickles.

Gasterosteus aculeatus Linnaeus, 1758: 295 Europe

Gasterosteus cuvieri Girard in Storer, 1857: 254-260 Labrador

Gasterosteus aculeatus cuvieri, Greeley, 1927: 63 Genesee drainage

Gasterosteus aculeatus, Greeley, 1928: 102 Oswego drainage

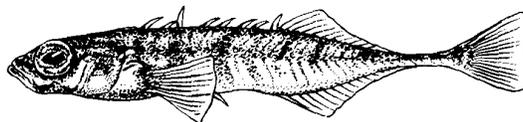
Gasterosteus neboracensis DeKay, 1842: 66-67 New York

Gasterosteus bispinosus (non Walbaum) Hankinson, 1924: 86 western New York

Gasterosteus biaculeatus Mitchill, 1815: 430 New York

Pungitius

The ninespine stickleback also belongs to a monotypic genus, characterized by nine short dorsal spines, a long slender caudal peduncle that is broader than deep, and lateral keels. The gill membranes are joined but free from the isthmus. The ninespine occurs in fresh and salt water in the northern parts of North America and Eurasia.



NINESPINE STICKLEBACK

Pungitius pungitius (Linnaeus, 1758)

Identification

The ninespine stickleback is more elongate and slender than the other species of sticklebacks and its caudal peduncle is wider than deep, with a distinct keel along each side. Its most distinctive feature is the number of dorsal spines, usually 9 or 10. It usually does not have bony plates along the sides.

Description

Body elongate and slender, slightly compressed. Caudal peduncle attenuate, depressed, with lateral keels. Dorsal spines short and lockable, alternately inclined left and right, with small triangular membranes. Second dorsal margin straight. Caudal fin slightly emarginate. Anal fin origin behind that of the second dorsal. Anal fin shape similar to that of the second dorsal. Pelvic fin inserted below the fourth dorsal spine. Pectoral fin base well behind head, nearly vertical. Pectoral fin symmetrical, its margin convex. Gill membranes broadly united across the isthmus. Mouth terminal, oblique. No scales but there are small, bony plates along the lateral line, at the bases of the fins, and on the caudal peduncle keels. Counts and proportional measurements are given in Table 29.

Color: The ninespine stickleback is somewhat bicolorated, the dorsal half pale green with a suggestion of irregular darker gray crossbars, and the lower half silvery white. The iris is silvery, the fin rays outlined with melanophores.

Juveniles and breeding adults: Breeding males sometimes become jet black on the belly, with white pelvic fin membranes.

Size: Adults are 2 to 3 inches long. Our largest New York specimens are 61 mm standard length.

Habitat

Along the coasts, the ninespine stickleback occurs in nearshore waters and moves into fresh water to spawn. In fresh water, it lives in deeper lakes where it occurs up to 250 feet deep. It apparently moves into shallow waters to spawn.



Distribution

The ninespine is a circumpolar species ranging from the British Isles across northern Eurasia to the Bering Strait and across Canada to Newfoundland, down the Atlantic coast to Long Island and New Jersey. It occurs in Alaska and the Aleutian Islands, and in eastern Asia south to Japan and China. In New York, it is known from Canandaigua Lake, Lake Ontario and eastern Long Island, where it is anadromous.

Life History

As in other sticklebacks, the male builds a barrel-shaped nest by cementing together bits of plant material using thread-like strands of a kidney secretion. The nest is usually constructed somewhat off the bottom. The male performs a courtship dance and entices the female into the nest where she lays a batch of 20 to 30 adhesive eggs. After she lays the eggs, the male chases her from the nest and swims through, fertilizing the eggs on the way. The male guards the nest and aerates the eggs by positioning himself at the entrance and fanning vigorously with his pectoral fins. After the eggs hatch, the male guards the young until they are about 2 weeks old and 15 mm long.

The young reach maturity at the end of the first summer and spawn the next year. Sometimes, they spawn more than once a season but they do not spawn in the fall. The maximum age is about 3.5 years.

Food and Feeding

The ninespine stickleback is carnivorous and feeds on immature insects, crustaceans, and the eggs and larvae of its own species.

References

McKenzie and Keenleyside, 1970 (reproductive behavior). Hynes, 1950 (food). Griswold and Smith, 1972 (growth and survival); 1973 (life history). Coad and Power, 1973 (ecology). Lindsey, 1962 (meristic variation and temperature). McPhail, 1963 (geographic variation). Morris, 1952 (homosexuality); 1958 (reproductive behavior). J. Nelson, 1968b (salinity tolerance). Lewis, Walkey, and Dartsall, 1972 (oxygen effects). Wootton, 1976 (taxonomy and biology).

Notes

McPhail found that the coastal form has more numerous dorsal spines, more lateral plates, and fewer gill rakers, but he did not believe that the two forms should be recognized as subspecies.

Names

Pungitius is Latin for pungent or sharp from *pungo*, to puncture.

Gasterosteus pungitius Linnaeus, 1758: 296 Europe

Pygosteus pungitius, Bean, 1903: 338-340 New York

Gasterosteus occidentalis Cuvier in Cuvier and Valenciennes, 1829: 509

Gasterosteus occidentalis, DeKay, 1842: 68 Manhattan

TABLE 29
AVERAGE PROPORTIONAL MEASUREMENTS AND COUNTS OF STICKLEBACKS
(Apeltes, Culaea, Gasterosteus, and Pungitius)

All proportions are expressed in percentage of standard length.

	<i>Apeltes</i> <i>quadracus</i>	<i>Culaea</i> <i>inconstans</i>	<i>Gasterosteus</i> <i>aculeatus</i>	<i>Pungitius</i> <i>pungitius</i>
ST. LENGTH (mm)	31.9	40.2	52.3	38.3
TOTAL LENGTH	116.0	116.7	115.2	114.4
FORK LENGTH	116.0	116.7	113.4	113.5
PREDORSAL	30.0	32.1	36.4	30.7
PREANAL	58.1	61.2	68.0	59.0
PREPELVIC	33.4	39.2	43.6	38.8
DORSAL BASE	27.0	25.8	25.5	30.6
ANAL BASE	24.7	28.2	20.4	23.8
BODY DEPTH	23.2	26.6	24.0	17.1
BODY WIDTH	14.2	16.1	12.0	10.1
C.PED. DEPTH	3.6	5.0	3.8	2.6
PECTORAL ALT.	11.6	15.2	11.5	9.8
HEAD LENGTH	27.9	29.3	29.5	27.6
SNOUT	8.1	7.5	8.9	8.5
EYE	7.7	7.6	8.8	8.8
MOUTH LENGTH	7.0	7.7	4.3	8.5
INTERORB	6.9	9.1	3.9	7.1
N (sample size)	5	5	5	5
COUNTS:				
DORSAL SPINES	IV-V	IV-VI	III	VIII-X
DORSAL RAYS	11-12	9-11	9-11	9-11
ANAL RAYS	I,9-11	I,10-11	I,9-11	I,8-10
PECTORAL RAYS	10	9-11	9-11	10-12
PELVIC RAYS	I,2	I,1	I,1	I,1
GILL RAKERS	4-6	11-13	18-20	12-13
VERTEBRAE	30-32	31-33	30-32	31-33

TEMPERATE BASSES

MORONIDAE

The temperate basses are rather generalized spiny-rayed fishes with ctenoid scales and strong spines in the dorsal, anal, and pelvic fins. They have 2 separate or slightly joined dorsal fins, the first consisting of all spines, the second with 1 spine and fewer than 15 soft rays. Unlike the drums and perches, they have three, rather than two, anal spines. The maxillary bone does not slip up under the suborbital bone as it does in the snappers and porgies. They have an internal bony shelf under the eyeball and a well-developed pseudobranch. Temperate basses tend to be silvery white with distinct, dark, longitudinal lines but the white perch is rather brassy, without distinct lines.

This family is represented in North America by four species, of which all but the yellow bass, *Morone mississippiensis*, occur in New York. Two closely related species occur in Europe. The striped bass and the white bass are more closely related to each other than to the white perch.

In the older literature, the species have been variously assigned to the genera *Morone*, *Roccus*, or

Lepibema (for the white bass). There is little justification for more than a single genus, and the rules of nomenclature dictate that the name *Morone* takes precedence over the others.

These species have been placed in the family Serranidae. However, serranids are marine fishes that have three points on the opercle bone rather than two and tend to be hermaphroditic or to have the gonadal structure of hermaphrodites. Temperate basses have separate sexes and live in fresh or brackish water or are anadromous. They have also been united with certain other species in a family called the Percichthyidae, but the evidence of this relationship is not convincing and it seems preferable to revert to an older name, the Moronidae.

Morone

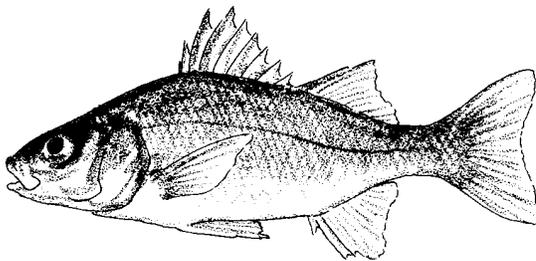
The relationships of this genus are currently under study by John Waldman. At present, it is the only genus in the family.

KEY TO THE SPECIES OF TEMPERATE BASSES

A. First and second dorsal fins definitely connected with membrane between all spines. No teeth on tongue. Body without dark longitudinal lines although light spots on the scales may suggest many pale longitudinal lines.

Morone americana

White perch, p. 281

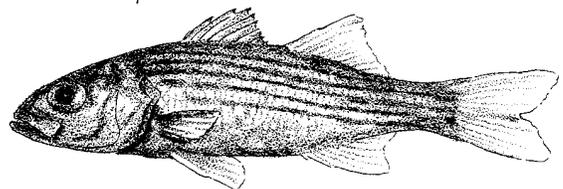


A'. First and second dorsal fins nearly separate, the membranes between the last spine of the first dorsal and the first spine of the second dorsal scarcely developed. One or two patches of teeth on the base of the tongue. Body with four to seven distinct narrow, dark, longitudinal lines.

B. Body elongate, its greatest depth distinctly less than the length of the head. Longitudinal streaks uniform and continuous although one or two may break and continue on the scale row above or below in some individuals. Young (up to about 4 inches in length) with about 10 narrow, indistinct vertical bars. Base of tongue with two patches of teeth, clearly separate and approximately equal in size.

Morone saxatilis

Striped bass, p. 284

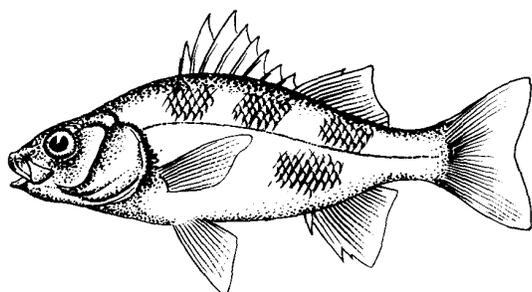
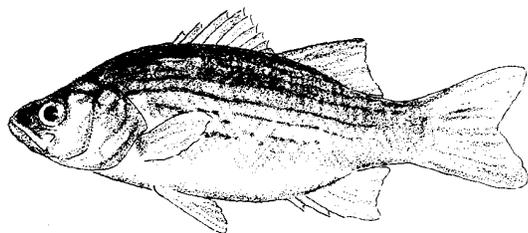


B'. Body shorter and deeper, its greatest depth about equal to the length of the head. Longitudinal stripes weaker and frequently interrupted. No vertical bars, even in the young. Base of the tongue with two patches of teeth that are usually unequal in size.

and so close together that they appear as a single patch.

Morone chrysops

White bass, p. 282



WHITE PERCH

Morone americana (Gmelin, 1789)

Identification

The white perch is the only species of temperate bass in our area that does not have definite dark longitudinal stripes on the body. It also differs in shape, being deeper and more tapered, and its dorsal fins are connected by membrane to a greater extent. It usually has 9 rays in the anal fin whereas the white bass has 11 or 12, and the striped bass has 9 to 11.

Description

Body deep and rather compressed. Dorsal profile highly arched, rising in an almost straight line to the origin of the dorsal fin. Ventral profile evenly curved. Distance from snout to dorsal origin one and one-half times in distance from dorsal origin to the caudal midbase. First dorsal rounded, its third and fourth spines longest. Dorsal fins connected by a low, but definite membrane. Spine at front of second dorsal fin about three-fourths length of the first soft ray. Last dorsal ray about half the spine length. Margin of second dorsal falcate, convex anteriorly, concave posteriorly. Caudal moderately forked, the middle ray two-thirds the longest upper rays. Caudal lobes bluntly pointed. Anal fin origin below anterior soft rays of the dorsal fin. Anal margin falcate, similar to second dorsal. First anal spine short, second and third spines longer and subequal. Pelvic fin insertion below the dorsal origin. No pelvic axillary process. Pelvic spines about two-thirds the length of the first soft ray, excluding the short filament on the latter. Pectoral base nearly vertical, pectoral asymmetrically pointed. Gill membranes separate, mouth terminal, preopercle with fine serrae on its vertical limb and the posterior part of its lower limb.

Lateral line complete, paralleling the dorsal profile. Counts and proportional measurements are given in Table 30.

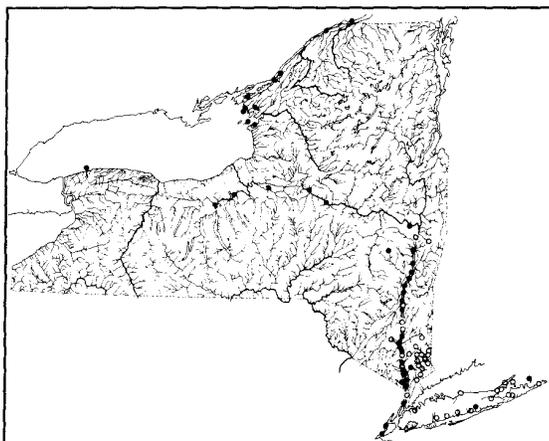
Color. The dorsal surface is dark gray or olive, sometimes brownish, shading to silvery on the sides and white on the belly. Many individuals have irregular short segments of lines formed by series of darker scales on the upper sides. Light centers of the scales also form indistinct longitudinal light lines on the upper sides. Lateral line dark and conspicuous.

Juveniles and spawning adults: There is no special juvenile color pattern but the spawning adults sometimes develop a bluish cast on the head and especially the lower jaw.

Size: The maximum recorded size is 4.75 pounds and 19 inches total length. The New York record is 2 pounds 14 ounces, a fish taken in the Carmans River 27 June 1982 by John Zinkowski. In the Lower Hudson, the average weight is 0.75 pound.

Habitat

White perch can tolerate a wide range of salinities from full sea water to fresh water. They are often found in rather turbid shallow areas and at times they form dense schools. Daily migrations to shallows at night and offshore during the daylight hours have been reported.



Distribution

The white perch is abundant in brackish waters along the Atlantic coast from New Brunswick to South Carolina. It is common in the Hudson River and in some landlocked lakes and ponds of the Lower Hudson drainage. During the past five decades, it has spread into the Great Lakes. Scott and Christie traced its invasion of Lake Ontario and the St. Lawrence River. In the 1930s, it was confined to the eastern end of the Mohawk River where it was taken by the Survey only as far west as Rexford. By 1948, it was in Cross Lake and must have been present in Oneida Lake as early as 1946 or 1947. It was collected in the Seneca River in 1951 and in that year a specimen was taken near Montreal. In 1952, four white perch were caught near Quebec City and since the species does not occur naturally north of the Miramichi River on the coast of New

Brunswick, Scott and Christie concluded that the St. Lawrence populations came from Lake Ontario rather than from the Atlantic Ocean. In 1952, it was first noticed in the Bay of Quinte on the north shore of Lake Ontario and by 1959 it was a dominant species there. In 1961, a small specimen was taken in the Welland Canal.

Busch, Davis and Nepszy summarized the records for Lake Erie. It was first taken in a pound net near Erie, Pennsylvania, in 1953. Later that year, two more were taken in Ohio waters near Conneaut and Fair Point. In 1973, one was caught near Port Clinton and, in 1974, three were recorded from Ohio waters of the western basin. In 1975, 34 were reported from the western half of Lake Erie. It still has not been reported from the eastern end of Lake Erie and its absence in the New York part of the lake remains unexplained.

Life History

The white perch reaches its greatest abundance in the brackish part of the Hudson River. There is evidence of an upstream migration of adults in the spring and early summer. Spawning apparently occurs in May and June when the water temperatures are 14 to 24 C and the peak of the spawning is reached at temperatures of 18 to 20 C.

Waldman reported what was apparently spawning activity in a tributary of Long Island Sound off the Hutchinson River Parkway in the Bronx. On 5 May 1980, a group of about 75 individuals were milling in an elliptical pattern over a small patch of coarse sand. The school was near the interface between fresh and salt water and the salt water was more turbid than the fresh. As the fish rolled, sunlight reflected from their sides as bright flashes. They appeared to avoid the shadow of the bridge.

White perch eggs are small, demersal, and adhesive. The water-hardened eggs are about 0.9 mm in diameter. Ovarian egg counts range from 15,740 to 247,681 according to the size of the females. Eggs hatch in 4 or 4½ days at 15 C, 30 hours at 20 C. Newly hatched young are 2.3 mm long and can reach 2.5 inches by the end of the first summer. The average life span is 5 to 7 years but some individuals may live 14 to 17 years.

Fritzsche and Johnson presented osteological features that can be used to distinguish white perch from striped bass at lengths as small as 7.5 mm.

Food and Feeding

Small white perch feed on such small invertebrates as copepods which are especially important foods during the first two summers. *Gammarus*, chironomid larvae, and occasional *Cyathura* are also important foods. Fish eggs are important May through July. White perch more than 200 mm long eat mostly fish.

References

Mansueti, 1961 (population dynamics); 1964 (development). Larsen, 1954 (first record in Lake Erie). Holsapple and Foster, 1975 (reproduction in Hudson River). Toman, 1955 (summary). Raney,

1965a (summary). Sheri and Power, 1969a; 1969b (biology). Alsop and Forney, 1962 (growth and food in Oneida Lake). Fritzsche and Johnson, 1980 (larval development). Dence, 1952 (status in New York). Scott and Christie, 1963 (spread in the Great Lakes). Busch, Davis, and Nepszy, 1977 (Lake Erie). Morgan and Prince, 1978 (effects of chlorine on larvae). Thoits, 1958 (life history and ecology). Webster, 1943 (food). Woolcott, 1964 (variation). Richards, 1960 (life history in New York). Texas Instruments, 1975 (summary in Hudson). Waldman, 1981 (spawning). Bath and O'Connor, 1982 (Hudson River). Elrod et al., 1981 (food). Kellogg and Gift, 1983 (preferred temperatures).

Names

Americana refers to its distribution.

Perca americana Gmelin, 1788: 1308 New York (after Schoepf)

Morone americana, Greeley, 1937: 98 Lower Hudson

Perca immaculata Walbaum, 1792: 330 New York (after Schoepf)

Morone rufa Mitchill, 1814: 18 New York

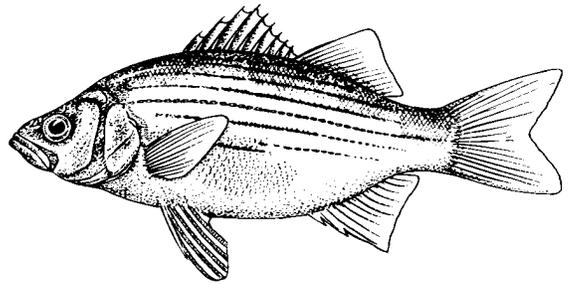
Labrax rufus, DeKay, 1842: 9-10 New York

Morone pallida Mitchill, 1814: 19 New York

Labrax pallidus, DeKay, 1842: 11-12 New York

Perca mucronata Rafinesque, 1818b: 204 Delaware, Schuylkill and Susquehanna Rivers

Labrax nigricans DeKay, 1842: 12-13 Long Island



WHITE BASS

Morone chrysops (Rafinesque, 1820)

Identification

The white bass is a silvery fish with distinct, narrow, dark, longitudinal lines and two dorsal fins that are nearly separate, although close together and connected by a low membrane. The white perch has three anal spines and its lateral line stops at the base of the tail. It has only fine serrae on the edge of the preopercle.

White bass are easily distinguished from the white perch, which lacks distinct longitudinal stripes and has 9 anal rays instead of 12 or 13. They are closely related to, and resemble, striped bass, but the striped bass is more elongate and has several dark stripes extending to the base of the tail whereas the

white bass has only one full length stripe; the rest are shorter. The white bass has two patches of teeth at the base of the tongue, but they are unequal in size and close together so they appear as a single patch in whole specimens. The striped bass has two tooth patches that are clearly separate.

White bass and striped bass hybridize and the hybrids are intermediate between the two. Hybrids have two tooth patches on the tongue, but they are deep-bodied like the white bass and usually have the longitudinal lines broken into short dashes on alternating scale rows. Hybrids reach weights of 10 pounds which is larger than white bass, which seldom reach 3 pounds.

Description

Body moderately deep and compressed. Dorsal profile more curved than the ventral but not as arched as in the white perch. Caudal peduncle deeper than that of the white perch. Distance from snout to the origin of the dorsal fin contained 1.5 times in the distance from the dorsal origin to the caudal midbase. First dorsal outline rounded, its third and fourth spines longest. Second dorsal margin concave, with rounded corners. The two dorsal fins are connected by a low membrane. Caudal fin moderately forked, its middle rays 1.25 in the longest upper ray. Anal origin below anterior dorsal soft rays. Second anal spine markedly shorter than the third. Margin of anal fin concave. Pelvic fin inserted below the dorsal origin. Pelvic fin retrogressive, with straight margin. Pectoral fin asymmetrically pointed, its base oblique. Gill membranes separate and free from the isthmus. Mouth terminal. Preopercle finely serrated on its vertical limb and the posterior part of the horizontal limb. Lateral line complete and straight. Counts and proportional measurements are given in Table 30.

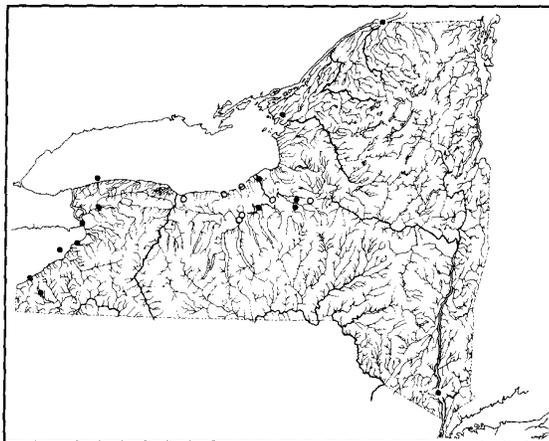
Color: Dusky silvery gray above, shading to silvery on the sides and white ventrally. Sides with about six (five to seven) longitudinal, narrow, dark stripes of which only the center one reaches to the base of the tail. Dorsal and caudal fins slightly dusky, pectoral and pelvic fins white, anal with melanophores on the central interradiation membranes.

Juveniles and breeding adults: The juveniles are less pigmented but otherwise look like small adults. There are no special breeding colors or structures in this species.

Size: The usual size is 11 to 12 inches total length. The IGFA all-tackle record is 5 pounds 9 ounces, a fish from the Colorado River in Texas. The New York State record is a 2-pound 12-ounce fish from the Oswego River taken 4 June 1982 by Dean Myers.

Habitat

White bass are confined to large lakes and reservoirs. It moves into the lower reaches of streams for spawning and occasional juveniles are taken in streams, but in general it is a fish of big waters. The white bass is quite tolerant of turbidity. It travels in schools and often moves considerable distances.



Distribution

This is a midcontinent species ranging from the St. Lawrence and the Great Lakes (few records in Lakes Superior and Huron) to the Red River of the North, and south in the Mississippi watershed to the gulf drainages and west to the Rio Grande. It has been introduced in the southeast and into some Pacific coast drainages. Recently, it has been collected in the Hudson River and this appears to be the result of some fish having moved through the Barge Canal.

Life History

White bass spawn in the spring when the water temperature reaches 55 or 60 F in May in Lake Erie and earlier farther south. The eggs are 0.8 mm in diameter, demersal, and adhesive. Spawning apparently takes place in daylight and fairly close to the surface. Ovarian egg counts of 242,000 to 933,000 have been reported. The eggs hatch in 46 hours at 60 F.

Food and Feeding

White bass are carnivorous sightfeeders. They are especially noted for feeding at the surface in groups as they pursue emerging insects or schools of small fish. During these feeding frenzies, they will strike at almost anything and even the most inept fishermen can catch white bass on almost every cast.

Small white bass feed on zooplankton and insect larvae; as they grow, the diet includes more fish including yellow perch, sunfish, minnows, and gizzard shad. They are opportunistic and even large adults feed heavily on insects.

References

Baglin and Hill, 1977 (fecundity). Riggs, 1955 (reproduction). Van Oosten, 1942 (life history). Forney and Taylor, 1963 (age and growth in Oneida Lake). Sigler, 1949 (life history). Raney, 1965a (summary in New York). Bonn, 1953 (food and growth). Dorsa and Fritsche, 1979 (larvae). Greeley, 1955b (general account). Starnes et al., 1983 (larval transport).

Names

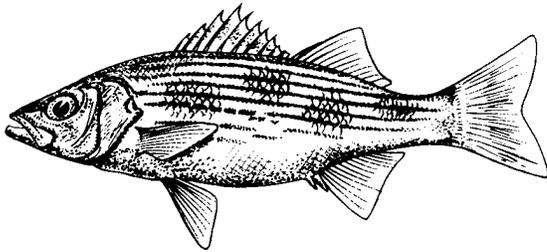
Chrysops is from the Greek *chryos*, gold and *ops*, eye.

Perca chrysops Rafinesque, 1820a: 22 Falls of the Ohio

Labrax notatus Richardson, 1836: 8 Lower St. Lawrence River

Labrax albidus DeKay, 1842: 13 Buffalo, New York

Lepibema chrysops, Greeley, 1928: 100 Oswego watershed



STRIPED BASS

Morone saxatilis (Walbaum, 1792)

Identification

Of the three species of temperate basses in New York State, the striper is the largest and most streamlined. It has seven to nine prominent narrow dark lines along the sides, of which two or three extend to the base of the tail. The white bass is most like the striper and has similar longitudinal dark lines, but in the white bass only one line extends from the gill opening to the base of the tail. The white perch is a smaller fish with a deeper and more arched body and no prominent dark lines.

The three species can be distinguished by the teeth on the base of the tongue: The striper has two clearly separated patches, the white bass has two patches close together so they appear to be a single patch, and the white perch has no teeth on the base of the tongue, but it does have a few teeth around the free edge of the tongue.

Description

Body elongate and somewhat compressed. Profiles about equally curved. Dorsal origin over middle of pectoral fin. First dorsal rounded, its fourth and fifth spines longest. Dorsal fins clearly separated with a scaled area between them. Second dorsal falcate with its margin concave anteriorly. Caudal fin forked, its middle rays contained 1.5 times in the longest upper ray. Anal fin inserted below the fourth dorsal soft ray. Anal spines graduated, anal fin margin concave. Third (the longest) anal spine a little more than half the first anal soft ray. Pelvic fin inserted under dorsal origin, pelvic retrogressive, its margin slightly convex. Pectoral fin shorter than the pelvic, asymmetrically pointed. Pectoral base oblique. Gill membranes separate and free from the isthmus. Mouth terminal, lower jaw protruding. Preopercles serrate. Top of head scaled forward to nostrils. Lateral line complete, straight. Counts and proportional measurements are given in Table 30.

Color: Striped bass are rather monochromatic

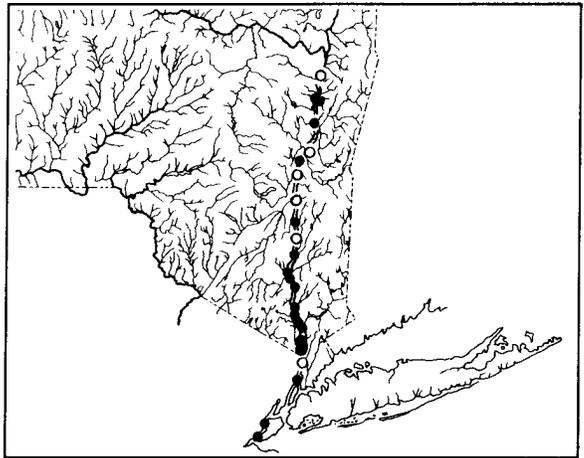
fishes, dusky gray to dark gray above, shading to silvery on the sides and white on the belly. Dorsal fins dusky, with the spines and rays darker than the membranes. Caudal fin dusky. Anal dusky anteriorly, white posteriorly. Pectoral fins dusky, pale along their ventral margins. Pelvic fins white. Iris silvery. Some individuals have one or more of the dark lines broken, continuing on the scale row above or below.

Juveniles and breeding adults: Striped bass less than 4 inches long have 8 to 10 dark vertical bars that dominate the longitudinal stripes. As the fish grow and the stripes become more prominent, the vertical bars disappear.

Size: Striped bass commonly reach weights of 30 pounds and the all-tackle record is a 76-pound fish from Montauk taken in 1981. The alltime record is about 125 pounds from North Carolina in 1891.

Habitat

Striped bass are anadromous, moving into rivers to spawn near the salt front. It is a coastal fish, often caught near rocks and around wrecks. This habit has earned it the local name of rockfish. Young stripers live in estuaries or bays and the adults range along the open coast, often moving into the deeper estuaries for the winter. In Lake Marion (Santee-Cooper Reservoir) in South Carolina, there is a freshwater landlocked population and this strain has been stocked in many inland waters.



Distribution

The striped bass ranges from the Gulf of St. Lawrence to the St. Johns River in Florida. It also occurs in the Gulf of Mexico. It was introduced on the Pacific coast from the Hudson and Shrewsbury Rivers in 1874 and 1882 and now ranges from the Gulf of California north to Vancouver Island.

Life History

Striped bass move into the Hudson River in April and remain until mid-June. Temperatures at the time of migration are 11 to 21 C. Spawning takes place in fresh water near the salt front and where there is sufficient current to keep the eggs suspended. In the Hudson, most of the spawning takes place between West Point and Kingston. The spawning behavior has not been thoroughly de-

scribed but it involves rolling and splashing at the surface in what are commonly termed "rock fights".

The eggs are semibuoyant and have been taken from the Tappan Zee to Kingston with the greatest concentration in mid-May from Haverstraw to Hyde Park. Yolk-sac larvae have been collected from late April to mid-June and post-yolk-sac larvae have been found from mid-May to late July. Juveniles appear in beach seine collections in late June and remain near shore until late fall, moving to deeper waters in November and December. Recently, it has been found that considerable numbers of striped bass juveniles overwinter in the pier area of lower Manhattan. It is believed that the juveniles would normally spend the winter in coastal marsh areas.

Striped bass returning to spawn for the first time are age IV to VII.

Food and Feeding

Merriman examined the stomachs of 250 striped bass from Connecticut between April and October, 1936. Forty-one percent of the stomachs were empty and the most common foods were silversides, menhaden, and shrimp (*Palaemonetes vulgaris*). Less common were gunnels, herrings, mummichogs and striped killifish, squid, sand-worms, and blood worms. Sand lances, crabs, clams, snails, amphipods, and isopods were taken rarely.

Notes

The striped bass is one of the most important sport and commercial fishes of the United States. Along the Atlantic coast, three areas seem to serve as the spawning grounds for most of the striped bass. These are the Hudson River, Chesapeake Bay, and the Roanoke River. In the past few years, the Chesapeake has not produced strong year classes and the Hudson River has been contributing comparatively more to the coastal population. Because of high PCB levels, the Hudson River commercial fishery for striped bass has been closed since 1976.

References

Raney, 1952 (life history). Rathjen and Miller, 1957 (ecology). Merriman, 1937; 1941 (life history and ecology). Fritzsche and Johnson, 1980 (larvae). Morgan and Prince, 1978 (effects of chlorine on young). Trent and Hassler, 1966 (feeding). Neel, 1979 (identification of hybrids). Markle and Grant, 1970 (food of young-of-the-year). Woolcott, 1957 (osteology). Schaefer, 1970 (feeding habits, Long Island). Austin and Hickey, 1978 (predicting abundance). Hickey and Amish, 1975 (growth of jawless individual). Hickey, Young, and Bishop, 1977 (abnormalities). Kellogg and Gift, 1983 (preferred temperatures). Raney, 1957 (subpopulations); 1958 (life history summary). Raney and Woolcott, 1955a and 1955b (races). Raney, Woolcott, and Mehring, 1954 (migration). Setzler et al., 1980 (summary). Jordan, 1885a (nomenclature). Groman, 1982 (histology). Gardinier and Hoff, 1983 (food).

Names

The Latin word *saxatilis* means dwelling among rocks.

Perca saxatilis Walbaum, 1792: 33 New York
Roccus saxatilis, Greeley, 1935: 98 Lower Hudson

Sciaena lineata Bloch, 1785: pl. 304

Labrax lineatus, DeKay, 1842: 7-9 New York

Roccus lineatus, Bean, 1903: 524-527 New York

Perca septentrionalis Bloch and Schneider, 1801: 90 New York

Roccus striatus Mitchill, 1814: 24 New York

Perca mitchilli Mitchill, 1815: 413 New York

Perca mitchilli alternata Mitchill, 1815: 415 New York

Perca mitchilli interrupta Mitchill, 1815: 415 New York

TABLE 30
AVERAGE PROPORTIONAL MEASUREMENTS AND COUNTS OF TEMPERATE
BASSES AND FRESHWATER DRUM (*Morone* and *Aplodinotus*)

All proportions are expressed in percentage of standard length.

	<i>americana</i>	<i>Morone</i> <i>chrysops</i>	<i>saxatilis</i>	<i>Aplodinotus</i> <i>grunniens</i>
ST. LENGTH (mm)	114.1	71.3	123.4	59.2
TOTAL LENGTH	123.5	128.8	123.5	138.0
FORK LENGTH	117.2	120.1	115.9	138.0
PREDORSAL	43.3	41.6	41.0	40.5
PREANAL	71.0	68.3	69.3	66.5
PREPELVIC	40.0	38.0	38.1	36.5
DORSAL BASE	44.1	41.4	41.7	62.2
ANAL BASE	14.4	17.1	15.5	11.9
BODY DEPTH	36.3	29.2	27.9	32.4
BODY WIDTH	17.6	13.1	14.0	15.0
C.PED. DEPTH	12.2	12.4	10.7	8.7
PECTORAL ALT.	22.8	19.4	18.1	21.4
HEAD LENGTH	35.4	35.9	34.8	35.6
SNOUT	10.6	8.4	10.4	7.2
EYE	7.9	9.3	7.6	12.1
MOUTH LENGTH	11.4	13.6	12.4	13.3
INTERORB	8.4	7.9	8.2	6.9
N (sample size)	5	5	5	5
COUNTS:				
DORSAL RAYS	IX,I,11-12	IX,I,14-15	IX,I,11-14	IX-X,I,25-31
ANAL RAYS	III,9-10	III,11-13	III,11	II,7
PECTORAL RAYS	15-16	15-17	16-17	17-18
PELVIC RAYS	I,5	I,5	I,5	I,5
GILL RAKERS	20-23	25	25	26
VERTEBRAE	25	21-25	25	24-25
SCALES:				
ABOVE L. L.	7-8	8	10	10
LATERAL LINE	48-49	52-55	65	48-53
BELOW L. L.	10	13-14	14	13

SUNFISHES

CENTRARCHIDAE

This is an eastern North American family with only one species native to the area west of the Rocky Mountains. The family includes the black basses, the crappies, and the typical sunfishes; altogether 29 species in 8 genera.

Centrarchids are rather generalized, freshwater, spiny-rayed fishes, perhaps more obviously allied by the similarity of their nesting habits than by their structure. Most species are quite colorful with shades of green, brown, orange and brassy. Young sunfishes tend to look very much alike with a series of prominent vertical bars, although young largemouth bass have a dark longitudinal stripe like that of the adult. One of the most consistent characteristics is a dark spot at the upper corner of the gill cover and in a number of species the margin of the operculum extends back as a dark flap which may be entirely black or have a colorful margin. Centrarchids have the pseudobranch poorly developed or

absent and lack a suborbital shelf. Branson and Moore (1962) made a comprehensive study of the lateral line system and Mok (1981) has recently re-evaluated the classification of the family on the basis of kidney morphology.

Sunfishes are extremely important to the warm-water sport fishery of the state. The smaller species are readily caught by less experienced fishermen and the basses are worthy quarry for the expert. They are commonly stocked in ponds and reservoirs where they have a tendency to become overcrowded with poor growth and small size as a result.

Sunfishes often hybridize, especially in modified habitats of artificial water bodies. Most fish hybrids can be recognized by their combination of the characters of both parents but hybrid sunfish are often fertile and backcrosses occur, so there can be a full range of intermediate individuals. For a recent study of hybridization in sunfishes, see Childers (1967).

KEY TO THE SPECIES OF SUNFISHES AND BLACK BASSES

A. Scales large, fewer than 53 in lateral line. Body deep and compressed, its greatest depth contained 2 to 2.7 times in the length.

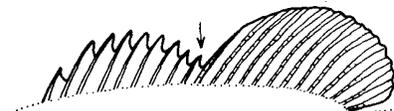
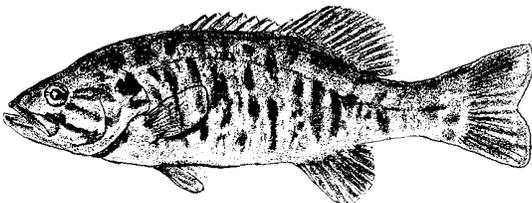
C.

A'. Scales small, more than 55 in lateral line. Body elongate, its depth contained 3 to 5 times in the standard length.

B. Dorsal fin with a shallow notch, its shortest spine more than half as long as the longest. Mouth smaller, the end of the maxillary bone reaching to below the middle of the pupil of the eye. Color brown or brassy, pattern uniform or consisting of one or two series of vertical bars on a lighter background. Young less than 5 or 6 inches long have an orange area at the base of the tail, separated from the clear outer part of the tail fin by a black band.

Micropterus dolomieu

Smallmouth bass, p.306



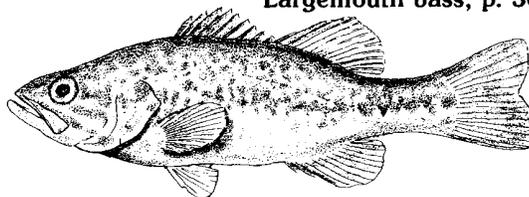
Dorsal fins of smallmouth (top) and largemouth bass.



B'. Dorsal fin with a deep notch, its shortest spine less than half as long as the longest. Mouth large, the end of the maxillary reaching beyond the posterior border of the eye (shorter in small juveniles). Color green rather than bronze, with a prominent longitudinal stripe along the midside. Young without orange and black bands on the tail although the caudal fin sometimes has an orange or reddish wash.

Micropterus salmoides

Largemouth bass, p. 307



C. (A. Scales large, body deep.) Anal spines three.

G.

C'. Anal spines five or more.

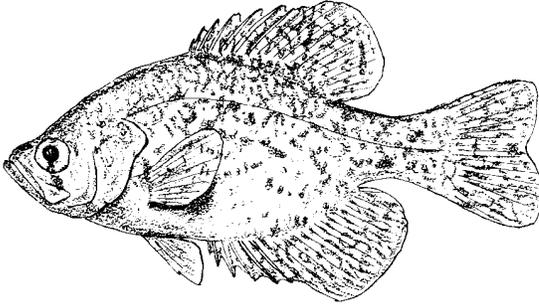
D. Dorsal spines 11 or 12.

F.

D'. Dorsal spines 10 or fewer.

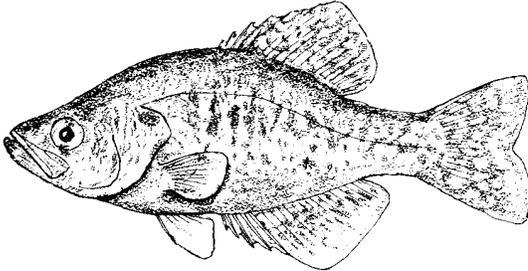
E. Dorsal spines seven or eight. Length of dorsal fin base about equal to distance from the dorsal origin to the back of the eye.

Pomoxis nigromaculatus Black crappie, p. 311



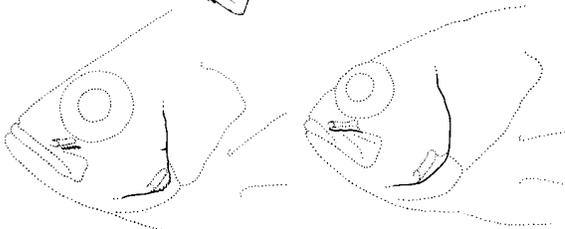
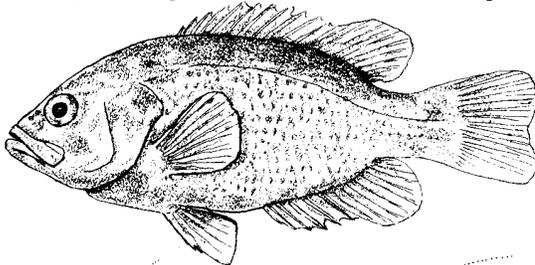
E'. Dorsal spines six or seven. Length of the dorsal base much less than the distance from the dorsal origin to the back of the eye.

Pomoxis annularis White crappie, p. 309



F. (D. Dorsal spines 11 or 12.) Scales ctenoid (rough to the touch). Posterior part of the ventral edge of the preopercle serrate, the vertical and horizontal margins of the preopercle meeting at an angle of about 90 degrees. Rear edge of the preorbital bones serrate.

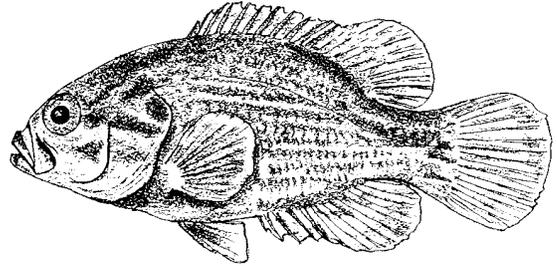
Ambloplites rupestris Rock bass, p. 291



Preopercle and suborbital bones of mud sunfish (left) and rock bass.

F'. Scales cycloid (smooth). Preopercle without dentations, its vertical and horizontal edges meeting in a smooth curve. Edge of the preorbital smooth.

Acantharchus pomotis Mud sunfish, p. 290



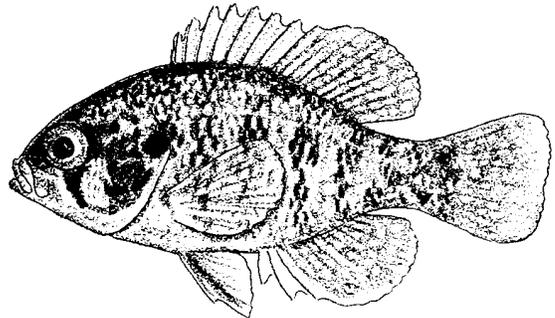
G. (C. Three anal spines.) Caudal fin forked.

I.

G'. Caudal fin rounded.

H. Color pattern consisting of five to eight distinct bands on a pale greenish background throughout life. No blue (pale in preserved specimens) spots on sides. Opercular spot small, its diameter about equal to that of the pupil. Caudal peduncle scales small, usually 19 to 22. Pale spots on dorsal membrane not surrounded by dense melanophores. Four suborbital bones, including the lacrimal and dermosphenotic.

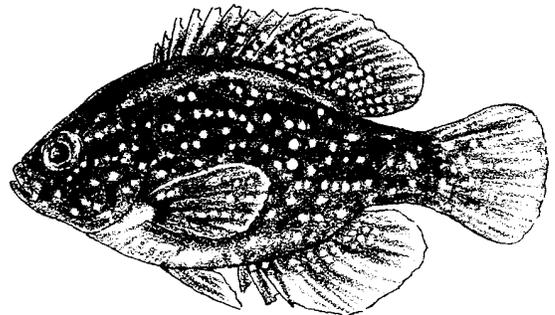
Enneacanthus obesus Banded sunfish, p. 294



H'. Color pattern of juveniles banded, that of larger fish consisting of blue spots on a darker background. Opercular spot larger, its diameter slightly greater than that of the pupil. Caudal peduncle scales fewer, (15) 16 to 18 (19). Pale spots on interradial membranes of dorsal fin surrounded by darker rings of dense melanophores. Five suborbital bones including the lacrimal and dermosphenotic.

Enneacanthus gloriosus

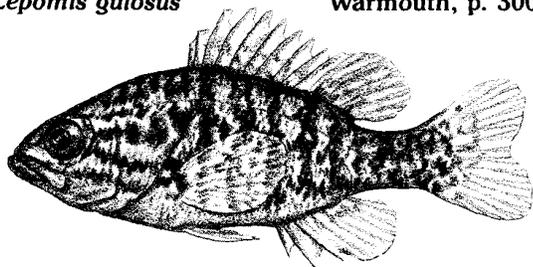
Bluespotted sunfish, p. 293



I. (G. Caudal fin forked.) Mouth large, maxillary bone ending below the posterior margin of the pu-

pil. Tongue with teeth. Supramaxillary bone longer than the widest part of the maxillary bone.

Lepomis gulosus Warmouth, p. 300



I'. Mouth smaller, maxillary ending below or in advance of the front of the eye. No teeth on tongue. Supramaxillary shorter than the maximum width of the maxillary bone or absent.

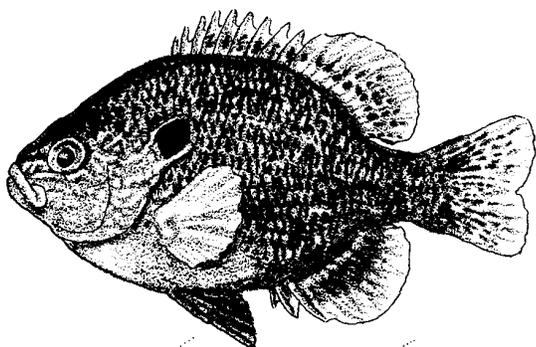
J. Pectoral fin long and pointed, its tip reaching above the lateral line when bent forward so that it is parallel to the edge of the gill cover.

M.

J'. Pectoral fin short and rounded, not reaching past the lateral line when bent upward.

K. Body short and deep, its depth contained about twice in the standard length. Edge of bony opercle, not the membrane, soft, flexible, and fimbriate (ragged). Margin of opercular flap with a red sector near its center.

Lepomis megalotis Longear sunfish, p. 303



Opercular bones of sunfish.

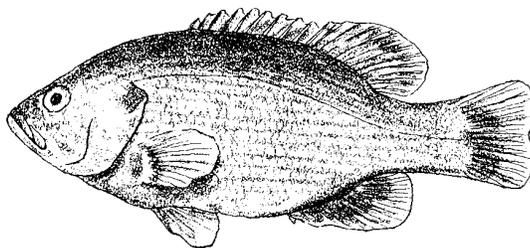
Left: Opercle flexible at its edge.

Right: Opercle stiff to its margin.

K'. Body more elongate, contained 2.3 to 2.75 times in the standard length.

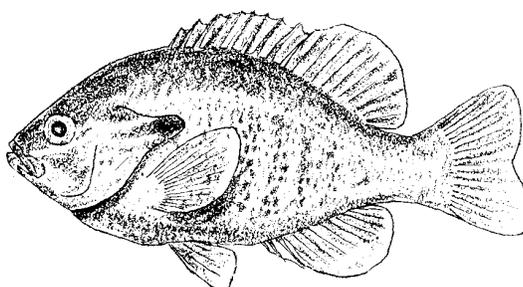
L. Mouth large, the maxillary ending below the front of the pupil. Eye small, about equal to or shorter than snout length. Gill rakers long, their tips reaching to the base of the second raker below. Opercular flap with a light margin, yellow to red in life. Opercular bone stiff to its margin. Adult males with black spots at the bases of the posterior soft rays of both the dorsal and anal fins.

Lepomis cyanellus Green sunfish, p. 298



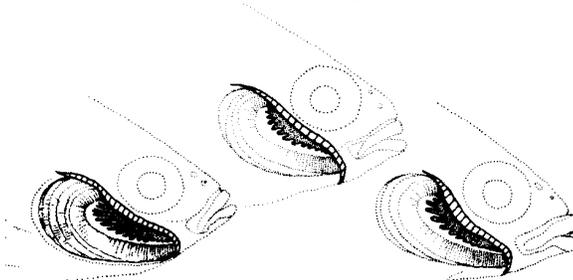
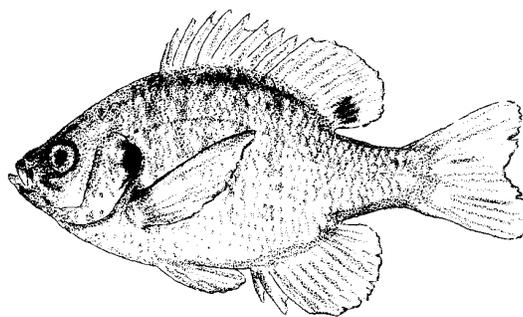
L'. Mouth smaller, the maxillary ending below front of the eye. Eye larger, longer than the snout. Gill rakers short, not reaching the second raker below. Opercular flap black, without a pale margin, very long in adults. Opercle bone flexible and fimbriate at its margin.

Lepomis auritus Redbreast sunfish, p. 297



M. (J. Pectoral fin long and pointed.) Opercular flap black to its margin. A prominent black spot on the soft dorsal fin. Gill rakers long, reaching the base of the second or third raker below.*

Lepomis macrochirus Bluegill, p. 302



Gill rakers of sunfishes.

Left: Long gill rakers of bluegill.

Center: Short gill rakers of green sunfish.

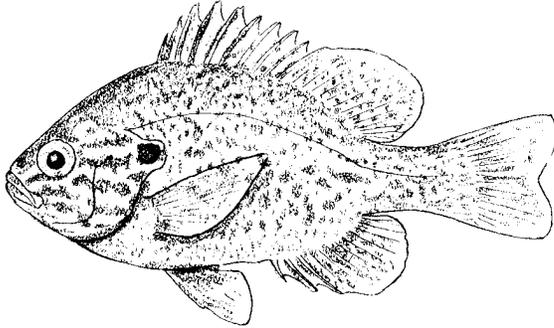
Right: Moderately long gill rakers of pumpkinseed.

* Juveniles of these two species are quite similar. The gill rakers are good distinguishing characters but because the young pumpkinseeds have relatively longer gill rakers than older pumpkinseeds, comparisons must be made between fish of the same size.

M'. Opercular flap with a light margin. In life, there is a red sector at the lower corner of the flap. No prominent spot in the dorsal fin. Gill rakers shorter, not reaching the base of the second one below.

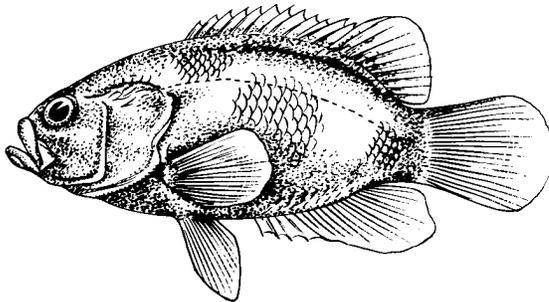
Lepomis gibbosus

Pumpkinseed, p. 299



Acantharchus

This is a distinctive monotypic genus. It has six anal spines, smooth scales, and a smooth preopercle. In appearance it seems to be closest to the rock bass, *Ambloplites*, but it has a rounded, rather than forked, caudal fin.



MUD SUNFISH

Acantharchus pomotis
(Baird, 1855)

Identification

The mud sunfish strongly resembles the rock bass in general color and shape and, like the rock bass, has five or six spines in the anal fin. The two are readily separated by the shape of the tail, round in the mud sunfish and forked in the rock bass. The scales of the rock bass are rough and those of the mud sunfish are smooth, and the mud sunfish has a brown rather than a red eye. The preopercle of the mud sunfish is smooth and gently rounded and that of the rock bass is toothed with a noticeable angle. Young mud sunfish have wavy dark lines along the

sides whereas young rock bass have a checkerboard pattern of squarish blotches.

Crappies are the only other sunfishes in our area with more than three anal spines and they are paler, with diamond-shaped and more compressed bodies.

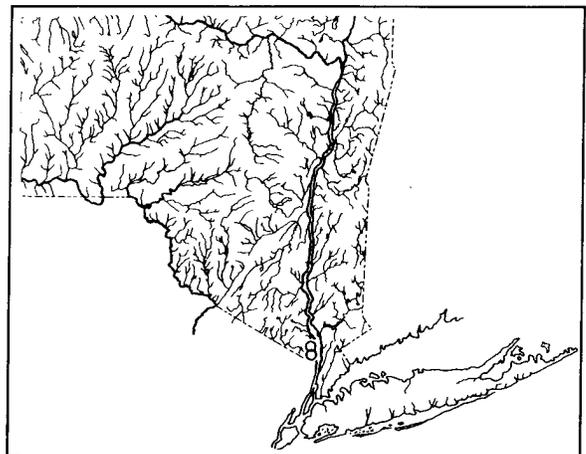
Description

Body rectangular, compressed. Dorsal and anal profiles about equally curved. Dorsal origin over pectoral base. Dorsal spines progressive, shorter than rays. No notch between the spiny and soft parts of dorsal. Soft dorsal rounded. Caudal convex. Anal similar to dorsal. Pelvics retrogressive, pointed anteriorly, inner ray joined to the body by membrane for about half its length. Pectorals short, rounded, slightly asymmetrical. Pectorals high on sides, their bases slightly oblique, nearly vertical. Scales ctenoid but smooth, with the denticules embedded, not cycloid as sometimes stated. Lateral line complete, arched, high on body. Opercle concave above its center, with two blunt points. Preopercle smooth, rounded. Gill membranes separate and free from the isthmus. Counts and proportional measurements are given in Table 31.

Color: Dusky reddish brown above, shading to pale brownish ventrally. Lateral line scales pale. Above this, and following the arch of the lateral line, there is a broad irregular stripe of dark scales about three scale rows wide. Below the lateral line, and not following its curve, are two straight dark bands, each two scale rows wide, and an incomplete third, lower, stripe one scale wide. Dorsal, anal, and caudal fins pale but finely peppered with melanophores and with dark edges. Fin spines and rays outlined. Pectoral fins hyaline, pelvic with dark anterior interradial membranes forming a streak behind the pale leading edge. Head with a dark spot on the operculum that is partly surrounded by a light ring, and two longitudinal streaks, one behind the eye and the other below it, the lower becoming indistinct on the operculum.

Juveniles and breeding adults: Juveniles are somewhat more contrastingly marked. Sexual dimorphism has not been reported.

Size: The maximum is about 170 mm or 6.6 inches total length.



Habitat

The mud sunfish lives in darkly stained waters in sluggish lowland streams and lakes with silt or mud bottoms.

Distribution

This species ranges from the Hackensack River in New York south to extreme northern Florida and along the gulf coast to the St. Marks River. The Survey collected it at three New York locations in the Hackensack River, all west and southwest of Nyack. Impoundments upstream and downstream of this area may have destroyed some of the habitat but there is still a chance that a small population remains in a wooded wetland.

Life History

This species appears to be more secretive in its habits and there are only a few reports of its activities. Breder and Redmond were unable to find nests in northern New Jersey although they handled numerous specimens. Fowler gave a secondhand account of a nest near Willow Grove Lake, New Jersey. The nest was in a patch of spatterdock in a hole in a cranberry bog, where it was partly shaded by trees. It was being guarded by a male on June first and was about a foot in diameter in water about a foot deep. The nest had a sandy bottom but there was mud around the edge.

The species is reported to make a deep grunting sound which may have a function in reproduction. It has been suggested that it is most active at night.

Mansueti and Elser reported on age and growth from a study of 14 specimens from Maryland. The Maryland specimens ranged from 2 to 8 years old and seemed to have grown somewhat faster than the fish from New Jersey studied by Breder and Redmond.

Food and Feeding

Not reported.

Notes

Adults frequently rest head down in aquatic vegetation. Cashner noted that gulf coast specimens have slightly different scale counts and coloration. Fowler described specimens from the Suwanee River as a separate subspecies, *Acantharchus pomotis mizelli*.

References

Abbott, 1884. Breder and Redmond, 1929 (life history). Mansueti and Elser, 1953 (habitat and life history). Breder, 1936b (life history). Cashner in Lee et al., 1980 (summary). Fowler, 1945 (new species).

Names

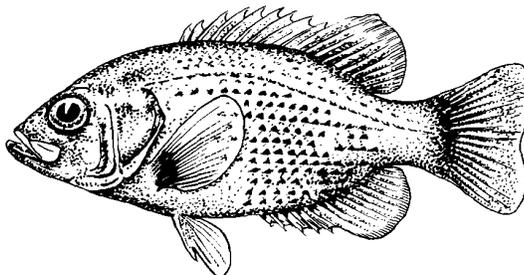
Acantharchus is from the Greek *akantha*, thorn, and *archos*, anus, in reference to the anal spines. *Pomotis* is from the Greek *poma*, a cover and *ot*, ear, in reference to the gill cover.

Centrarchus pomotis Baird, 1855: 325 New Jersey

Acantharchus pomotis, Greeley, 1937: 103 Hackensack River

Ambloplites

This is a small genus with four species. It resembles the mud sunfish, *Acantharchus*, in shape, color, and in having more than three anal spines, but it has ctenoid scales and a serrated preopercle. It also has a slightly forked (emarginate) caudal fin.



ROCK BASS

Ambloplites rupestris (Rafinesque, 1817)

Identification

The rock bass is a robust brownish-colored sunfish with five spines in the anal fin. It resembles the mud sunfish, but the mud sunfish has a rounded tail whereas the tail of the rock bass is definitely forked. Other differences between the rock bass and the mud sunfish are the shape of the preopercle, angled in the rock bass, curved in the mud sunfish, and the scales which are smooth in the mud sunfish and rough in the rock bass. The only other New York sunfishes with more than three spines in the anal fin are crappies and they have thinner, diamond-shaped bodies and short dorsal fins.

Description

Body deep, rectangular, robust but moderately compressed. Dorsal and ventral profiles about equally curved. Dorsal origin slightly behind the pectoral base. Dorsal single, the spiny part progressive, with deeply incised membranes. Last dorsal spine about two-thirds as long as the first soft ray. Soft dorsal rounded. Caudal fin slightly forked, with rounded lobes, its middle rays a little shorter than the longest upper rays. Anal origin below the ninth dorsal spine. Anal shape similar to that of the dorsal. Spiny part of the anal fin rounded, with the fourth spine longest. Anal interspinous membranes deeply notched. Soft part of the anal fin rounded, with the last anal ray connected to body by membrane for more than two-thirds its length. Pelvic fins inserted below the pectoral base, retrogressive, with convex margin. Pelvic spine a little more than half as long as the first pelvic ray, which ends in a short filament. No pelvic axillary process. Last pelvic ray connected to body for about one-half to two-thirds its length. Pectoral fins high with base oblique. Pectoral asymmetrically rounded. Mouth terminal, lower jaw projecting. Supramaxillary wider than the free end of the maxillary bone. Top of head scaled

forward to the interorbital area. Gill membranes separate and free from the isthmus. Lateral line complete, arched to the end of the dorsal base and straight on the caudal peduncle. Counts and proportional measurements are given in Table 31.

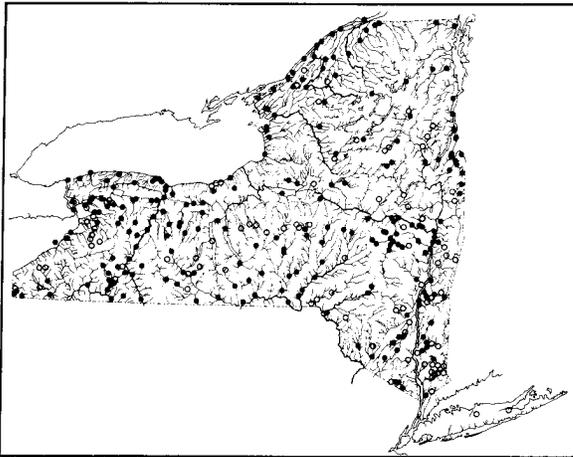
Color: Adults are generally brassy brown. The centers of the scales below the lateral line are darker, forming 11 or more lines of dark spots. Belly scarcely lighter in some specimens but bronze white in others. Vertical fins with spots and reticulations, often with pale oval or round spots. Fins usually darker at their margins. Tips of anal spines white. Pectoral fins clear, with melanophores along rays. Pelvic fins sometimes with a white leading edge. Opercle with a distinct darker spot at upper corner. Head sometimes with a blotch or bar below the eye, iris red in large individuals.

Juveniles and breeding adults: Juveniles have a striking "checkerboard" pattern of squarish blotches.

Size: As in most sunfishes, the size is extremely variable and stream fish often become stunted. In large lakes, the rock bass may reach 10 inches and Trautman reports a 14.7-inch specimen from Ohio that weighed 1 pound 15 ounces. The IGFA all-tackle record is 3 pounds from Ontario, Canada.

Habitat

The rock bass occurs in a variety of lake and stream habitats but it is probably most abundant in rocky-bottom streams of moderate size where there is abundant shelter and considerable current. In lakes, it occurs along gravelly and rocky shores. The young are frequently abundant in aquatic vegetation.



Distribution

The rock bass occurs from New England across southern Canada to the Red River of the North. West of the Appalachian Divide, it ranges south to the Tennessee system and is widespread east of the Mississippi and Missouri Rivers, with some native and many introduced populations farther west. In the south, it is replaced by the shadow bass, *Ambloplites ariommus*. There are two other species in the genus, the Roanoke bass on the Atlantic Coastal Plain and the Ozark rock bass on the Ozark Plateaus.

The rock bass is distributed throughout New York State.

Life History

The life history of the rock bass has been studied intensively in Lake Opinicon, Ontario (Gross and Nowell). Spawning took place between mid-May and mid-June. Adults moved into the shallows when temperatures reached 20 to 23 C. Males arrived 3 or 4 days before the females, established territories, and began to build dish-shaped nests by fanning and pushing gravel with the pectoral, anal, and caudal fins. The nests averaged 7.3 cm in depth and 26.6 cm in diameter, which was approximately 1.9 times the body length of the male. The water depth varied from 45 to 138 cm with gravel 0.9 to 2.4 cm in diameter. If gravel was not available, the nests were built on mud or vegetation. The nests were well separated, with distances to the nearest neighboring nest 103 cm if the neighbor was another rock bass or 78.6 cm if the neighbor was a pumpkinseed. The nests were usually completed in 1 day and the spawning began 1 to 4 days later. Spawning took place during the day with some preference for the morning over midday or evening.

Males did not court females but waited until females entered the nest and came to lie parallel with the male. Sometimes a pair circled with the male on the outside. During spawning, the male became almost black. It is suggested that this may reduce intimidation of the females by reducing contrast of the eye and fin color bands. Spawning consists of the female "dipping" (tilting her body to press her genital region against that of the male) and shaking two or three times. After spawning, the male may make an aggressive display toward the female, flaring his gills and biting her, or chasing her from the nest. The females may then return to the nest in a few minutes to spawn with other males over a 2-hour period. Gross and Nowell estimated that three to five eggs were released at each dip and that 120 dips occurred during a spawning session.

The males guarded the nests and fanned the eggs with their pectoral fins for an average of 14 days. During the time the eggs were in the nest, the male hovered with his head near the center of the nest but after the eggs hatched, he stationed himself with the center of his body at the center of the nest.

Small pumpkinseeds were persistent egg predators and the male rock bass responded to their approach by spreading their gill covers and chasing them a meter or so from the nests. About a third of the nests were vacated before the larval fishes dispersed, presumably because predators had consumed all of the eggs. Two nests contained 398 and 417 larvae.

Many males nested a second or even a third time. Females probably spawned twice, judging from the fact that early in the season the females had two size classes of oocytes in the ovaries; they had only one later.

Gross and Nowell noted that the behavior of the

rock bass differs from that of members of the genus *Lepomis*. Males use the pectoral fins more than the tail to build their nests. The darkening of the male and the irregular circling were not seen in *Lepomis*. Rock bass use the pectoral fins for fanning the eggs rather than the anal and caudal.

After nesting, the adult rock bass leave the nesting area for more suitable habitat since the shallow sites are often exposed and offer little protection.

Food and Feeding

Rock bass are extremely varied in their feeding habits. Some workers have reported that they feed only during the day with a peak of feeding activity in late afternoon but other investigators have found that they feed both day and night. They feed mostly on the bottom but may also take food in the water column or near the surface. Small rock bass feed on copepods and cladocerans, then switch to insects and crustaceans, and finally the adults feed on fish and crayfish. The diet varies with season; in the early summer adults in Oneida Lake fed on worms, crustaceans, and insect larvae but later in the season fish and crayfish dominated the diet. In the winter, amphipods make up a large part of the diet.

Notes

The rock bass has been studied intensively and there are many papers on its physiological ecology. The paper by Hile on age and growth is one of the most important early studies of the use of scales to determine growth patterns. In Pennsylvania, rock bass were not present in streams polluted by acid mine wastes when the pH was below 4.6.

References

Adams and Hankinson, 1928 (ecology). Breder, 1936b (life history). Hile, 1941 (age and growth). Hallam, 1959 (associations). Raney, 1965b (summary). Keast and Webb, 1966 (feeding). Keast and Welsh, 1968 (ecology). Gross and Nowell, 1980 (reproductive behavior). Buynak and Mohr, 1979c (larval development). Wolfert, 1980 (age and growth). Elrod et al., 1981 (food). Storr et al., 1983 (movements in Lake Ontario).

Names

Ambloplites comes from the Greek *amblys*, blunt or stupid, and *hoplon*, armor. *Rupestris* is New Latin for "living among rocks."

Bodianus rupestris Rafinesque, 1817b: 120 lakes of New York, Vermont and Canada

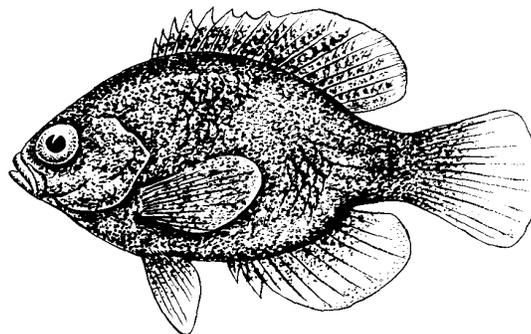
Ambloplites rupestris, Greeley, 1927: 63 Genesee drainage

Cichla aenea Lesueur, 1822a: 214 Lake Ontario

Centrarchus aeneus, DeKay, 1842: 27-28 Lake Champlain

Enneacanthus

This is a genus of three species of small sunfishes with nine dorsal spines, three anal spines, and rounded caudal fins. Two of the three species occur in New York, the third lives farther south on the Atlantic coast.



BLUESPOTTED SUNFISH

Enneacanthus gloriosus (Holbrook, 1855)

Identification

The bluespotted sunfish is a rather small species, seldom exceeding 3 inches total length, with a deep body, three anal spines, and a rounded tail. It closely resembles the banded sunfish and for many years there was some doubt that the two species were distinct. Part of the confusion is due to the fact that young bluespotted sunfish have vertical bands on the body very much like those of the banded sunfish. The adults are quite different, however, and the bands disappear in the bluespotted but not in the banded. The best feature for differentiating the two is probably the number of scale rows around the caudal peduncle. There are 16 to 18 rows in the bluespotted and 19 to 22 in the banded.

Other color differences include the smaller opercular spot in the bluespotted, and that the pale spots in the dorsal fin are surrounded by dark rings in the bluespotted but not in the banded sunfish.

Description

Body short, deep, and strongly compressed. Profiles regularly and about equally curved. Dorsal origin slightly behind the end of the operculum. Spiny part of the dorsal fin rounded, fifth and sixth spines longest. Membranes of the spiny dorsal incised. Soft dorsal rounded. Caudal rounded, its middle rays somewhat longer than the longest upper ray. Anal origin below last dorsal spine. Anal similar in shape to soft dorsal. Pelvic fin inserted below the dorsal origin. No pelvic axillary process. Pelvic spine less than two-thirds the first soft ray. Pelvic margin slightly convex. Last pelvic ray bound to the body for two-thirds its length. Pectoral base steeply oblique. Pectoral fin asymmetrically rounded. Scales ctenoid, body completely scaled. Top of

head scaled forward as far as interorbital region. Gill membranes separate and free from the isthmus. Mouth terminal, maxillary reaching to below front of eye. Preopercle smooth. Lateral line complete, arched parallel to the dorsal profile as far as the end of the dorsal fin base. Counts and proportional measurements are given in Table 31.

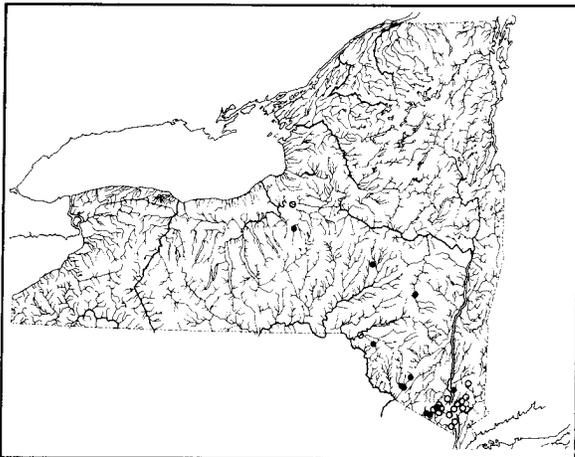
Color: Adults generally greenish above, slightly paler ventrally, breast a dirty white. Adult males with sides of head and body as well as bases of the vertical fins with irregularly spaced, bright turquoise spots, each surrounded by a black ring. Pelvic fins dusky, pectoral fins hyaline, with the rays outlined. Opercular spot smaller than pupil. Iris with a bronze ring around the pupil. A moderately distinct, vertical, subocular bar.

Juveniles and breeding adults: Juveniles and adult females are lighter than adult males and have pale creamy, rather than green or turquoise, spots. The young have about seven black bars on the sides and indistinct pale greenish spots. Adult males lose the bars and develop numerous pale green or blue spots.

Size: Our largest New York specimen is 75.2 mm standard length.

Habitat

The bluespotted sunfish lives in slow-moving streams and standing waters where there is dense aquatic vegetation, especially *Potamogeton* species. It usually occurs where the water is darkly stained and the bottom is muck and decaying vegetation.



Distribution

This species ranges from southern New York, along the Atlantic coast to the southern part of peninsular Florida, and west along the gulf coast to the Florida Panhandle.

In New York, it is common in the Basher Kill in the Delaware drainage and in some lakes in southeastern New York. It has been taken in Jamesville Reservoir where it is believed to have been stocked. There is, however, a series of specimens from Oneida Lake, collected in 1916, in the archives of the College of Environmental Science and Forestry at Syracuse University. It is possible, therefore, that

the Jamesville population is a relict population or that the species was introduced much earlier than is generally believed.

Life History

The life history of the bluespotted sunfish is not well known. Fowler described the nests as having a diameter of 4 or 5 inches in beds of filamentous algae. Breder stated that the nests are sometimes 12 inches in diameter in soft material. Nests have been reported in water about a foot deep. Spawning occurs in spring, May in New Jersey.

Food and Feeding

Breder reported snails, *Daphnia*, *Asellus*, amphipods, and insects in the stomachs of specimens from New Jersey. Most of their feeding is done in close proximity to plants but they learn to take food from the surface in aquaria.

Notes

The bluespotted and banded sunfishes are confused in much of the older literature.

References

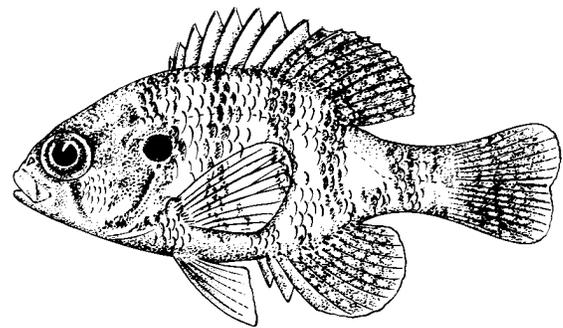
Abbott, 1870 (habitat). Breder and Redmond, 1929 (life history). Breder, 1936b (life history). Casterlin and Reynolds, 1979 (thermoregulation); 1980 (diel activity). Werner, 1972 (occurrence in Lake Ontario drainage). Sweeney, 1972 (systematics).

Names

Enneacanthus is from the Greek *ennea*, nine, and *acantha*, a thorn or prickle. *Gloriosus* is Latin for superb, full of glory.

Bryttus gloriosus Holbrook, 1855: 52 Cooper River, South Carolina

Enneacanthus gloriosus, Greeley, 1936: 87 Delaware drainage



BANDED SUNFISH

Enneacanthus obesus (Girard, 1854)

Identification

The banded sunfish can be confused only with the bluespotted sunfish as these are the only New York species of sunfishes with three anal spines and rounded, rather than forked tails. The two are very similar in appearance, however, and for a long time there was doubt that they were distinct species.

They differ in adult color pattern, in the number of scales around the caudal peduncle (19 to 22 in *obesus*, 16 to 18 in *gloriosus*), and number of circum-orbital bones (5 in *gloriosus*, 4 in *obesus*). The latter feature is difficult to use as the bones are thin and deeply embedded in the skin. Color and scale count are sufficient to distinguish the two. (See account of the bluespotted sunfish for color differences).

Description

Body short and deep, compressed. Profiles symmetrical or the dorsal slightly more curved. Dorsal origin over edge of the opercle. Spiny dorsal arched, with spines V to VII longest. Interspinous membranes incised. Soft dorsal rounded. Tail rounded, longest upper ray slightly longer than middle rays. Anal origin below last dorsal spine. Anal shape similar to soft dorsal, rays 3 and 4 longest. Pelvic insertion slightly behind dorsal origin. Pelvic margin straight, last ray joined to body by membrane for two-thirds its length.

Pectoral base steep. Pectoral fin asymmetrically rounded. Gill membranes separate and free from the isthmus. Mouth terminal, maxillary reaching to below front of eye. Preopercle smooth. Lateral line arched, ending at front of caudal peduncle. Counts and proportional measurements are given in Table 31.

Color: Body generally light greenish beige with six or seven vertical lines formed by broad dark scale margins. The first of these runs from the dorsal origin to the tip of the operculum, and the top of the head ahead of this line is generally dark. Sides of head with a horizontal pale streak from the middle of the eye to the edge of the operculum. A second pale streak above this curves to connect with the pale lateral line. A dark teardrop is present. Lower jaw dusky. Spiny dorsal dusky, with the spines outlined. Soft dorsal, caudal, and anal dark, with rows of pale spots on the membranes. Pectorals hyaline. Pelvic leading edge white, the rest of the fin dark anteriorly, shading to clear posteriorly. Iris with bronze tones. Opercular spot larger than pupil, partly ringed with white.

Juveniles and breeding adults: The adult males are similar to the juveniles, not developing the high

coloration of the large males of the bluespotted sunfish.

Size: This is the smallest of our species of sunfishes. Its maximum size is slightly more than 2 inches. Our largest New York specimen is about 38 mm standard length.

Habitat

This coastal plain species occurs in slow-moving and often darkly stained water where there is abundant submerged vegetation.

Distribution

Banded sunfishes are found from the northern part of peninsular Florida along the gulf coast to Alabama and north in the Atlantic drainages to New Hampshire.

In New York, the only unquestioned records are from the Peconic drainage on Long Island and in Spruce and Cranberry Lakes in the Passaic River drainage.

Life History

The life history of the banded sunfish is not well known. It is presumed to build nests in vegetation, rather than in sand or gravel.

Food and Feeding

The food habits have not been studied but it probably feeds on insects and other small invertebrates.

Notes

Because of its restricted distribution in New York, the banded sunfish is now protected. Owing to the difficulty of distinguishing it from the bluespotted sunfish, much of the older literature is unreliable.

References

Harrington, 1956 (photoperiod). Lee and Gilbert in Lee et al., 1980 (distribution).

Names

Obesus is Latin for stout, fat.

Pomotis obesus Girard, 1854b: 40 vicinity of Hingham and Charles River near Holliston, Massachusetts

Enneacanthus obesus, Greeley, 1937: 103 Spruce and Cranberry Lakes, Passaic River drainage

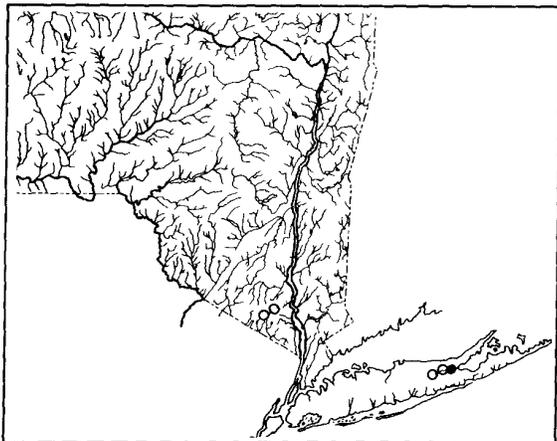


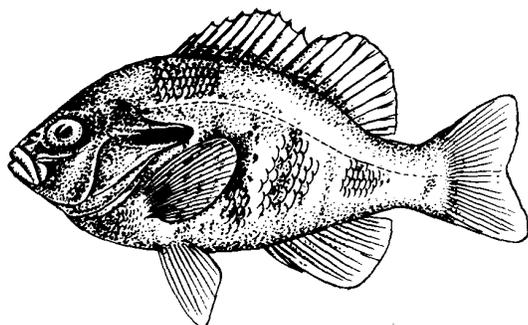
TABLE 31
AVERAGE PROPORTIONAL MEASUREMENTS AND COUNTS OF
SUNFISHES (*Acantharchus*, *Ambloplites*, and *Enneacanthus*)

All proportions are expressed in percentage of standard length.

	<i>Acantharchus</i>	<i>Ambloplites</i>	<i>Enneacanthus</i>	
	<i>pomotis</i>	<i>rupestris</i>	<i>gloriosus</i>	<i>obesus</i>
ST. LENGTH (mm)	69.2	64.3	43.3	29.2
TOTAL LENGTH	131.0	124.6	129.2	131.5
FORK LENGTH	131.0	122.4	129.2	131.5
PREDORSAL	45.4	45.2	43.0	45.1
PREANAL	61.8	60.4	61.7	62.2
PREPELVIC	40.6	41.0	45.1	45.0
DORSAL BASE	47.0	46.5	48.8	48.4
ANAL BASE	26.8	28.9	29.3	27.2
BODY DEPTH	38.0	42.3	49.4	46.4
BODY WIDTH	18.0	19.4	19.9	19.3
C.PED. DEPTH	16.0	15.5	16.6	15.0
PECTORAL ALT.	26.9	29.5	33.0	32.9
HEAD LENGTH	41.7	39.6	37.8	40.6
SNOUT	7.5	10.7	9.0	7.7
EYE	11.9	11.8	12.7	14.5
MOUTH LENGTH	18.4	16.4	14.2	14.5
INTERORB	7.3	10.3	10.7	8.3
N (sample size)	2	5	5	5
COUNTS:				
DORSAL SPINES	XI	XI-XII	VIII-IX	VII-IX
DORSAL RAYS	10-11	10-11	10-11	11-12
ANAL RAYS	V,10	VI,10-11	III,9-11	III,10-11
PECTORAL RAYS	14-15	14-15	11-12	11-13
PELVIC RAYS	I,5	I,5	I,5	I,5
GILL RAKERS	15-16	12	11-15	13-14
VERTEBRAE	30-31	31	27-28	27-28
SCALES:				
ABOVE L.L.	5-6	6	5	5
LATERAL LINE	38-39	38	30-33	30-33
BELOW L.L.	12-13	11	9-10	9-10

Lepomis

The genus *Lepomis* contains about 11 species. Its members have three anal spines and a forked tail. They range in shape from the bass-like green and warmouth sunfishes to the deep-bodied species like the pumpkinseed and bluegill. The warmouth was long placed in its own genus, *Chaenobryttus*, because it has teeth on the tongue and a well-developed supramaxillary bone, but because it frequently hybridizes with species of *Lepomis* it is no longer recognized as distinct.



REDBREAST SUNFISH

Lepomis auritus (Linnaeus, 1758)

Identification

The redbreast sunfish is a rather elongate sunfish with a short, rounded pectoral fin, short gill rakers, and an opercular flap that is dark to its margin. It resembles the green sunfish, *Lepomis cyanellus*, most closely but the green sunfish has a larger mouth and a pale margin on the opercular flap. The warmouth differs in color pattern, in having teeth on the tongue, and in having a large supramaxillary bone. The longear and the pumpkinseed both have some red and white on the opercular flap and the bluegill has a long pointed pectoral fin.

Description

Body deep and compressed but rather elongate for a *Lepomis*. Dorsal and ventral profiles about equally curved. Dorsal fin single, without a notch between the spiny and soft parts, its origin over, or slightly behind, the pectoral base. Spiny part arched, with incised membranes, soft part round with rounded corner. Caudal fin slightly forked, with round lobes. Anal similar in shape to soft dorsal, its origin below the last dorsal spine. Pelvic inserted below the dorsal origin, retrogressive, with acuminate first ray, sharp anterior, round posterior corners, and straight margin. No pelvic axillary process, last ray bound for one-half its length. Pectoral base oblique, pectoral fin asymmetrically rounded. Scales ctenoid, body completely scaled, top of head scaled to back of orbits. Operculum with long flap in adult males, margin of the bone fimbriate and flexible at its margin. Mouth terminal,

maxillary reaching to below anterior edge of the eye. Gill membranes separate and free from the isthmus. Lateral line complete and arched. Villiform teeth present on the premaxillary, vomer, palatines, and dentary. Counts and proportional measurements are given in Table 32.

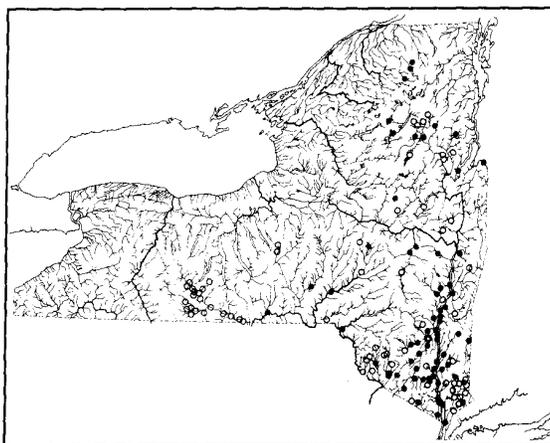
Color: The redbreast sunfish is a rather somber species, dark olive above, shading to paler ventrally. The scales of the sides have dark centers and paler edges. The vertical fins are dusted with melanophores, especially along the rays, and sometimes tinged with red. The pelvic fins are dusky, and pectoral fins are clear, with outlined rays. In females, the breast is yellowish and in males it is reddish, becoming brighter during the breeding season, with the red color spreading to the lower sides and underparts of the head. The iris is often reddish or bronze, and the lips of breeding males are pale blue. Some individuals have a blue line from the middle of the upper lip to below the center of the eye, occasionally continuing across the upper part of the cheek as a line of blue spots.

Juveniles and breeding adults: The juveniles are quite plain, with only a trace of vertical bars in contrast to other species of *Lepomis* which have pronounced vertical bands in the young stages.

Size: This is a small- to moderate-sized sunfish, usually 5 to 8 inches long. The maximum total length is about 9.5 inches.

Habitat

The redbreast is a fish of standing waters and the slower parts of streams. It is sometimes found in slightly brackish water. George has noted that it frequents sandy or rocky areas where it is commonly associated with rock bass and smallmouth. Scott and Crossman also mentioned that it seeks shelter under rocks.



Distribution

The redbreast is essentially an Atlantic coast species. Its original range was from the Chattahoochee drainage in western Florida, east through the panhandle and peninsular Florida, north on the Atlantic Coastal Plain and Piedmont to eastern New York, and through New England to southern New Brunswick. It has been introduced in the Mobile

drainage and in other areas, including a large section of east Texas.

In New York, it is confined to the eastern part of the state in the Susquehanna, Delaware and Mohawk systems, parts of the Raquette drainage and elsewhere in the Adirondacks. George believes its presence in Lake George is long standing, probably dating from postglacial times when Lake George was connected to glacial Lake Albany.

Life History

The life history of the redbreast sunfish has not been thoroughly documented. Fragmentary reports indicate that its breeding habits are similar to those of other sunfishes. Nests are excavated in water 6 to 18 inches deep and guarded by males. The spawning season in New York ranges from early June to mid-August.

Food and Feeding

The redbreast feeds on plankton and a variety of aquatic insects and invertebrates.

References

Breder and Nigrelli, 1935 (social behavior). Roosa and Slack, 1975 (occurrence). George, 1981a (Adirondack distribution). Richmond, 1940 (spawning in tidal waters).

Names

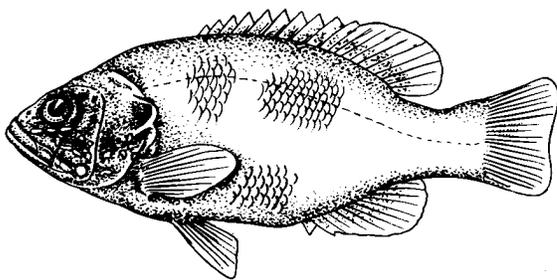
Auritus is Latin for eared, in reference to the well-developed opercular flap.

Labrus auritus Linnaeus, 1758: 283 Philadelphia

Lepomis auritus, Greeley, 1930: 86 Lake Champlain drainage

Labrus appendix, Mitchill, 1818a: 247 New York

Pomotis appendix, DeKay, 1842: 32-33 New York



GREEN SUNFISH

Lepomis cyanellus
Rafinesque, 1819

Identification

The green sunfish is rather elongate for a *Lepomis*, with a large mouth and small scales. It resembles the warmouth in shape, but not in color, and sometimes has a few teeth on the tongue but not a definite patch of teeth like that of the warmouth. It has a short, rounded pectoral fin and a pale margin around the opercular flap. In life, the pale centers of the scales form an elusive pattern of longitudinal lines.

Description

Body compressed, rectangular, its dorsal profile slightly more curved than the ventral. Dorsal fin single, with slight notch. Dorsal origin over pectoral base. Spiny part of dorsal fin arched, with incised membranes. Soft part rounded. Caudal slightly forked, with rounded lobes. Anal origin below penultimate dorsal spine. Anal fin rounded. Pelvic inserted below third dorsal spine. Pelvic fin retrogressive, with acuminate first ray and rounded posterior corner. No pelvic axillary process. Last ray bound to body for one-half to two-thirds its length. Pectoral fin asymmetrically rounded, with oblique base. Scales ctenoid, body completely scaled. Top of head scaled to eyes, cheeks and opercles scaled. Operculum rounded, opercle stiff to its margin, not fimbriate. Preopercle and suborbital smooth. Mouth terminal, oblique, and large, reaching to below middle of eye. Gill membranes separate and free from the isthmus. Lateral line complete, arched. Counts and proportional measurements are given in Table 32.

Color: As its name implies, the green sunfish is predominantly green or olive, shading to dirty white on the belly. Its fins are generally dusky, with yellow margins on the vertical fins. The pelvics are predominantly yellow or dusky in breeding males. Pectoral clear.

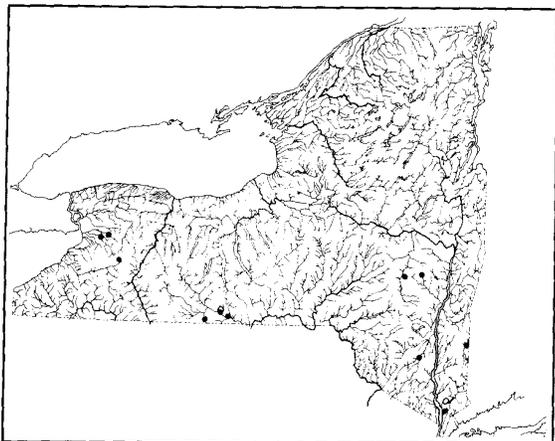
The centers of the scales on the sides are pale or emerald green, forming pale lines. Sometimes there is a suggestion of 7 to 12 vague vertical bars on the body. There are greenish lines on the cheeks, one extending from the maxillary to the angle of the preopercle, others above and more or less parallel to this. A particularly prominent line extends from the middle of the maxillary toward the lower edge of the opercular spot but sometimes ends just behind the eye. The opercular spot is prominent, with a white to orange margin above, behind, and below, but not anteriorly. The last rays of the dorsal and anal fins have intense pigment that sometimes forms definite spots at the bases of these fins.

Juveniles and breeding adults: Juveniles have brighter longitudinal lines, but they do not have prominent vertical bands like the young of some other species of *Lepomis*.

Size: The size of adult green sunfish is extremely variable. Trautman records individuals up to 10.8 inches total length. Our largest New York specimens are 101 mm standard length, about 4 inches. The IGFA line class categories are open, that is, no fish have been submitted for record status.

Habitat

The green sunfish occupies a wide range of habitats from small streams and ditches to larger rivers, lakes, and ponds where there is adequate aquatic vegetation to provide shelter. Trautman notes that it does best in the absence of other species of sunfishes and it is more tolerant of silt than most other species of sunfishes, hence it often becomes abundant in perpetually turbid waters. In New York, we have found it in moderate-sized, turbid streams.



Distribution

The original range of the green sunfish was the Mississippi Valley and the Great Lakes, from western New York to Wisconsin and southeastern South Dakota, south to New Mexico and northern Mexico. It has been widely introduced across the southern United States and on the west coast from northern Mexico to Oregon.

In New York, it apparently was originally only in the Great Lakes drainage but has been introduced in the Susquehanna and in the Lower Hudson drainage in the Wallkill, New Croton Reservoir, and Iron Mine Pond and the Webatuck River in the Housatonic drainage.

Life History

In Wisconsin, Hunter found that this species spawned from mid-May to early August when the water temperature was 68 to 82 F. Males built nests in water usually less than 1 foot deep, and often in areas sheltered by rocks or logs. Nesting was colonial: One male would start to build a nest and others would build nearby. Spawning took place over a day or two and then the male guarded the nest until the eggs hatched 3 to 5 days later. He then herded the young for an additional period. A day or two after the young dispersed, the cycle began again.

Food and Feeding

The green sunfish feeds on a variety of organisms including insects, mollusks, and small fishes.

Notes

Green sunfish are able to reproduce when they are only 3 inches long and they often become stunted in ponds. They hybridize readily with other sunfish species including longear, bluegill, orangespotted, pumpkinseed, and redbreast sunfish.

References

Greenberg, 1947 (behavior). Hunter and Hasler, 1965. Heimstra, Damkot, and Benson, 1969 (effects of turbidity). Hunter and Wisby, 1961. Hunter, 1963 (reproductive behavior). Sadzikowski and Wallace, 1976 (food). Kaya and Hasler, 1972 (photoperiod). Trautman, 1981 (Ohio).

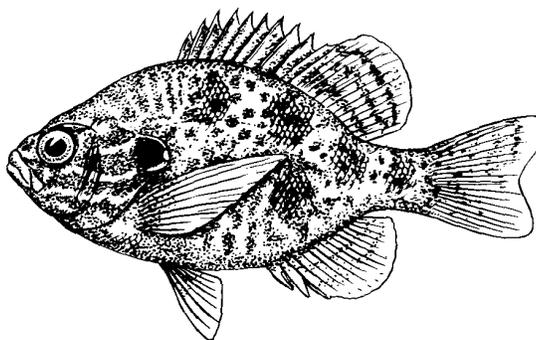
Names

Cyanellus is from the Greek *kyaneos*, blue.

Lepomis cyanellus Rafinesque, 1819: 420 Ohio River

Lepomis cyanellus, Meek, 1889: 313 Montezuma marshes

Apomotis cyanellus, Greeley, 1928: 101 Oneida Lake



PUMPKINSEED

Lepomis gibbosus (Linnaeus, 1758)

Identification

The pumpkinseed is the most abundant and widespread species of sunfish in New York State. It is a short, deep-bodied species with a long, pointed pectoral fin and its opercular flap has a pale margin with a red sector. The opercle bone is stiff to its margin and not fimbriate. It is often taken with the bluegill but the bluegill is thinner, has no pale margin on its opercular flap, and has a distinct spot in the soft dorsal fin. The longear sunfish has a red area in the white margin of the opercular flap but it has a short rounded pectoral fin and a flexible fimbriate opercle.

Description

Body deep and compressed but somewhat streamlined. Dorsal profile slightly more arched than the ventral. Dorsal fin single, slightly notched, originating just behind the pectoral base. Spiny part of dorsal fin arched with incised membranes. Soft part rounded. Caudal fin slightly forked, its lobes blunt. Anal origin below last dorsal spine. Anal fin rounded. Pelvic insertion below second dorsal spine. Pelvic fin retrogressive, its anterior corner blunt, its posterior corner round. No axillary process. Last ray bound for two-thirds its length. Pectoral fin pointed, retrogressive. Pectoral base oblique. Scales ctenoid, body completely scaled. Top of head scaled to eyes, cheeks and opercula scaled. Opercle stiff to its margin, entire. Mouth small, terminal, maxillary ending below front of eye. Gill membranes separate and free from isthmus. Lateral line complete, arched to caudal peduncle. Gill rakers short and stubby. Counts and proportional measurements are given in Table 32.

Color: Head and body dark green, lighter ventrally. Sides with patches of dark scales, some of which are reddish brown. Breast clear white to yellow. Dorsal fin dusky mottled, sometimes with orange on the interradiation membranes of the soft part.

Caudal similar. Anal rays pale, anal interradiated membranes dusky. Pelvics slightly dusky, pectoral clear. Sides of head with irregular narrow blue lines radiating from the eye. Opercular spot dark, opercular flap with a pale margin interrupted by a red sector. Iris with bronze tones. Lower jaw blue.

Juveniles and breeding adults: Juveniles have definite vertical bars with some spots in the pale interspaces. Breeding males are brighter than females.

Size: The pumpkinseed is a rather small species not exceeding 8 or 10 inches total length. The IGFA does not list it.

Habitat

The pumpkinseed occurs in a wide variety of habitats, from streams and small ponds to the slower parts of large rivers.



Distribution

The pumpkinseed is a northeastern species ranging from New Brunswick south along the Atlantic coast to northeastern Georgia. It ranges west through southern Ontario to Lake Winnipeg, but it is absent from the Lake Superior basin. It reaches its southern limit in northeastern Missouri, Illinois, southern Indiana and Ohio. Like most sunfishes, it has been widely introduced outside its original range. In New York State, it is essentially universal and was native to the higher parts of the Adirondacks, although apparently absent from some lakes where it now occurs.

Life History

The pumpkinseed builds its nests near shore where the water is 6 to 12 inches deep. Often, the nests are located close to aquatic vegetation and sometimes they are so close together that the nesting is described as colonial. Males begin nesting when the water temperature reaches the high 60s F and spawning may continue until August. Courtship takes place in the daytime. The female rolls against the male so that her body is at a 45-degree angle while the male remains upright. Spawning occurs repeatedly and more than one female may contribute eggs to a nest. Females lay 600 to 5,000 eggs depending on their size and presumably other factors. Hatching takes place in about 3 days and the

male guards the young for another week or more. After the young disperse, the males may build another nest and repeat the process.

Food and Feeding

The pumpkinseed is an opportunistic feeder that consumes a wide variety of prey including many kinds of insects, amphipods, mollusks, larval salamanders, and small fish.

Notes

Shoemaker reported that in a small pond, near Rensselaerville, chain pickerel fed on golden shiners that concentrated around the nests in order to feed on the sunfish eggs.

References

Creaser, 1926b (age and growth). Ingram and Odum, 1941 (nesting). Breder, 1940 (life history). Shoemaker, 1952 (homing). Greeley, 1954b (general account). Stacy and Chiszar, 1978 (behavior). Burns, 1976 (reproductive cycle). Colgan and Gross, 1977 (aggression). Shoemaker, 1952 (behavior). Sadzikowski and Wallace, 1976 (food). Domermuth and Reed, 1980 (food). Laughlin and Werner, 1980 (resource partitioning). Brown and Colgan, 1981 (juveniles). Colgan and Ealey, 1973 (nest selection).

Names

Gibbosus is Latin for hunched or humped, or shaped like the nearly full moon.

Perca gibbosa Linnaeus, 1758: 292-293 Carolinas (after Catesby)

Sparus aureus Walbaum, 1792: 290 lakes of New York

Eupomotis aureus, Mather, 1886: 7 Adirondacks

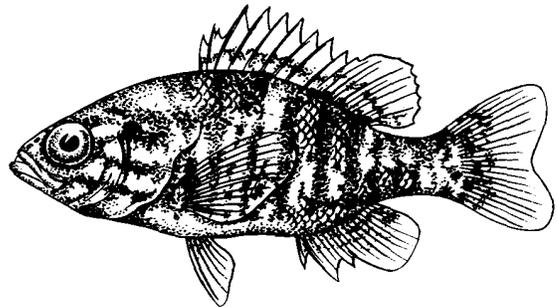
Morone maculata Mitchill, 1814: 18 New York City

Labrus anutus Mitchill, 1817: 289 Wallkill River

Pomotis vulgaris Cuvier in Cuvier and Valenciennes, 1829: 91

Eupomotis gibbosus, Greeley, 1927: 63 Genesee River

Lepomis gibbosus, Hubbs and Lagler, 1964: 114 (distribution)



WARMOUTH

Lepomis gulosus (Cuvier, 1829)

Identification

The warmouth is somewhat similar in shape to the

rock bass but it differs in having three, not five or six, anal spines. It is a rather somber fish that lacks the bright colors of some other species of *Lepomis*, and frequently has a purplish cast in life. It has a large supramaxillary bone, longer than the greatest width of the maxillary bone, and well-developed patches of teeth on its tongue. It also has short, rounded pectoral fins.

Description

Body deep but rectangular, robust. Dorsal origin slightly behind the pectoral base. Dorsal single with shallow notch. Spiny dorsal arched, with incised membranes. Soft dorsal rounded. Caudal fin slightly forked. Anal origin below next to last or last spine. Anal rounded. Pelvic insertion below dorsal origin. No pelvic axillary process. Pelvic fin retrogressive, with pointed anterior and rounded posterior corners. Last pelvic ray bound to body for two-thirds to three-fourths its length. Pectoral base oblique. Pectoral fin asymmetrically rounded. Scales ctenoid, body completely scaled, top of head to eye, cheeks and opercula scaled. Mouth terminal, slightly oblique, large, with maxillary ending below middle or rear of eye. Supramaxillary bone well developed. Opercle, preopercle, and pre-orbital bones smooth. Gill membranes separate and free from the isthmus. Lateral line complete, arched to caudal peduncle. Gill rakers moderately long in small individuals. Counts and proportional measurements are given in Table 32.

Color: Generally brownish, with a purplish cast above, shading to yellowish brown on the sides and greenish yellow to dirty white below. Sides with 5 to 11 irregular, narrow, dark bars. Spiny dorsal dusky, rest of vertical fins vermiculated or dusky with pale yellow spots. Pelvic dusky, pectoral clear. Sides of head with narrow dark lines radiating from eye, and a dark streak along the edge of the maxillary and continuing to the margin of the opercle. Opercular spot black, with a pale margin. A white band along the upper margin of the operculum.

Juveniles and breeding adults: Juveniles are more contrastingly marked than the adults, with more pronounced vertical bars. Small young have transparent fins. Breeding males are said to have a bright orange spot on the base of the last three dorsal rays.

Size: The usual size of the warmouth adults is about 4 to 7 inches total length. The IGFA all-tackle record is a 2-pound 2-ounce fish from South Carolina.

Habitat

Larimore noted that, in Illinois, dense weeds and soft bottom are the two habitat characteristics with which it is most often associated. Trautman reported that, in Ohio, it is most abundant in densely vegetated, slow-moving waters with clear water and muck bottom but less common in silty areas. Our few specimens from Woodbury Creek came from deep pools without much vegetation.

Distribution

Originally, the warmouth ranged from southern

Wisconsin, southern Michigan and Ohio south through the Mississippi basin to the Rio Grande drainage in Texas and New Mexico. It also occurred along the gulf coast to peninsular Florida and north on the Atlantic seaboard to Maryland and Virginia.

In New York, it is an introduced species with surviving, but apparently not spreading, populations in Woodbury Creek in Orange County and the Saw Kill in Dutchess County.



Life History

The life history of the warmouth in Illinois was thoroughly studied by Larimore. Maturity is reached at lengths between 3 and 4 inches when the fish are 1 or 2 years old. Spawning begins in early May and sometimes lasts until early August, with the peak in early June. Larger warmouth spawned over a longer period and some fish spawned several times during the season.

Males build nests in water 6 to 60 inches deep and often the nests are close together although Larimore ascribed this to a shortage of nesting sites rather than to any tendency to gregariousness. The male sweeps away the loose debris, forming a rather shapeless depression about 4 by 8 inches. One male kept working on his nest until it was symmetrical, 18 inches in diameter and 5 inches deep but this seemed to be exceptional.

When the female is ready to spawn, she allows herself to be guided into the nest by the male. Unripe females are chased and, in the confines of an aquarium, may be killed. Courting males turn bright yellow and their eyes become bright red. The male pursues the females with his opercles spread and his mouth wide open. Several females may contribute eggs to a single nest but once the eggs are being guarded, courtship ceases so that any one nest will contain eggs of approximately the same stage of development. Only a few eggs are laid during each spawning episode. At 25 to 26 C, the average time to hatching was 34 hours 30 minutes. Warmouth live 6 to 8 years.

Food and Feeding

Crayfish and insects make up the bulk of the diet, with cladocerans, ostracods, annelids, copepods, fishes, some snails, and other invertebrates being

taken less frequently. Larimore found considerable local and seasonal variation in diet.

Notes

The warmouth was formerly placed in its own genus, *Chaenobryttus*, but because it shares many features with other members of the genus *Lepomis*, and hybridizes freely with some of them, it is now placed in the latter genus. For a time, it seemed that the correct name for the species should be *coronarius*, which was the earliest name, but the author of *coronarius*, Bartram, did not consistently use binomial nomenclature and his names must be disregarded.

References

Larimore, 1957 (ecology, life history).

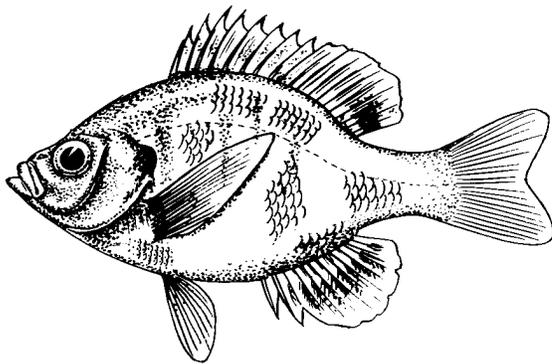
Names

Gulosus is the Latin word for gluttonous, from *gula*, the throat.

Pomotis gulosus Cuvier in Cuvier and Valenciennes, 1929: 498 Lake Pontchartrain, Louisiana

Chaenobryttus gulosus, Greeley, 1937: 103 Saw Kill near Annandale

Lepomis gulosus, Bailey et al., 1970: 75 (nomenclature)



BLUEGILL

Lepomis macrochirus Rafinesque, 1818

Identification

The bluegill is a deep-bodied, highly compressed fish with a long, pointed pectoral fin and a distinct spot on the soft dorsal fin. The opercular flap is well developed but never has a pale margin; the opercle bone is flexible to its margin and fimbriate.

Juvenile bluegills and juvenile pumpkinseeds are both barred and similar in appearance but they differ in gill raker size. The comparison, however, must be made between fish of the same size because the gill rakers become shorter as the fish grow. Thus, a small pumpkinseed can have longer gill rakers than a somewhat larger bluegill, although at the same size, the gill rakers of the bluegill will be longer.

Description

Body deep and strongly compressed. Profiles about equally curved. Dorsal single with slight notch, orig-

inating over pectoral base. Spiny part arched, with incised membranes. Soft part of dorsal fin rounded. Caudal slightly forked, with rounded lobes. Anal origin below last dorsal spine. Anal fin rounded. Pelvic insertion below fourth dorsal spine. Pelvic retrogressive, with pointed anterior and rounded posterior corners. No pelvic axillary process. Last ray bound by membrane for two-thirds its length. Pectoral long and asymmetrically pointed. Its posterior corner rounded. Pectoral base oblique. Scales ctenoid, body completely scaled. Top of head scaled to eye, cheeks and opercles scaled. Opercle with fimbriate, flexible margin. Preopercle with small dentations at its angle. Mouth small, slightly oblique, maxillary ending below front of eye. Gill membranes separate and free from isthmus. Lateral line complete, arched to caudal peduncle. Counts and proportional measurements are given in Table 32.

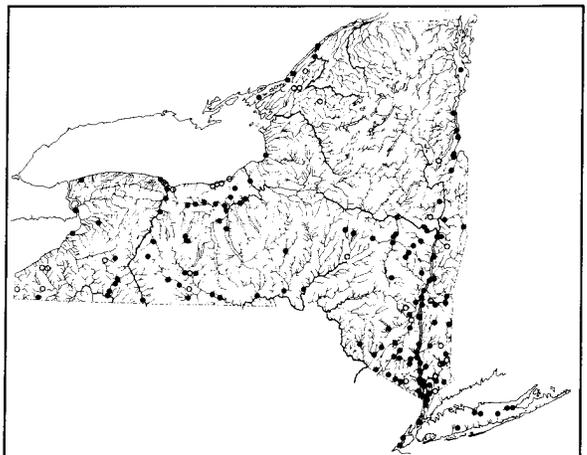
Color: Rather greenish olive above and pale below, usually with traces of six to eight double, vertical dark bars. Vertical fins dusky, with the rays paler than the membranes. Soft dorsal with a definite spot on the lower half of the last four rays. Pelvic fin clear to slightly dusky, pectoral fins clear. Breast yellowish white except in breeding males when it takes on a red color. Opercular spot blue black, without a pale margin. Lower jaw pale blue, this color continuing backward to the gill membranes. No radiating turquoise lines on sides of head.

Juveniles and breeding adults: Juveniles have regular vertical bands with few or no spots in the interspaces. These bands tend to become double in larger fish. The dorsal spot is visible in fish as small as 1 inch total length. Breeding males become dark blue, with the breast dark red.

Size: The usual adult size is 4 to 6 inches but the IGFA all-tackle record is 4 pounds 12 ounces from Ketone Lake, Alabama, and the New York record is a 1-pound 13-ounce fish from Wilds Pond taken in May 1977.

Habitat

The bluegill occurs in standing or slow-moving water where there is vegetation or other shelter.



Distribution

This species is a southeastern and Mississippi Valley

fish ranging from Texas to peninsular Florida and north on the Atlantic coast to North Carolina. In the Mississippi Valley, its original range extended through the eastern parts of Oklahoma, Kansas and Nebraska to South Dakota and southern Wisconsin, into the Great Lakes drainage to the St. Lawrence watershed in New York. It now occurs throughout New York and has been introduced widely in North America and in Europe and South Africa as well.

Life History

The bluegill nests in colonies where the nests are sometimes so close that they become hexagonal rather than round. Usually, the preferred sites are on rather firm sand or mud with some debris but little vegetation. The nests are 8 to 12 inches in diameter in water 1 to 3 feet deep or shallower. Spawning occurs from May to June or July at our latitude, when air temperatures are in the high 70s F.

Bluegills have been known to live as long as 11 years. A vast amount of work has been done on their age and growth, and much of this has been summarized by Carlander. In the South, bluegills may reproduce toward the end of their first summer but in our area they do not mature until age I or II.

Dominey observed that small males unable to defend their own territories assume the coloration of the female and join in the spawning pairs on a nest, thus reproducing successfully in spite of being unable to drive the larger males from the nesting sites.

Food and Feeding

Bluegills feed during the day and most actively in the morning and afternoon. They eat a wide variety of organisms including, at times, significant amounts of plant material. Young bluegills feed on rotifers and copepod nauplii. Larger individuals eat insects and other larger particles. They feed throughout the water column.

Notes

The bluegill is frequently planted in farm ponds and other impoundments. It is also widely used in physiological studies and for toxicity tests.

Several workers have indicated that there is a fairly well-differentiated subspecies of bluegill in the Florida Peninsula, and possibly there are recognizable subdivisions in other parts of its range. The Florida form is thought to have originated when Florida was isolated from the rest of the continent during high waters of a Pleistocene interglacial period. Hubbs and Allen thought that the Florida form ranged north to North Carolina. They called it *Lepomis macrochirus purpureescens* and noted that it was distinguished by having red fins, broader lateral bars, and a modal anal ray count of 12 rather than 11. In addition, the spawning males of the southern form develop a white bar at the nape. Avise and Smith found biochemical differences at two enzyme loci, GOT-2 and Esterase-3, and were able to delimit the geographic distribution of the populations. Felly, using both morphological and genetic data,

demonstrated a zone of intergradation from southern South Carolina through central and eastern Georgia and in a narrow band across the eastern end of the Florida Panhandle to the gulf coast.

References

Breder, 1936b (life history). Hubbs and Allen, 1943 (subspecies). Snow et al., 1960 (summary). O'Hara, 1968 (temperature response). Werner, 1969 (ecology of limnetic fry). Siefert, 1972 (first food). Sadzikowski and Wallace, 1976 (food). O'Brien et al., 1976 (prey selection). Werner and Hall, 1974 (optimal foraging). Avise and Smith, 1974 (genetics). Carlander, 1977 (age and growth). Felly, 1980 (subspecies). Bain and Helfrich, 1983 (parental care). Dominey, 1980 (female mimicry). Regier, 1963a (management in farm ponds).

Names

Macrochirus is from the Greek *makros*, larger, and *cheir*, hand, in reference to the long pectoral fin.

Lepomis macrochirus Rafinesque, 1818e: 420 Ohio, Wabash, Genesee, and Licking Rivers

Helioperca macrochira, Greeley, 1936: 87 Delaware and Susquehanna watersheds

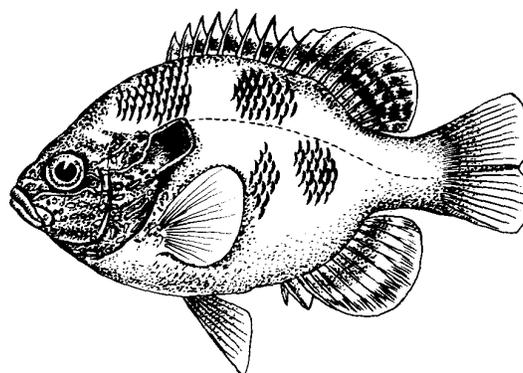
Lepomis m. macrochirus, Hubbs and Lagler, 1964: 114 (distribution)

Pomotis incisor Valenciennes in Cuvier and Valenciennes, 1831: 466-467 New Orleans

Helioperca incisor, Greeley, 1928: 101 Oswego drainage

Labrus pallidus Mitchell, 1815: 407 New York

Lepomis pallidus, Bean, 1903: 380 (identification uncertain)



LONGEAR SUNFISH

Lepomis megalotis
(Rafinesque, 1820)

Identification

The longear sunfish most resembles the pumpkinseed in that its opercular spot has a white margin with a red sector. It is, however, a stouter fish with a short, rounded pectoral fin whereas the pectoral fin of the pumpkinseed is long and pointed. The opercle of the longear has a flexible and fimbriate margin but the opercular bone of the pumpkinseed is stiff to

its margin and is smooth. There are also color differences.

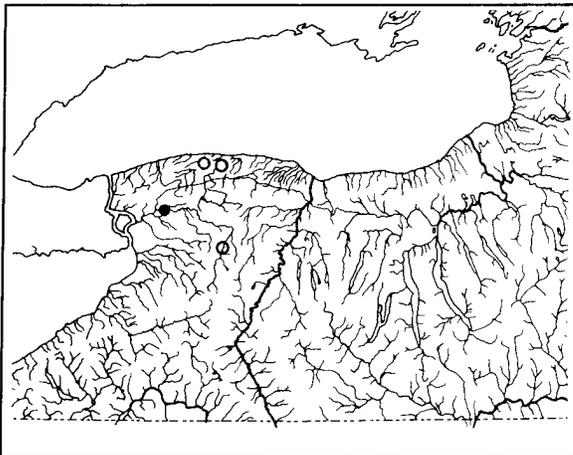
Description

Body stubby and compressed but not as compressed as the pumpkinseed or bluegill. Profiles equally curved or the dorsal slightly more curved. Dorsal fin single, with a slight notch, its origin behind the pectoral base. Spiny part of the dorsal arched, with deeply incised membranes. Soft dorsal rounded. Caudal fin slightly forked, with rounded lobes. Anal origin below anterior dorsal soft rays. Anal fin rounded. Pelvic inserted below dorsal origin, retrogressive, with sharp anterior and rounded posterior corners. No pelvic axillary process. Last ray bound to body for two-thirds or more of its length. Pectoral short and asymmetrically rounded, its base oblique. Scales ctenoid, body completely scaled. Top of head scaled to eyes, cheeks and opercles scaled. Operculum with well-developed flap, opercle with flexible and fimbriate margin. Preopercle and subopercle smooth. Gill membranes separate and free from the isthmus. Lateral line complete, arched to the caudal peduncle. Counts and proportional measurements are given in Table 32.

Color: Adult males are rather uniform mottled gray above, shading to bright orange ventrally. The mottling is due to light centers on some scales and dark centers on others. The vertical fins are dusky, with orange on the membrane. Pelvic fins dusky, pectoral fins clear, with outlined rays. Sides of head with blue-green lines and rows of spots. Opercular flap dark, with a white margin that has a red sector at its middle. Caudal fin reddish brown. Females are paler and more greenish.

Juveniles and breeding adults: Breeding males are extremely colorful and many have dark reddish central spots on all of the scales on the sides of the body. The juveniles are rather plain and have only weakly developed vertical bars.

Size: The northern longear is a small species, usually only 2 to 4 inches in total length. The largest Ohio specimen reported by Trautman was 4.8 inches total length.



Habitat

The northern longear shows a distinct preference for dense weedy areas of larger streams.

Distribution

The longear is widely distributed from northeastern Mexico throughout the Mississippi and Great Lakes drainages to Wisconsin, Michigan and western New York and along the gulf coast to the Florida Panhandle. This species is quite variable but its subdivisions are not satisfactorily worked out. Bauer in Lee et al. (1980) noted that there may be four to six subspecies.

In New York State, it is confined to the western part of the state in Lake Erie and part of the Lake Ontario drainages. Raney mentioned its spawning in Oneida Lake, but we have found it only in Tona-wanda Creek of the Lake Erie drainage.

Life History

The life history of the northern longear was studied by Hubbs and Cooper in northern Michigan where spawning takes place from late June into August. In Oneida Lake, Raney noted that it spawns in July. The nests are saucer-shaped depressions in about 1 foot of water. Hubbs and Cooper found that it matures in the third summer and that the maximum age was about 10 years. Males were about an inch longer than females.

Food and Feeding

The food habits have not been studied but it would be expected to feed on small invertebrates, especially aquatic insects.

Notes

Relatively little work has been done on the northern form, although southern populations of the longear have been studied intensively. It appears to be disappearing in New York and our few specimens were probably hybrids with the pumpkinseed. Specimens from the eastern part of the state that I first identified as this species I now believe to be hybrids between the pumpkinseed and the redbreast sunfish.

References

Hubbs and Cooper, 1935 (life history). Witt and Marzolf, 1954 (behavior of southern subspecies). Keenleyside, 1972 (nest defense). Raney, 1965b (popular account). Huck and Gunning, 1967 (behavior). Laughlin and Werner, 1980 (resource partitioning). Trautman, 1981 (Ohio). Bauer in Lee et al., 1980 (subspecies).

Names

The species name comes from the Greek *me-gas*, great, and *ot*, ear.

Ichthelis (Pomotis) megalotis Rafinesque, 1820a: 29 Kentucky, Licking, and Sandy Rivers, Kentucky

Lepomis peltastes Cope, 1870: 454 Huron River, Michigan

Xenotis megalotis, Greeley, 1928: 101-102 Oneida Lake

Xenotis megalotis peltastes, Greeley, 1940: 78 Lake Ontario watershed

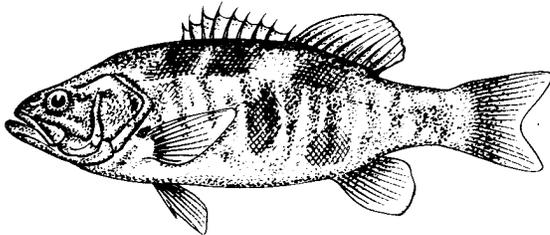
Table 32
PROPORTIONAL MEASUREMENTS AND COUNTS OF SUNFISHES (*Lepomis*)

All proportions are expressed in percentage of standard length.

	<i>auritus</i>	<i>cyaneus</i>	<i>gibbosus</i>	<i>gulosus</i>	<i>macro-</i> <i>chirus</i>	<i>megalotis</i>
STANDARD LENGTH	111.7	76.6	41.1	53.1	88.5	66.4
TOTAL LENGTH	123.0	124.6	129.8	126.6	126.8	126.6
FORK LENGTH	118.1	119.2	123.9	121.8	121.3	120.9
PREDORSAL	44.9	45.5	43.8	46.3	42.1	45.5
PREANAL	65.3	65.5	64.1	63.7	63.4	65.9
PREPELVIC	41.2	44.1	44.5	41.8	42.6	42.6
DORSAL BASE	46.1	44.1	45.3	42.7	45.8	48.3
ANAL BASE	19.0	19.2	22.2	18.8	22.6	23.1
BODY DEPTH	44.7	41.9	42.3	38.0	46.4	51.5
BODY WIDTH	18.5	19.2	16.1	17.7	16.8	19.4
C. PED. DEPTH	14.6	16.2	14.2	13.6	14.3	14.9
PECTORAL ALT.	29.0	29.1	28.3	25.2	29.7	33.8
HEAD LENGTH	42.5	39.6	36.5	41.6	35.4	44.1
SNOUT LENGTH	10.8	11.4	9.3	10.0	9.6	8.7
EYE LENGTH	8.6	9.3	13.9	13.2	9.5	12.1
MOUTH LENGTH	9.4	15.6	11.5	13.0	5.9	13.2
INTERORBITAL	6.4	15.1	11.1	5.3	6.2	9.9
N (sample size)	5	5	5	1	5	5
COUNTS:						
DORSAL SPINES	X	X	X	X	X	X
DORSAL RAYS	9-12	10-12	11-12	9-10	11-12	11
ANAL RAYS	III,9-11	III,10-11	III,10-11	III,9	III,10-12	III,9-11
PECTORAL RAYS	14	13	13-14	12-13	13	12
PELVIC RAYS	1,5	1,5	1,5	1,5	1,5	1,5
GILL RAKERS	10-12	14	11	12	20	9
VERTEBRAE	30	29-30	30	28-29	29-30	30
SCALES:						
ABOVE L. L.	7	7	6	6	7	5
LATERAL LINE	41-44	43	40	39	41	36
BELOW L. L.	11-14	14	12	10	11	—

Micropterus

Although they belong to the sunfish family, members of the genus *Micropterus* are called black basses. They are elongate fishes with slightly forked tails, 3 anal spines, and more than 55 lateral line scales. They are larger and less compressed than members of the genus *Lepomis*. Six species are currently recognized.



SMALLMOUTH BASS

Micropterus dolomieu Lacepède, 1802

Identification

With its rather elongate but robust body, the smallmouth is similar in shape to the largemouth and easily differentiated from the other sunfishes in our area, all of which have deeper and more compressed bodies. While it is true that the smallmouth has a smaller mouth than the largemouth, mouth size is not always easy to judge in small individuals and color is a much easier feature to use. The smallmouth is brown or greenish bronze, plain, or with two rows of narrow vertical lines; the largemouth is greenish, with an irregular dark stripe along the middle of its side. Juvenile smallmouth have orange and black bands across the base of the tail.

The mouth of the smallmouth ends below the middle of the eye; mouth of the largemouth extends to below the back of the eye or farther. Also, the dorsal fin of the smallmouth is less deeply notched than that of the largemouth, and the pyloric caeca of the smallmouth are not branched.

Description

Body elongate, robust. Dorsal profile slightly more curved than the ventral. Dorsal origin over middle of pectoral fin. Dorsal fin notched, its margin arched, its membranes incised. Soft dorsal arched, its posterior corner rounded. Caudal slightly forked, with its middle lobes rounded. Anal fin origin under second dorsal soft ray. Anal similar in shape to soft dorsal. Pelvic fins inserted below basal one-fourth of the pectoral fin, retrogressive, with straight margin, blunt anterior corner, and rounded posterior corner. No pelvic axillary process. Last ray bound to body for one-third to one-half its length. Pectoral base oblique, pectoral fin asymmetrically rounded. Scales ctenoid. Body completely scaled, top of head scaled to eyes, cheeks and opercles scaled.

Opercle rounded, preopercle smooth, with rounded angle. Mouth terminal and slightly oblique. Gill membranes separate and free from the isthmus. Lateral line complete, arched to caudal peduncle. Counts and proportional measurements are given in Table 32.

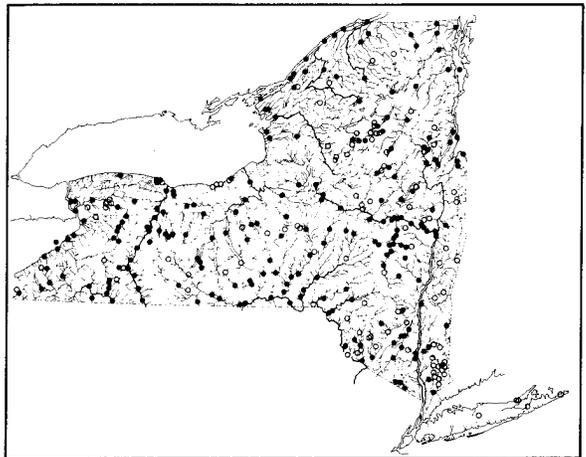
Color: Generally greenish bronze to brown with sides lighter, shading to dirty white on belly. Sides have 8 to 11 narrow vertical bars in a row along the midside and usually a second row of similar but shorter and wider bars above, and alternating with, the first. Sometimes, there is a third series of spots on each side of the middorsal line. Sides of head with two dark lines radiating from the eye and a third line from the top of the maxillary to the operculum. Vertical fins dusky, with some pigment along the rays. Pelvic fins dusky; pectoral fins clear.

Juveniles and breeding adults: The tails of juveniles are distinctively marked with three prominent bands. The basal third of the fin is bright yellow to orange, the middle third is black, and the outer third is pale yellow or clear. Tiny fry are jet black.

Size: The IGFA all-tackle record is a fish from Kentucky that weighed 11 pounds 15 ounces. The New York State record is a 9-pound fish from Friends Lake Outlet in Warren County taken by George Tennyson in 1925.

Habitat

The smallmouth lives in streams, with slow to moderate current, and in standing water where it tends to select areas of rocky shoreline with considerable shelter. Although it tolerates a wide range of habitats, it generally occurs in cooler, clearer water than the largemouth.



Distribution

The original distribution of the smallmouth was throughout the north-central part of the United States and southern Canada, from Minnesota and the Dakotas to the St. Lawrence drainage in southern Ontario, south in the Mississippi Valley to the Ozarks and the Tennessee drainage of northern Alabama.

Cheney did not distinguish between the largemouth and smallmouth in making the statement that the black basses were not originally found in

New York State except in waters tributary to the Great Lakes and the St. Lawrence.

The smallmouth bass has been introduced in many areas and now occurs throughout New York State. George has summarized the events that led to its distribution in the Adirondacks. According to Cheney, it entered the Mohawk system through the Erie Canal and became established in Saratoga Lake. From there it was introduced into Efnor Lake of the Great Sacandaga watershed and then into the Schroon system. In 1872, Seth Green successfully introduced it into Raquette Lake and it had spread throughout most of the Adirondacks by the turn of the century.

Life History

The smallmouth is a spring spawner and begins nesting when the water temperature reaches 62 to 65 F. One nest was reported where the water temperature was 55.4 F. Nests are usually built over gravel along shores where the water is 2 to 20 feet deep, the average being about 3 feet. Usually, the diameter of the nest is roughly twice the length of the fish. The males construct and guard the nest. Females ready to spawn become more prominently marked as their dark markings become more intense and the background becomes paler. The female enters the nest and circles or hovers there. Every 2 or 3 minutes she rubs her belly against the gravel bottom. During spawning, the fish lie side by side with the male upright and the female inclined at a 45-degree angle. The eggs are laid during episodes of 4 to 6 seconds duration separated by intervals of 22 to 45 seconds. Females remain in the nest for as long as 2 hours or more. After one female leaves, another may enter the same nest, the male remaining receptive for 30 to 36 hours and usually spawning with at least three females. Males guard the nest for the entire incubation period. Hatching takes 7 to 16 days depending on temperature; at 50 to 60 F, the eggs hatched in 21 days. The newly hatched larvae remain motionless in the nest at first, then rise as a dense school that is herded by the male for a short time.

Food and Feeding

Smallmouth bass are opportunistic predators and feed on tadpoles, frogs, and almost any small animal in the water. Insects, crayfish, and fish make up most of the diet. Small individuals feed on plankton and invertebrates, switching to larger items as they become larger. In many waters, yellow perch are the prey they consume most frequently.

Notes

Smallmouth bass are among the most important game fishes in New York. However, their introduction into the Adirondacks and other areas has probably had a profound effect on other native species, including trout and some of the items trout feed on.

References

Cheney, 1897 (occurrence in New York). Hubbs and Bailey, 1938 (general account); 1940 (relationships). Tester, 1930 (spawning); 1932a (food);

1932b (growth rates). Reighard, 1906 (life history). Westman, 1941 (life history and management). Greeley, 1954 (range); 1955a (popular account). Webster, 1954a, 1954c (life history and management). Stone et al., 1954 (St. Lawrence). Raney, 1959 (young). Latta, 1963 (life history). Schneider, 1971 (SCUBA observations). Horning and Pearson, 1973 (temperature). Robbins and McCrimmon, 1974 (distribution). Tandler and Beamish, 1979 (activity). James, 1930 (spawning). Buynak and Gurzynski, 1978b (growth in polluted waters). Burdick et al., 1954 (lethal oxygen concentration). Forney, 1961, 1972 (management). George, 1981a (Adirondacks).

Names

The smallmouth bass is named for M. Dolomieu, a French geologist for whom the rock dolomite is also named.

Micropterus dolomieu Lacepède, 1802: 324-326 (no locality)

Micropterus dolomieu dolomieu, Hubbs and Bailey, 1940: 34-36 (systematics)

Bodianus achigan Rafinesque, 1817b: 120 New York

Cichla fasciata Lesueur, 1822a: 216-218 Lake Erie at Erie and Buffalo; Lake George

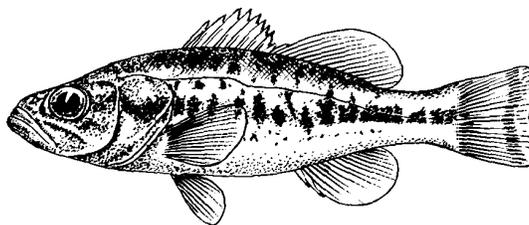
Centrarchus fasciatus, DeKay, 1842: 28-29 New York

Cichla minima, Lesueur, 1822a: 220-221 Lake Erie lagoons

Grystes salmoides (non Lacepède) Cuvier in Cuvier and Valenciennes, 1829: 54-58 New York and the Wabash River

Micropterus salmoides Jordan, 1876: 230

Centrarchus obscurus DeKay, 1842: 30 Onondaga Creek, New York



LARGEMOUTH BASS

Micropterus salmoides (Lacepède, 1802)

Identification

Compared to other members of the sunfish family, the largemouth and smallmouth bass are both elongate, robust fish, a shape that we have come to know as bass-like. As the name implies, the largemouth bass has a larger mouth, with the end of the maxillary falling below or beyond the rear margin of the eye. The largemouth also has a more deeply notched dorsal fin, larger scales, and bifurcate pyloric caeca.

The most conspicuous differences, however, are

those of color. The largemouth is a greenish fish, with a pronounced stripe running along the mid-side whereas the smallmouth is a bronze or brassy greenish color, with two rows of narrow vertical bars on the upper side of the body. Juvenile smallmouths have black and orange bands on their caudal fins but the tail of juvenile largemouth is clear or with a faint reddish tinge.

Description

Body elongate, robust, profiles equally curved. Dorsal fin single, deeply notched, its origin over the basal one-fourth of the pectoral fin. Spiny part arched, with the membranes incised. Soft part arched, with the posterior corner rounded. Caudal slightly forked, with blunt lobes. Anal fin origin below second dorsal soft ray, its margin arched, its corners rounded. Pelvic fin inserted below the dorsal origin, retrogressive, its anterior corner pointed, its posterior corner round. No pelvic axillary process. Last pelvic ray bound to body for one-half its length. Pectoral fin asymmetrically rounded, its base oblique. Scales ctenoid, body completely scaled, top of head scaled to back of eyes, cheeks and opercles fully scaled. Operculum with two points. Preopercle rounded, smooth. Mouth terminal, oblique, maxillary reaching to or beyond the posterior margin of the eye. Supramaxillary well developed. Gill membranes separate and free from the isthmus. Lateral line complete, arched. Gill rakers short. Pyloric caeca bifurcate. Counts and proportional measurements are given in Table 33.

Color: Dark green above, shading to white ventrally, with a broad midlateral stripe that is irregular on the body and has a nearly straight upper margin on the caudal peduncle. There are patches of dark scales above and below the lateral stripe, these sometimes forming short longitudinal lines. Sides of head with dark stripes, one from the back of the eye to the dark spot above the point of the opercle, one from the lower part of the eye to the angle of the preopercle, and a short line from the upper margin of the maxillary to the edge of the lower limb of the preopercle. Vertical fins dusky, with the rays outlined. Paired fins clear.

Juveniles and breeding adults: Post-larval largemouth are clear, with weak pigment. The lateral stripe develops when they are less than an inch long. Juveniles are miniatures of the adults.

Size: The IGFA all-tackle record is 22 pounds 4 ounces from Montgomery Lake in Georgia. The New York record was a 10-pound 12-ounce fish from Chadwick Lake caught October 1975 by M. Rutkowski.

Habitat

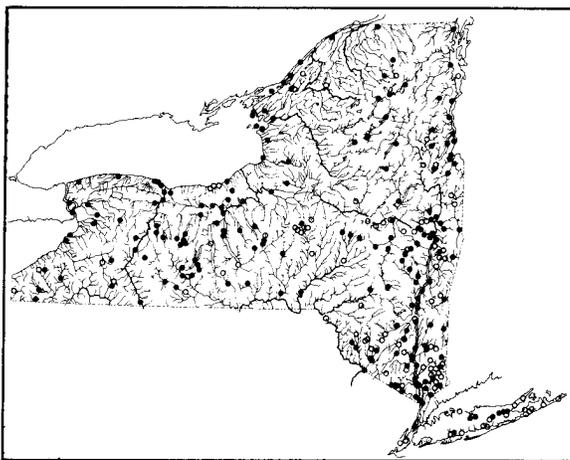
The largemouth is a fish of warm, weedy parts of lakes, ponds, and streams.

Distribution

The original range of the largemouth is somewhat more southern than that of the smallmouth, extending from central and northern Mexico east along the gulf coast to peninsular Florida, where it is

represented by a separate subspecies, and north on the Atlantic coast to South Carolina. In the Mississippi Valley, it ranged north to South Dakota, southern Wisconsin and across southern Ontario to Quebec in the Great Lakes drainage. It has been introduced into many other parts of the world.

In the 1896 report of the Commissioners of Fisheries, Game, and Forests, Cheney stated, "In nature's distribution of black bass New York State was omitted except in waters having connections with the Great Lakes or the St. Lawrence." He believed that the Erie Canal enabled it to spread to the Mohawk-Hudson drainage and that it was then stocked in New England about 1850. Its present distribution is throughout the state.



Life History

The largemouth spawns in deeper waters than the sunfishes, usually in depths of 1 to 4 feet. Males build nests 2 to 3 feet in diameter by sweeping the bottom. Usually, the nests are at least 30 feet apart. Males entice females into the nest by circling and nipping them. Once in the nest, the female tilts her body or lies alongside the male who remains upright. Eggs are emitted in small batches at intervals of about 30 seconds. After spawning, the female leaves the nest although she, or another female, may return to spawn again later. The eggs hatch in 3 or 4 days and the young remain near the nest until they are about 0.75 inch long. Maturity is achieved at age V and largemouth bass can live as long as 15 years. Females produce 2,000 to 7,000 eggs per pound of body weight. Growth rates are extremely variable.

Food and Feeding

Until they are 2 inches long, largemouth juveniles feed on plankton and miscellaneous insects and other invertebrates. As they get larger, their diet shifts to fishes and other large items and, in fact, they will try to eat almost anything that moves.

Notes

Largemouth bass from Florida reach a much larger size and are generally recognized as constituting a separate subspecies, *Micropterus salmoides floridanus*. Florida largemouth bass are currently being stocked in other parts of the country.

References

Reighard, 1906 (life history). Cheney, 1897 (distribution in New York). Hubbs and Bailey, 1940 (systematics). Lewis and Flickinger, 1967 (home range). Regier, 1963a, 1963b (management in ponds). Dudley and Eipper, 1975 (oxygen requirements). Cech et al., 1979 (temperature and respiration). Pickett, 1979 (pughead). Heimstra et al., 1969 (effects of turbidity). Nyberg, 1971 (prey capture). Heidinger, 1976 (summary). Hackney and Linkous, 1978 (striking behavior). Mraz et al., 1961 (summary).

Names

The name *salmoides* comes from *salmo*, trout and the Latin *oides*, having the form of.

Labrus salmoides Lacepède, 1802: 716-718
Charleston, South Carolina

Grystes salmoides, DeKay, 1842: 26 New York
(May include more than one species.)

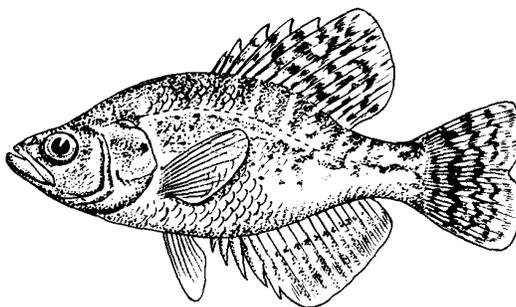
Grystes megastoma Garlick, 1857: 108-110
Lake Erie

Aplites salmoides, Greeley, 1927: 64 Genesee
drainage

Huro salmoides, Greeley, 1939: 43 Long Island

Pomoxis

The crappies are the most specialized members of the family Centrarchidae. They have a large number of anal spines (5 or more), few dorsal spines (6 to 8), a strongly compressed body, fewer than 55 lateral line scales, and a large mouth. There are only two species in the genus, both of which live in New York.



WHITE CRAPPIE

Pomoxis annularis
Rafinesque, 1818

Identification

Crappies are distinguished from other sunfishes by their compressed and rhombic bodies, long anal fins with six spines, and short dorsal fins with six to eight spines. The black and white crappies are separable by the length of the dorsal fin base. If the length of the base of the dorsal fin is stepped forward from the dorsal fin origin, it will reach the rear margin of the eye if the fish is a black crappie and only to the occiput if the fish is a white crappie. The shorter dorsal fin of the white crappie has six or seven spines rather than seven or eight. White crappies tend to be paler than black crappies but there is considerable variation and color patterns alone are not reliable for identification.

Small young-of-the-year crappies are banded and resemble juveniles of *Lepomis* species but young *Lepomis* have only three anal spines.

Description

Body rhombic, deepest at center, compressed. Dorsal and ventral profiles about equally curved. Dorsal fin origin midway between the caudal base and the tip of the snout. Dorsal fin progressive to fourth soft ray, then retrogressive. Soft dorsal rounded. Caudal weakly forked, its lobes blunt. Anal origin below third dorsal spine, similar in shape to the dorsal. Pelvic insertion below lower end of pectoral base. Pelvic retrogressive, with pointed anterior and rounded posterior corners. No pelvic axillary process, last ray bound by membrane for four-fifths of its length. Pectoral fin asymmetrically rounded, its base oblique. Body fully scaled, cheeks, opercles, and top of head forward to orbits scaled. Mouth large, maxillary reaching to below center of eye. Supramaxillary much longer than width of maxillary.

Operculum pointed, preopercle angled with fine serrations at the angle. Suborbital margin finely serrated. Gill membranes separate and free from the isthmus. Lateral line complete, arched. Counts and proportional measurements are given in Table 33.

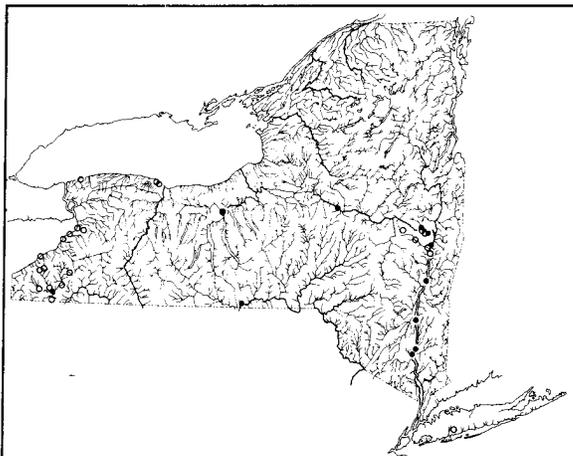
Color: Generally, silvery white, shading to pale olive dorsally. Upper sides with patches of dark scales that tend to coalesce to form a mottled pattern, often forming irregular vertical bars. Fins mottled, with rows of pale spots across the soft parts of the vertical fins.

Juveniles and breeding adults: Juveniles are pale, nearly transparent, with pronounced vertical bars. There are no bright breeding colors.

Size: The IGFA all-tackle record is a 5-pound 3-ounce fish from Enid Dam, Mississippi.

Habitat

The white crappie occurs in lakes and ponds and slower parts of streams. It can tolerate considerable turbidity and occurs over silty bottoms as well as in vegetated areas.



Distribution

The original range of the white crappie seems to have been from western New York and southern Ontario through southern Michigan to southern Wisconsin and South Dakota. It occurs throughout the Mississippi drainage and west to the eastern parts of Nebraska, Kansas, Oklahoma, and Texas to southern Mexico, then east along the gulf coast at least to Alabama. It may have been somewhat more widely distributed, but its original range is difficult to identify because it has been stocked in many areas across the Southwest and on the west coast as far north as southern Oregon.

Life History

Possibly, because it lives in turbid water and spawns in deeper waters, the life history of the white crappie is not as well known as that of the black crappie. Hansen described the nests along the shore of a lake in Springfield, Illinois where the sod bank had been undercut about 12 inches. The nests were 2 to 4 feet apart in water 4 to 8 inches deep, and located in sheltered areas either under the overhanging bank or where they were sheltered by an elm sapling. The bottom was hard clay, with no silt, and the

eggs were deposited on tree root fibers and other vegetation above the bottom. One nest was under a boathouse and was a small depression fanned down to clean gravel.

Siefert described the nesting and spawning in artificial ponds in South Dakota. Nests were areas swept clear of loose silt but not actual depressions. The nests were usually about 30 cm in diameter and located near some underwater objects where the bottom was gravel, rocks, or a clump of sod. Most of the sweeping was done by the males but sometimes females also exhibited the sweeping behavior. Spawning commenced with the female approaching the male on the nest. At first, he chased her but in time she refused to retreat and circled him several times before coming to lie parallel to him in the nest and facing the same direction. After remaining motionless for a few moments, they came together, moving upward and forward with their bodies quivering. Usually, the female moved under the male and pushed him upward during the 2- to 5-second episodes. The spawning acts were usually repeated after a period of 30 seconds to 2 hours. Up to 50 spawning episodes were completed in a single session lasting as long as 145 minutes. Occasionally, a second male would try to join the spawning pair but was usually chased away by the primary male. Most spawning took place between 8 am and 4 pm, usually starting before noon. Cloudy water and minor temperature variations did not interrupt the spawning. Siefert noted that the eggs were adhesive and often more eggs were on the vegetation surrounding the nest than in the nest itself. Most eggs had sand and other fine particles adhering to their surface.

Spawning began when the water temperatures were between 14 and 23 C and the hatching required 93 hours at 14.4 C, 42 hours at 22.8 C. The young fish left the nest 95 hours after hatching when they were 4.1 to 4.6 mm long.

Food and Feeding

The postlarvae fed on copepod nauplii at first, then on *Cyclops*, and still later on cladocerans. Larger white crappies fed on a variety of aquatic insects and other invertebrates as well as small fishes.

Notes

The two species of crappies sometimes hybridize with each other but not with other sunfishes.

References

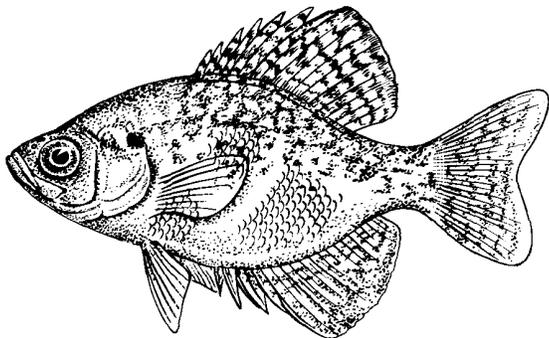
Hansen, 1943 (nesting); 1951 (life history); 1965 (ecology). Morgan, 1954 (life history). Siefert, 1965 (scale development); 1968 (reproduction and feeding); 1969a (larval development); 1969b (biology). Johnson, 1945 (age and growth). Marcy, 1954 (food and growth). Mathur and Robbins, 1971 (feeding chronology). Mathur, 1972 (food habits).

Names

The species name is from the Latin *annulus*, a ring, probably in reference to the color pattern of vertical bars that partly encircle the body.

Pomoxis annularis Rafinesque 1818e: 417 Falls of the Ohio

Pomoxis annularis, Greeley, 1929: 178 Erie-Niagara drainage



BLACK CRAPPIE

Pomoxis nigromaculatus
(Lesueur, 1829)

Identification

The crappies are easily recognized by their highly compressed, diamond-shaped bodies, the presence of more than three anal spines, and their short dorsal fins with only six to eight spines. Black crappies have seven or eight dorsal spines and the base of the dorsal fin is so long that when the length of the base is stepped forward of the dorsal origin it reaches to, or close to, the back of the eye. The white crappie has six or seven dorsal spines and the base of the dorsal fin is much shorter than the distance from the dorsal origin to the eye.

Description

Body deep, rhombic and strongly compressed. Dorsal and ventral profiles equally curved. Dorsal fin single, without notch, its origin closer to snout than to caudal base. Spiny part progressive, its membranes deeply incised. Soft dorsal arched with its posterior angle rounded. Caudal fin slightly forked with blunt lobes. Anal origin below third or fourth dorsal spine, similar to dorsal in shape. Pelvic fin inserted below the upper base of the pectoral, retrogressive, with straight margin, sharp anterior and rounded posterior corners. No axillary process. Last ray bound to the body for its entire length. Pectoral fin asymmetrically rounded, its base steeply oblique. Scales ctenoid, body completely scaled. Top of head scaled to the interorbital, cheeks and opercles scaled. Operculum with two blunt points. Preopercle weakly toothed at angle, suborbital with small serrations posteriorly. Mouth terminal, oblique, maxillary reaching to below center of the eye. Gill membranes separate and free from the isthmus. Lateral line complete, arched. Counts and proportional measurements are given in Table 33.

Color: The black crappie is pale silvery white on the sides and belly, dark green dorsally with dense patches of dark scales that coalesce to form irregu-

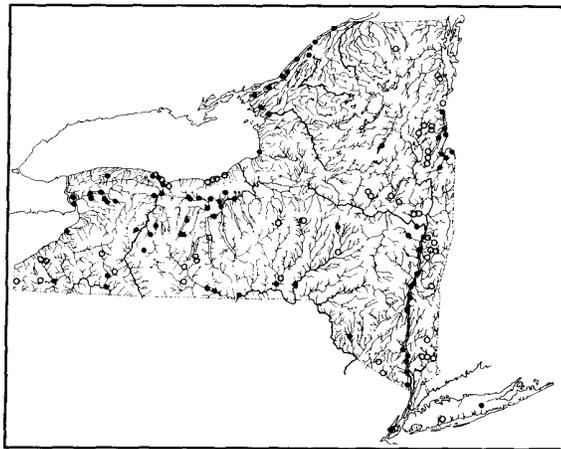
lar blotches and marblings. There is a dark vertical bar through the eye and suborbital region. The vertical fins are dusky, with pale spots in irregular rows. The pelvic fins have a white leading edge and are otherwise lightly punctate. The pectoral fins are clear.

Juveniles and breeding adults: The juveniles are more transparent with irregular vertical bands.

Size: The IGFA record is held by a 4-pound fish from Westwego, Louisiana. The New York record weighed 3 pounds 1 ounce and was caught in Indian Lake by Albert Schuldwachter.

Habitat

Black crappies are less tolerant of silt and turbidity than white crappies and are more apt to be found in clear water where there is abundant vegetation.



Distribution

The original range of the black crappie was from the St. Lawrence Valley of southern Quebec west to southeastern Manitoba, the eastern half of North and South Dakota, Nebraska, Kansas, Oklahoma, and east Texas. On the gulf coast, it ranged east to the tip of peninsular Florida and north to northeastern Virginia. West of the Appalachians, it reached the Great Lakes and extended eastward to western and northern New York.

It is now generally distributed through New York State but is not very common in the Adirondack Mountains.

Life History

The spawning season is May to July when the water temperatures are higher than 68 F. Nests 8 or 9 inches in diameter are constructed by fanning depressions in water 10 inches to 2 feet deep. Nests are usually built in sandy bottom in weedy areas and are generally at least 5 or 6 feet apart. The eggs are slightly less than one mm in diameter and hatch in 3 to 5 days. The maximum age is about 10 years in the North, less in the South.

Food and Feeding

Young crappies are plankton feeders but older fish feed on insects and fish. Considerable feeding takes place at night.

References

Breder, 1936b (reproductive habits). Huish, 1954 (life history in Florida). Siefert, 1969a (identification of larvae). Johnson, 1945 (age and growth).

Names

The name of the species comes from the Latin *niger*, black, and *maculatus*, spotted.

Cantharus nigro-maculatus Lesueur in Cuvier and Valenciennes, 1829: 88-89

Pomoxis nigromaculatus, Bailey, 1941: 23 (nomenclature)

Pomoxis sparoides (non Lacepède, which is *Centrarchus macropterus*), Greeley, 1927: 63 Genesee drainage

TABLE 33
AVERAGE PROPORTIONAL MEASUREMENTS AND COUNTS OF BLACK BASSES
AND CRAPPIES (*Micropterus* and *Pomoxis*)

All proportions are expressed in percentage of standard length.

	<i>Micropterus</i>		<i>Pomoxis</i>	
	<i>dolomieu</i>	<i>salmoides</i>	<i>annularis</i>	<i>nigromaculatus</i>
ST. LENGTH (mm)	71.5	102.8	46.8	67.2
TOTAL LENGTH	123.6	123.4	132.2	133.8
FORK LENGTH	119.0	120.3	126.7	125.7
PREDORSAL	44.0	41.7	50.5	48.7
PREANAL	66.2	66.1	52.0	52.5
PREPELVIC	38.3	38.6	38.3	40.5
DORSAL BASE	40.5	41.9	30.1	36.3
ANAL BASE	14.7	16.5	32.4	36.0
BODY DEPTH	29.0	31.4	34.5	40.4
BODY WIDTH	15.8	16.5	11.3	13.3
C.PED. DEPTH	11.7	12.7	12.6	13.0
PECTORAL ALT.	18.0	21.1	21.8	28.0
HEAD LENGTH	37.4	37.1	37.4	38.6
SNOUT	11.1	9.6	8.0	8.0
EYE	8.3	7.2	10.3	13.1
MOUTH LENGTH	10.3	14.8	14.2	17.2
INTERORB	10.3	7.7	7.7	7.4
N (sample size)	5	5	5	5
COUNTS:				
DORSAL SPINES	X	X-XI	VI-VII	VII-VIII
DORSAL RAYS	13-15	12-13	16-18	15-18
ANAL RAYS	III, 11-12	III, 10-12	VI, 17-18	VI, 17-18
PECTORAL RAYS	13-17	12-14	13-15	13-15
PELVIC RAYS	I, 5	I, 5	I, 5	I, 5
GILL RAKERS	8-11	8-10	28-32	27-29
VERTEBRAE	31-32	32	32	33-34
SCALES:				
ABOVE L. L.	13	7	6	7
LATERAL LINE	68-78	60-68	34-35	36-41
BELOW L.L.	18	13	13-14	12

PERCHES

PERCIDAE

The true perches are strictly freshwater fishes of the Northern Hemisphere. They are typical spiny-rayed fishes with two dorsal fins which may be quite close together, and one or two anal spines. Most are rather elongate and slender species, with strongly ctenoid scales. They have no subocular shelf.

The family is small and the species are all similar except for size. Collette (1963) reviewed the family and proposed the following classification:

Percidae

Subfamily Percinae

Tribe Percini

Perca (North America and Europe, 3 species)

Gymnocephalus (Europe, 3 species)

Percarina (Europe, 1 species)

Tribe Etheostomatini (North America)

Percina (more than 25 species)

Ammocrypta (7 species)

Etheostoma (more than 80 species)

Subfamily Luciopercinae

Tribe Luciopercini

Stizostedion (North America and Europe, 5 species)

Tribe Romanichthyini (Europe)

Zingel (3 species)

Romanichthys (1 species)

Both the yellow perch and the walleye are important commercial species in Lake Erie and the sauger used to be until it became commercially extinct in the late 1930s. Walleyes and perch are important sport fishes in inland lakes and streams. The darters (*Etheostomatini*) are too small to be of sport or commercial interest, but they are among the most colorful fishes in the world and they have an interesting variety of breeding habits. Two recent books with keys and excellent color photographs of darters in breeding colors are Page (1983) and Kuehne and Barbour (1983). A valuable study of the nomenclature of darters with a list of the known type specimens is Collette and Knapp (1966). Collette et al. (1979) present the results of a recent international symposium with papers of general interest to the student of percid biology, especially the paper on zoogeography by Collette and Banarescu (1977). Danyman (1979) studied the chromosomes of several species.

KEY TO THE SPECIES OF PERCHES IN NEW YORK

A. Margin of preopercle smooth or slightly dentate but never strongly serrated. Mouth small, maxillary not reaching to below middle of the eye. Size small, adults less than 6 inches total length, usually less than 4 inches.

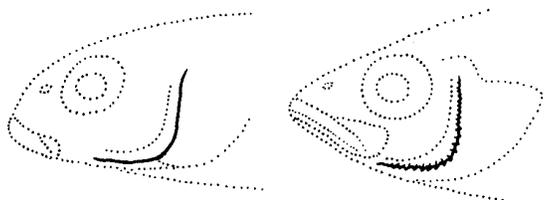
E.

A'. Preopercle strongly toothed. Mouth larger, mouth reaching nearly to, or beyond, a point below the middle of the eye. Adults usually longer than 7 inches total length.

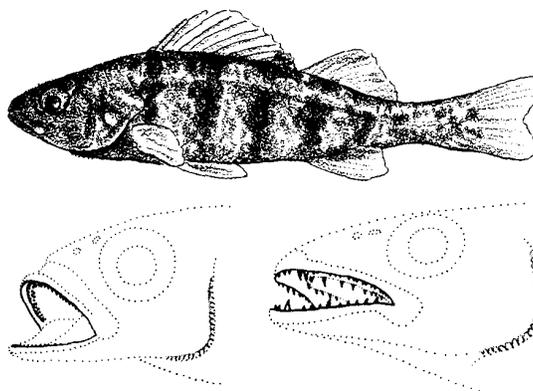
B. Jaws with small teeth of uniform size and arranged in bands. Body conspicuously marked with even vertical bands. Pelvic fins close together. Pelvic fin with two spines and six to eight soft rays.

Perca flavescens

Yellow perch, p. 337



Preopercles of darters (left) and other perches.

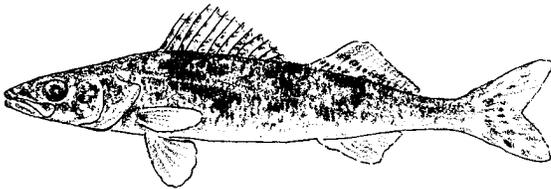


Teeth of yellow perch (left) and walleye.

B'. Jaws with some enlarged canine teeth. Body color uniform or with indistinct, irregular and sloping saddle-shaped bands. Space between the pelvic fins wide, exceeding the length of the pelvic fin base. Anal fin II, 12 or 13.

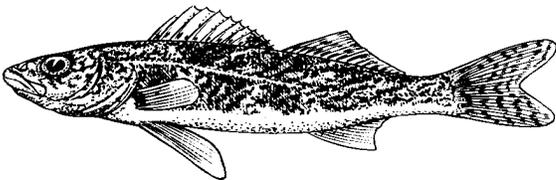
C. Posterior end of spiny dorsal fin without a conspicuous black blotch. Usually there is no white tip on the lower lobe of the caudal fin. Dorsal fins with rows of distinct round black spots. Back crossed by three or four saddle-shaped bands, indistinct in young. Pyloric caeca usually four to six, extremes three to nine, each shorter than the stomach.

Stizostedion canadense Sauger, p. 347



C'. Posterior end of spiny dorsal fin with a conspicuous black blotch (also present in yellow perch). Lower tip of tail fin white. Dorsal fin with various mottlings but not regular rows of round black spots. Body with irregular crossbands. Usually there are three pyloric caeca, each about the same length as the stomach.

Stizostedion vitreum D.

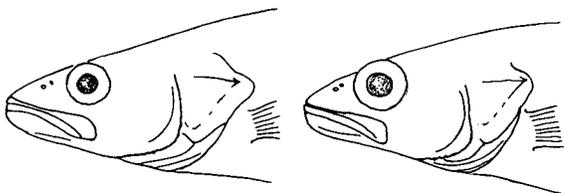


D. Color usually yellowish or brassy, rarely pale gray. Eyes small and wide apart, the bony interorbital width contained 1.1 to 1.4 times in the eye length.

Stizostedion v. vitreum Walleye, p. 348

D'. Color bluish gray, paler below. Eyes larger and closer together, bony interorbital width contained 1.4 to 2.0 times in the eye length.

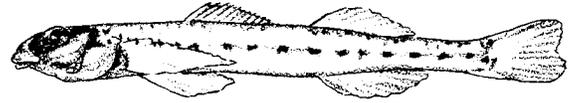
Stizostedion v. glaucum Blue pike, p. 348



Lateral view of head of walleye (left) and blue pike.

E. (A. Small fishes with the preopercle nearly smooth.) Body very slender with large naked areas, the scales confined to a narrow row along the lateral line. Body nearly colorless except for rows of small round spots along the sides and middorsal line.

Ammocrypta pellucida Eastern sand darter, p. 318



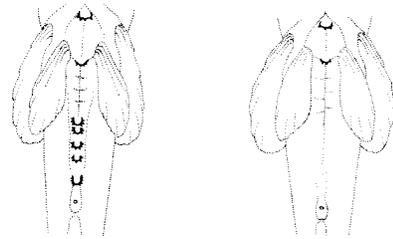
Eastern sand darter, *Ammocrypta pellucida*

E'. Body less slender with sides completely scaled. Various pigmented but not almost colorless.

F. Space between the pelvic fin bases with at least one large star-shaped scale. Belly often with a midventral row of enlarged stellate scales.

genus *Percina* S.

F'. No enlarged scales between the pelvic fin bases. Belly may be naked or scaled but never with a midventral row of modified scales.



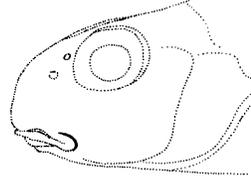
Midventral scales of *Percina* species.

G. Snout pointed or rather blunt but not conspicuously overhanging the mouth. Maxillary separated from the preorbital region for most of its length by a deep groove.

I.

G'. Snout very blunt, overhanging the mouth. Premaxillary protractile but maxillary attached to the preorbital region for most of its length with only a short groove at its posterior end.

Etheostoma blennioides Greenside darter, H.



Suborbital region of greenside darter.

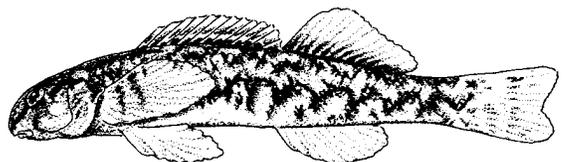
Only the tip of the maxillary bone is separated from the suborbital region by a groove.

H. Lateral line scales 57 to 71, average 65.4. Allegheny and Upper Genesee systems.

Etheostoma b. blennioides p. 319

H'. Lateral line scales 50 to 63, average 55 to 58 depending on population. Erie, Ontario, including the Lower Genesee, and Mohawk drainages.

Etheostoma b. pholidotum p. 319



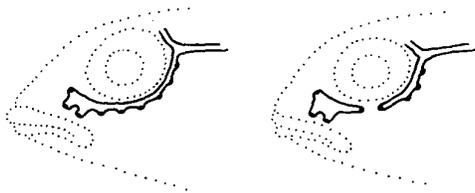
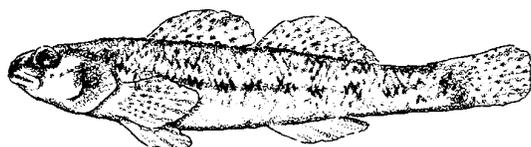
I. (G. Snout not especially overhanging the mouth, maxillary not bound to the preorbital region.) Two anal spines.

L.

I'. A single anal spine.

J. Infraorbital canal usually interrupted with four pores in the anterior section and two in the posterior. Preopercular-mandibular canal with eight or nine pores. Pectoral rays 10 or 11, sometimes 12. Mouth horizontal, profile before the eyes steeply declivous so the profile is almost vertical at the mouth. Six or more X- or W-shaped marks along the sides of the body. \mathcal{D}^c

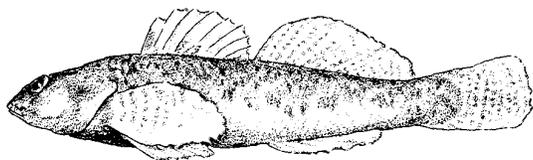
Etheostoma nigrum Johnny darter, p. 330



Infraorbital canal of tessellated (left) and Johnny darters.

J'. Infraorbital canal usually complete with eight pores. Preopercular-mandibular canal with 10 or 11 pores. Mouth somewhat oblique, snout pointed, profile sloping at the mouth. Nine to eleven X- or W-shaped marks along the midsides.

Etheostoma olmstedi Tessellated darter, K.



K. Nape usually naked; cheek partly to completely scaled. Breast usually naked. Belly partly scaled.

Etheostoma o. olmstedi p. 332

K'. Nape, cheek, breast, and belly fully scaled. Hudson River estuary.

Etheostoma o. atromaculatum p. 332

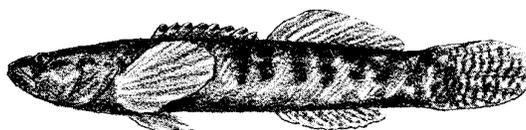
L. (I. Anal spines two.) Gill membranes separate, or at most only slightly joined anteriorly, but never broadly joined across the isthmus.

O.

L'. Gill membranes broadly joined across the isthmus.

M. Lateral line incomplete. Dorsal spines six to nine, short and often ending in fleshy knobs in mature males.

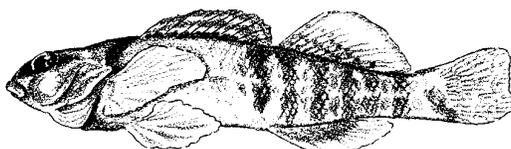
Etheostoma flabellare Fantail darter, p. 325



M'. Lateral line complete, dorsal spines more than nine, longer, and without fleshy tips.

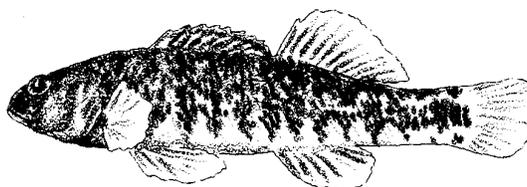
N. Dorsal spines 12. Cheeks naked. A dark band extends downward and forward across the nape to a blotch above the pectoral fin and behind the gill opening.

Etheostoma variatum Variegate darter, p. 333



N'. Dorsal spines fewer than 12. Cheeks scaled but the scales are often embedded and difficult to see. No oblique band anterior to the dorsal fin but the rounded upper ends of two dark blotches almost meet in the midline, leaving a characteristic pale space just ahead of the dorsal fin.

Etheostoma zonale Banded darter, p. 335



O. (L. Gill membranes separate or slightly joined across the isthmus.) Lateral line incomplete, ending below spiny or soft dorsal fin. Color pattern of sides mottled, or with bars, but never with narrow lines between the scales.

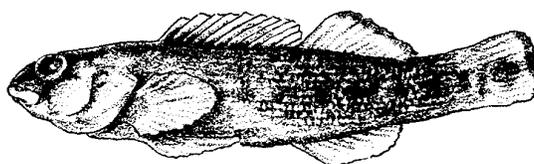
Q.

O'. Lateral line complete, or nearly so, ending near the caudal fold. Sides with narrow longitudinal lines of pigment between the scales.

P. Soft dorsal, anal, and caudal fins with a distinct black marginal band (the very edge of the fin is pale) and a pale submarginal band that is orange or red in life. Head only moderately pointed, contained about 3.5 to 3.8 times in the standard length. Tail square in young, slightly emarginate in adults. Lateral scales 50 to 60, usually about 55.

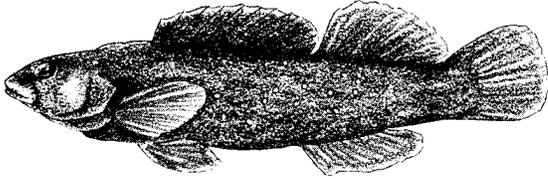
Etheostoma camurum

Bluebreast darter, p. 322



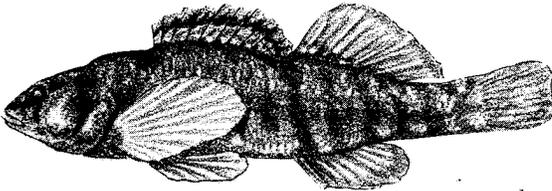
P'. Soft dorsal, anal, and caudal fins of adults without black marginal bands. Head long and pointed, about 3.2 to 3.6 times in the standard length. Tail rounded. Lateral scales 56 to 63, usually about 60.

Etheostoma maculatum Spotted darter, p. 329



Q. (O. Lateral line quite incomplete.) Body rather deep, its greatest depth about 4 to 4.5 times in the standard length. Scales large, 40 to 50 in lateral series. Lateral line ending below the soft dorsal fin.

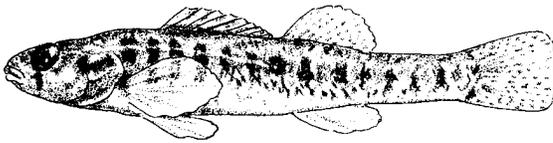
Etheostoma caeruleum Rainbow darter, p. 321



Q'. Body slender, its greatest depth 5.5 to 6.5 times in the standard length. Scales small, 47 to 62 in lateral series, usually more than 50.

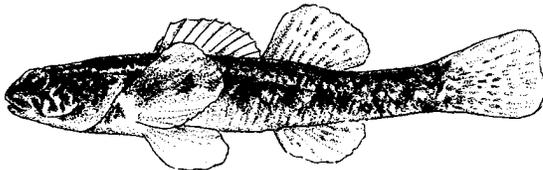
R. Lateral line only slightly arched and longer, ending below the soft dorsal fin. Scales 53 to 62, 4 or more scale rows between the lateral line and the base of the spiny dorsal fin. Erie and Ontario drainages.

Etheostoma exile Iowa darter, p. 324



R'. Lateral line noticeably arched and shorter, ending below the spiny dorsal. Scales 47 to 53, only 3 scale rows between the lateral line and the base of the spiny dorsal fin. Eastern Long Island and coast drainages.

Etheostoma fusiforme Swamp darter, p. 328



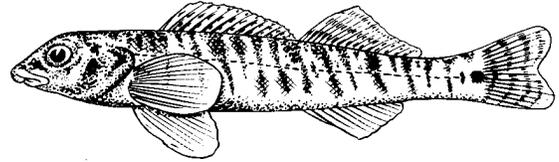
S. (F. One or more modified scales between the pelvic fins.) Snout pointed or blunt but not conical and not protruding in front of the mouth. Color pattern variable but not of alternating long and short vertical bars.

U.

S'. Snout conical and overhanging the mouth. Body pale yellowish and conspicuously marked with alternating long and short, narrow dark vertical bars.

Percina caprodes

Loggerperch, T.



T. Nape entirely scaled. Bars uniform and regular.

Percina c. caprodes

p. 338

T'. Nape with a triangular scaleless area. Bars less regular and often expanded at their lower ends into a midlateral row of blotches.

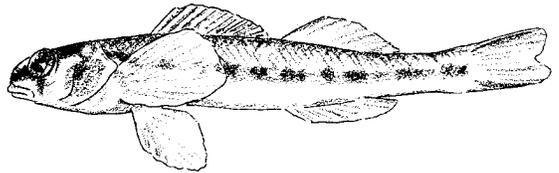
Percina c. semifasciata

p. 338

U. (S. Snout not conical and not protruding in front of the mouth.) Premaxillaries protractile, the upper lip separated from the tip of the snout by a groove.

Percina copelandi

Channel darter, p. 340



U'. Premaxillaries not protractile, the upper lip connected to the snout by a fleshy frenum (bridge) that interrupts the groove between the upper lip and the snout at the middle. (In *Percina shumardi* the frenum is sometimes crossed by a shallow groove.)

V. Belly mostly scaleless except for a patch of scales immediately in front of the anus. No midventral row of modified scales. Not definitely recorded from New York.

Percina shumardi

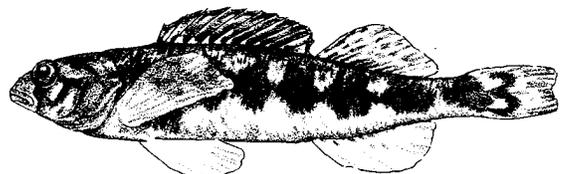
River darter

V'. Belly mostly scaled. Males with a midventral row of enlarged stellate scales.

W. Back with squarish, saddle-shaped blotches that line up with the midlateral blotches to form interrupted vertical bars.

Percina evides

Gilt darter, p. 341

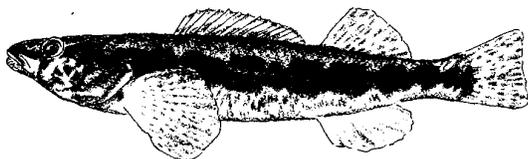


W'. Saddle-shaped blotches, if present, more or less alternating with the midlateral blotches, not forming vertical bars.

X. Ventral sides of head with one to three dusky blotches, the last of which sometimes joins the sub-orbital bar to form a sickle-shaped "teardrop" mark below the eye. Head long and narrow. Midlateral blotches almost fused to form a longitudinal stripe that varies in width.

Percina macrocephala

Longhead darter, p. 342

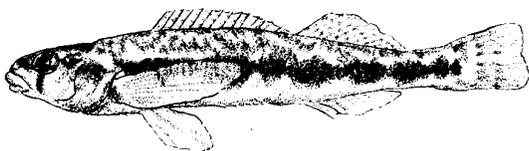


X'. Ventral side of head without blotches. Head wider, snout short. Midlateral blotches more or less separate, not forming an undulating band.

Y. Cheeks with scales.

Percina maculata

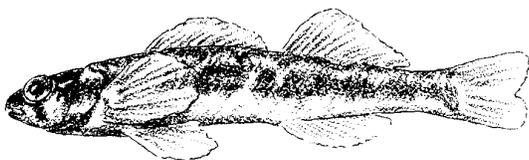
Blackside darter, p. 343



Y'. Cheeks scaleless.

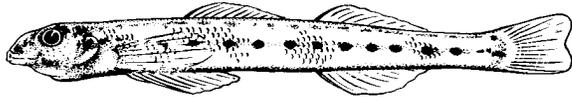
Percina peltata

Shield darter, p. 344



Ammocrypta

The genus *Ammocrypta* includes seven species of slender elongate darters with reduced scales. The preopercle is weakly serrated and there is one anal spine. Most of the species are nearly transparent. The belly and breast are without modified scales.



EASTERN SAND DARTER

Ammocrypta pellucida (Putnam, 1863)

Identification

The eastern sand darter is the most distinctive darter in the state. It is extremely long and slender, very pale, and has large areas of the body without scales.

Tiny young might be confused with correspondingly small johnny or tessellated darters but even when they are only a few millimeters long, the shape of the sand darter is distinctive.

Description

Body terete and very elongate. Profiles almost parallel. Dorsal origin over distal part of pectoral fin. Dorsal fins separated by a wide space. Third dorsal spine longest. Margin of spiny dorsal arched, interspinous membrane little indented. Soft dorsal low anteriorly, its rays progressively longer. Caudal emarginate, little rays equal to longest upper ray. Caudal lobes rounded. Anal origin below third dorsal soft ray. Anal rays progressively longer to antepenultimate. Pelvics inserted behind pectoral base well in advance of the dorsal origin. Pelvics pointed, no axillary process. Pectoral base vertical, pectoral pointed. Gill membranes joined anteriorly. Mouth small, horizontal, maxillary reaching to front of eye. Snout declivitous, lower jaw included. Scales on anterior part of body confined to a band along the side; caudal peduncle completely scaled. Lateral line complete. Counts and proportional measurements are given in Table 34.

Color: (from fresh specimens collected 17 August 1979) Sides with 11 to 15 oval spots that are shorter than the interspaces. These spots have their long axis horizontal and form a row just below the lateral line. Scales with sparse melanophores along their posterior margin but not completely outlined. Scales near the anal fin lack pigment. Dorsum with irregular spots that tend to be paired except along the base of the spiny dorsal fin where they alternate. On top of the caudal peduncle, these spots join to form short, irregular, crossbars. In larger specimens there are other spots and smudges on the dorsal surface, irregularly placed, but more abundant along the margin of the naked middorsal region.

Sides of snout with a dark spot in front of each eye. Tip of snout and upper lip densely pigmented. A dark line curves along the inner margin of each nostril, the two suggesting a lyre shape when the fish is viewed head on. There is a small spot at the tip of the snout.

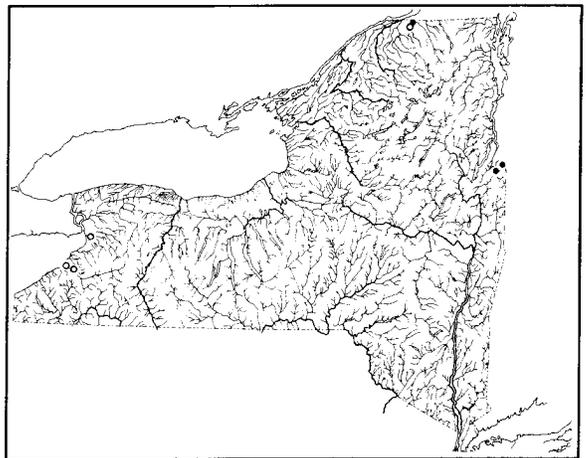
Fresh specimens have a broad yellow stripe on the middorsal surface from the tip of the snout to the base of the tail. A bright yellow line about two scales wide extends from the gill opening to the base of the caudal rays. All fins are hyaline except that there is a bar at the base of the caudal fin formed by melanophores along the margins of the fin rays. The pelvic fins of one large individual have similar subbasal bars and bright yellow pigment on the basal half of the inner two rays. The iris has a golden ring around the pupil.

Juveniles and breeding adults: Breeding tubercles are present on the ventral surface of the pelvic spines and pelvic rays, the dorsal surface of the pelvic rays and on the anal spine and rays (Williams, 1975).

Size: The largest specimens are slightly longer than 2 inches standard length.

Habitat

The sand darter is restricted to moderate-sized streams with clean sandy bottoms. This species is apparently becoming scarce throughout much of its range, and this decline is ascribed to habitat degradation. The sand darter requires fine sand with currents slow enough to retain sand but fast enough to prevent deposition of fine silt. Clearing the land for agriculture has probably resulted in silting of many streams that were formerly suited for the sand darter.



Distribution

The eastern sand darter occurs east of the Mississippi from southern Illinois and Kentucky through the Mississippi, Ohio, and Great Lakes drainages to southern Michigan and southern Ontario. It occurs in Lake Erie and its tributaries but the only New York records are from Cattaraugus Creek near Gowanda and Irving, and Cazenovia Creek near Buffalo where it was taken in 1893 by A. J. Woolman. There are no records from Lake Ontario but it is

present in the St. Lawrence River near Montreal where it was reported as common as recently as 1941. The Survey collected it in the Little Salmon River near Ft. Covington and J. Platt confirmed that it still is present by collecting a single specimen in 1980. In 1935, it was taken in the Lamoille River in Vermont about four miles from Lake Champlain. In 1979, we found a breeding population (as indicated by the presence of juveniles) in the Mettawee River south of Whitehall. Recently, it has been collected in the Poultney River on the border between New York and Vermont.

The absence of this species from Lake Ontario suggests that it may have reached Lake Champlain through glacial connections in the Mohawk Valley and glacial Lake Albany, although a more northern route is possible.

Life History

Apparently, the breeding behavior of this species has not been studied.

Food and Feeding

Several authors have reported that the sand darter dives into the sandy bottom and then lies concealed with only its eyes showing. From this position it ambushes its prey, mainly midge larvae and entomostacans. Some authors have reported that it buries itself headfirst and others have stated that it enters the sand tailfirst.

References

Jordan and Copeland, 1877 (general account). Williams, 1975 (systematics). Barnes, 1979 (occurrence, Ohio). Starnes et al., 1977 (distribution).

Names

Pellucida is from the Latin *pellucidus*, clear or transparent.

Pleurolepis pellucidus Agassiz in Putnam, 1863: 5 Black River, Elyria, Ohio

Ammocrypta pellucida (Baird), Greeley, 1929: 127 Lake Erie drainage

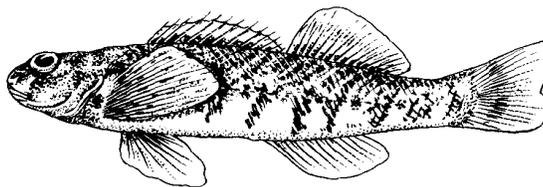
Ammocrypta pellucida (Putnam), Bailey et al., 1970: 75 (authorship)

Ammocrypta pellucida (Agassiz), Williams, 1975: 17-21 (review)

The confusion in the authorship of this species stems from the fact that Baird knew of the species and had intended to describe it under the name *E. pellucidum* but had not done so when it was cited in the article by Putnam. However, it is clear that Agassiz is responsible for the description and, under the International Code of Zoological Nomenclature, is the author of the species.

Etheostoma

The genus *Etheostoma* contains more than 100 species (91 described and about 12 more known but not yet formally described). Members of this genus are diverse but lack the clear flesh of *Ammocrypta* and the modified ventral scales of *Percina*.



GREENSIDE DARTER

Etheostoma blennioides Rafinesque, 1819

Identification

The greenside darter is a fairly large darter with a blunt head. The snout overhangs the mouth and the maxillaries are bound to the preorbital region for most of their length, which is to say that the groove between the maxillary and the area below the eye is present only at the posterior end of the maxillary bone.

In the field, young greenside darters resemble johnny or tessellated darters in general coloration but their markings tend to be in the shape of large W's or V's rather than X's or small W's. Greenside darters also have the caudal fin noticeably emarginate whereas the tails of the johnny and tessellated darters are nearly square or very slightly emarginate.

The two subspecies that occur in New York differ in scale size: *E. b. blennioides* from the Allegheny and Upper Genesee averages 65 or 66 lateral line scales; *E. b. pholidotum* from the Lower Genesee and Great Lakes tributaries averages 54 to 58, depending on locality.

Description

Body elongate, somewhat compressed, dorsal profile more curved than the ventral. Head blunt, snout overhanging the mouth, which is low and horizontal. Eyes high on the side of the head. First dorsal fin rectangular, last dorsal spines about as long as the first, originating over the anterior half of the pectoral fin. Dorsal fins contiguous. Second dorsal higher than the first, retrogressive, its margin slightly convex, corners rounded. Caudal emarginate with rounded lobes. Anal origin under soft dorsal origin, pelvics bluntly pointed, middle rays longest. Pelvic insertion anterior to dorsal origin. Pectorals pointed, slightly asymmetrical. Pectoral base nearly vertical. Gill membranes broadly joined across isthmus. Lateral line complete and nearly straight. Breast and prepectoral areas naked. Counts and proportional measurements are given in Table 34.

Color: Body pale tan to green, lighter ventrally. Dorsal surface with a squarish, saddle-shaped blotch in front of the dorsal origin and five or six less well developed squarish saddles along the base of the dorsal, the last of which ends at the upper procurrent caudal rays. Upper sides spotted with wavy dark lines that sometimes connect the lower ends of the saddle-shaped blotches. Sides with a longitudinal dark line interrupted by about eight V- or W-shaped marks. Upper sides of the males with scattered reddish brown spots. Dorsal fins with dark bands at their bases, the rest of the fins dusky. Caudal with four or five broad, vertical, irregular, dusky bands separated by pale spaces. Anal white, pectoral with rows of spots forming about five or six transverse dark bands. Pelvics with indistinct dark spots. Top of head dark, side of snout with a dark line connecting the anterior part of the eye with the anterior part of the upper lip. Teardrop mark sloping downward and forward. A dark spot on the opercles and another on the upper pectoral base.

Juveniles and breeding adults: In general, males of the greenside darter grow faster and reach a larger size than the females. During the breeding season, there is a marked difference in coloration and the males tend to have somewhat larger fins. Breeding color begins to develop in the fall and by January the males are quite dark. During the spawning season, both sexes are so dark that some of the blotches on the head and body are obscured. Males develop dark green vertical bands and their fins turn green. The red spots on the sides are prominent in all but the darkest males. The dorsal fin has a reddish basal bar, then a light green middle band, and a darker green outer band at the center of the fin, becoming paler toward the distal edge of the fin. The second dorsal has an orange-red basal bar that is wider at the front, a moderately dark middle band, and a light yellow or yellow-green outer band. Females tend to be predominantly yellow or greenish yellow.

Tubercles are present only in males, on the posterior part of the belly beginning about one-third of the distance from the pelvics to the anus behind the pelvics, and extending along the ventral surface of the belly and caudal peduncle to the base of the tail fin. There are three rows of scales with tubercles anteriorly, four or five rows just in front of the anus, and two rows on each side of the anal fin. There are no tubercles on the fins but the leading edge of the pelvic fin and the tips of its soft rays become swollen during the spawning period.

Size: The largest specimens are about 4.5 inches total length.

Habitat

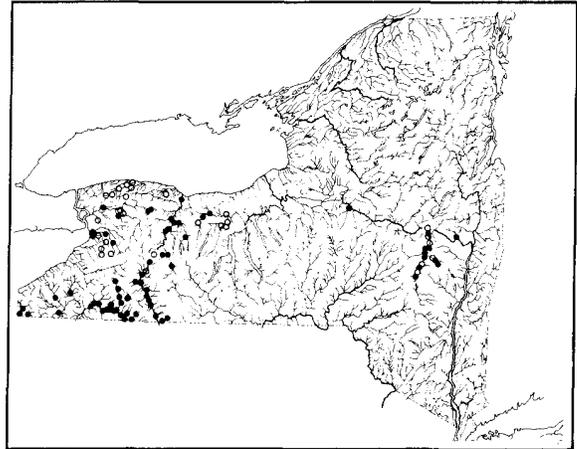
The greenside inhabits deeper riffles with cobbles and often some algae. It is most common in moderate-sized to larger streams. Small individuals are sometimes found in somewhat slower backwater areas.

Distribution

This species lives in the Ohio and Tennessee River

basins with disjunct populations in the Ozark region of Missouri and Arkansas and some populations in the Great Lakes drainage of northern Ohio, southern Michigan, and southern Ontario. Possibly it reached Lake Erie through the Wabash-Maumee connection. On the Atlantic coast, there are populations in the Potomac and a few western tributaries of the Susquehanna, which it apparently reached from the Allegheny. It also occurs in the Mohawk system.

In New York State, two subspecies are represented: *E. b. blennioides* lives in the Allegheny and Upper Genesee and *E. b. pholidotum* inhabits the Great Lakes, Lower Genesee and Mohawk systems. This indicates that the Mohawk population reached there from the Great Lakes rather than from the Susquehanna. Miller postulated that it reached the Mohawk during the Lake Warren stage or slightly later. Apparently, there are two populations in the Mohawk, one in Oriskany Creek and one in Schoharie Creek and eastward.



Life History

The greenside darter spawns in New York from the second week in April until June. Spawning takes place in swift riffles and the eggs are deposited on algae on rocks. Spawning is initiated when the water temperature reaches 51 F. Fahy noted that spawning takes place mostly at night and the eggs are laid in batches of 2 to 192 eggs. An individual may spawn as often as 5 times a night and the average female spawns approximately 37 times during a season. The eggs are demersal and adhesive and about 1.85 mm in diameter. Hatching takes place in 18 days at 55 to 58 F and the yolk sac is absorbed in 6 days at 60 F. Most individuals live 36 to 39 months; a few survive into the fourth or fifth growing season.

Food and Feeding

Turner reported that both large and small greenside darters fed on mayfly and midge larvae. Small young eat some entomostracans.

Notes

R. V. Miller reviewed the systematics of the greenside darter and divided it into four subspecies: *blennioides* Rafinesque, *newmani* Agassiz, *gutselli*

Hildebrand, and *pholidotum* Miller. There are slight differences between the Allegheny and Upper Genesee populations and in the Great Lakes populations as indicated by differences in lateral line scale count:

E. b. blennioides

Allegheny 57 to 72, average 65.15

Upper Genesee 60 to 71, average 65.91

E. b. pholidotum

Lake Erie 51 to 63, average 57.45

Lake Ontario 53 to 63, average 58.03

Lower Genesee 53 to 59, average 58.03

Seneca-Mohawk 50 to 58, average 54.94

In general, *E. b. pholidotum* has a fully scaled belly whereas in *E. b. blennioides* there is frequently a naked area on the anterior part of the belly.

References

Fahy, 1954 (life history). Winn, 1957 (egg site selection). Miller, R. V. 1968 (systematics). Denoncourt et al., 1977 (records in Susquehanna). Turner, 1921 (food). Ross, 1973 (chromosomes).

Names

Blennioides is a combination of the Latin *blennius*, a kind of blenny, and the New Latin *-oides*, like.

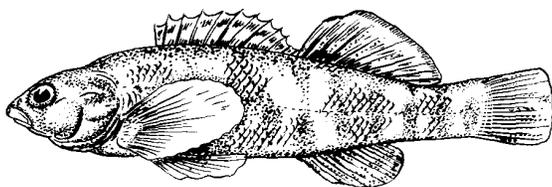
Etheostoma blennioides Rafinesque, 1819: 419
Ohio River

Diplesion blennioides, Hankinson, 1927: 484
Allegheny River

Etheostoma b. blennioides, Greeley, 1938: 71
Allegheny watershed

Etheostoma b. blennioides, Fahy, 1954 near Rochester (This is the form now called *E. b. pholidotum*.)

Etheostoma b. pholidotum Miller, 1968: 26-36
Bear Creek, Vermillion County, Illinois



RAINBOW DARTER

Etheostoma caeruleum Storer, 1845

Identification

The rainbow darter is a rather heavy-bodied species but it is more tapering than the spotted or bluebreast darter. Its gill membranes are narrowly joined across the isthmus, its belly is usually scaled, and its lateral line is short, with 18 to 30 pored scales out of a total count of 39 to 50. Males have some red in the fins throughout the year and become brilliant during the breeding season.

Description

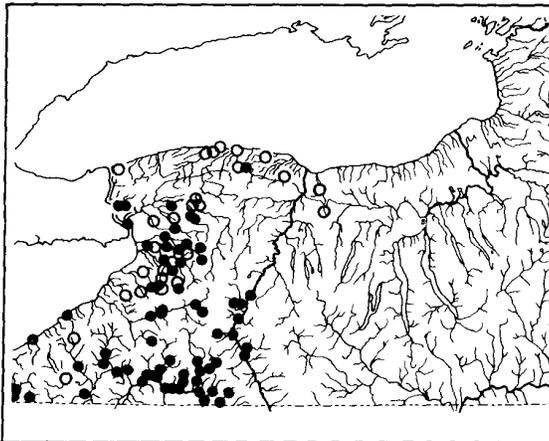
Body robust, moderately compressed. Profiles nearly symmetrical. Dorsal origin over basal half of

the pectoral fin. Dorsal fins contiguous, connected by a keel of membrane that is not crossed by scales. Spiny dorsal outline arched, its fourth to sixth spines longest, its membranes little incised. Soft dorsal highest anteriorly, its margin slightly convex, its last ray a little more than half the longest, its corners rounded. Caudal square to slightly emarginate, its middle rays longer than the longest upper rays, corners round. Anal round, its fourth or fifth rays longest. Pelvic insertion slightly ahead of dorsal origin. No pelvic axillary process. Pelvic fin pointed, its middle ray longest. Pectoral base slightly off vertical. Pectoral pointed, asymmetrical. Gill membranes slightly united across isthmus. Mouth moderate, slightly oblique, terminal, maxillary reaching to below the eye. Opercles scaled, cheeks, breast, and prepectoral naked. Predorsal scaled. Lateral line incomplete, ending below end of the second dorsal. Counts and proportional measurements are given in Table 34.

Color: Immatures have the body brownish or olive above, shading to pale grayish white ventrally. Dorsal midline with dark saddles immediately in front of dorsal origin, at rear of the spiny dorsal, and just behind the soft dorsal. A dark humeral scale present. Sides with dark bars, of which the last six extend to the anal base or the midventral line. The anterior, incomplete, bars are less prominent and often reduced to indistinct midlateral spots.

The spiny dorsal has a reddish-brown basal band separated by a clear area from a brownish central band. Distal to this there is a clear area with the last few interradial membranes red. Beyond this there is a broad, blue, submarginal band and a narrow clear margin. Soft dorsal dark, with two to four rows of dark spots. Caudal with a few irregular spots; anal clear. Pectorals and pelvics hyaline or slightly dusky. Lower side of head with a short, broad, subocular bar and a more distinct longitudinal bar on the side of the snout.

Juveniles and breeding adults: Juveniles are more prominently barred than adults. Breeding males develop intense blue on top of the head and body and bright orange on the vertical fins. Some of the lateral scales have red margins. The pale spaces



between the bars on the posterior sides of the body become bright reddish orange.

Collette found breeding tubercles on belly scales starting halfway between the pelvic and anal fins and extending four rows on each side of the anal fin. On the caudal peduncle, breeding tubercles are present on the five midventral scale rows.

Size: The maximum total length is about 68 mm.

Habitat

The rainbow darter lives in small creeks to moderate-sized rivers. It is very much a riffle species and is usually found in the gravel and cobble areas of the fastest parts of the streams.

Distribution

The rainbow darter ranges from the Ozarks of Missouri and northern Arkansas, and in the Mississippi drainage to central Minnesota, Wisconsin, and northern Illinois. It is found in the Tennessee and Ohio basins including the Wabash and other major tributaries. It occurs in Lakes Michigan, Huron, Erie, and the western part of Lake Ontario.

In New York, it is present in the Allegheny, Erie, and Ontario drainages. The Survey did not record it from the Genesee but it is now common in the region from Portageville to Caneadea and in Caneadea and Angelica Creeks. It appears to be a recent introduction in the Genesee where it is still in its explosive expansion stage.

Life History

In southern Michigan, Winn found that the males migrate to the spawning grounds in late March. Spawning takes place over fine gravel in water 4 inches to 2 feet deep. The females remain in pools below the riffles. When a female is ready to spawn, she moves onto the riffle where she is pursued by a male who drives away any competing males, thus, in effect, defending a moving territory around the female. Often a male becomes so occupied with chasing a competing male that he loses the female who is then pursued by another male or simply returns to the pool without spawning. The spawning female settles to the bottom and forces her head into the gravel and wriggles until the lower half of her body is buried. The male clasps her with his pelvic fins ahead of her depressed dorsal fin and his caudal region beside hers, with his anal and caudal fins on the same side of her body. The two vibrate rapidly and the eggs are released into the gravel. The female may spawn several times in succession with the same or other males before returning to the pool.

Rainbow darter eggs are 1.5 mm in diameter with a single oil droplet. The yolk is pale yellow. Cooper has described the developmental stages. Yolk absorption is complete by the time they reach 8 mm and the fin rays are fully formed at 9 mm total length. In this species there is no pigment around the vent until after the yolk has been absorbed. Lutterbie found that the young-of-the-year reach 37 to 42 mm by the first fall and 60 mm by the time the fourth annulus is formed.

Food and Feeding

Turner reported that young rainbow darters fed on entomostracans but that entomostracans were a negligible part of the diet of individuals more than 35 mm standard length. Fish more than 15 mm long fed on small mayfly and midge larvae while larger individuals took increasingly larger proportions of larger insect larvae, snails, and small crayfish.

Notes

The spread of this species through the Genesee Valley should be monitored carefully over the next few years.

References

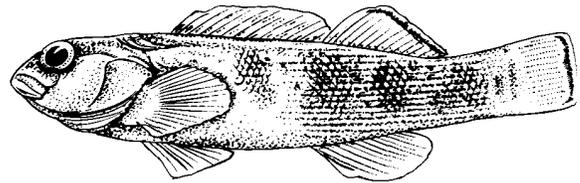
Reeves, 1907 (life history but part of the observations pertain to the orangethroat darter which the author did not distinguish). Adamson and Wissing, 1977 (food and feeding). Lutterbie, 1979 (age and growth). Winn, 1957 (egg site selection); 1958a, 1958b (life history). Cooper, 1979 (development). Knapp, 1964 (systematics). Esmond and Stauffer, 1983 (populations). Ross, 1973 (chromosomes). Collette, 1965 (breeding tubercles). Turner, 1921 (food and feeding).

Names

Caeruleus is Latin for the color blue.

Etheostoma caerulea Storer, 1845: 47 Fox River, Illinois

Poecilichthys caeruleus caeruleus, Greeley, 1929: 177 Erie-Niagara drainage



BLUEBREAST DARTER

Etheostoma camurum (Cope, 1870)

Identification

The bluebreast is a deep-bodied, rather compressed fish with a deep caudal peduncle and a moderately pointed head. It most resembles the spotted darter but differs in having conspicuous, dark, submarginal bands on the soft dorsal, anal, and caudal fins. It also has a less pointed snout and a more square or slightly convex tail than does the spotted darter.

Description

Body moderately elongate, compressed, upper profile somewhat more curved than the ventral. Caudal peduncle rather deep. Dorsal origin above basal half of pectoral fin. Dorsal fins contiguous, connected by a low keel of membrane. Spiny dorsal arched, its interspinous membranes little incised. Soft dorsal high anteriorly, its last rays about half the first, its margin nearly straight. Caudal fin square, its middle rays longer than the longest upper rays.

Anal origin under origin of second dorsal. Anal margin convex, its fourth ray longest. Pelvic pointed, its third ray longest. Pelvic insertion under origin of spiny dorsal. Pectoral asymmetrical, bluntly pointed, its base nearly vertical. Gill membranes separate. Mouth low, horizontal, maxillary reaching to below front of eye. Frenum present. Lateral line complete. Opercle scaled; breast, prepectoral, predorsal and cheek naked. Counts and proportional measurements are given in Table 34.

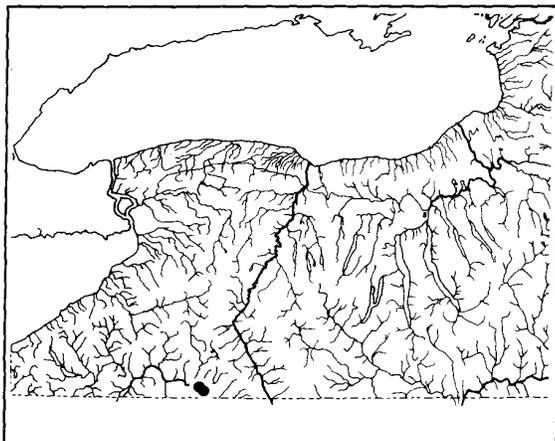
Color: Overall color yellowish olive, lighter below. Sides with irregular patches of one to four dark scales each. Posterior sides with lines of dark pigment in the region of overlap between the longitudinal scale rows. There are eleven of these lines which become fainter beneath the spiny dorsal and are absent from the belly. Scattered scales of the sides are bright red in life. There are two pronounced white spots, each about equal in size to the pupil, at the base of the caudal fin. Most of the scales of the upper sides are outlined by a single row of melanophores. There is a dusky teardrop band below the eye and a pronounced dark spot behind the lower posterior part of the orbit. There is another dark spot above and slightly behind the upper pectoral fin base. Paired fins whitish. First dorsal fin dusky except for a light submarginal band. Soft dorsal, anal, and caudal dusky at base with a white stripe, distal to which there is a darker marginal band, then a very narrow white edge on all three of these fins.

Juveniles and breeding adults: Juveniles are miniatures of the adults. The breeding males have the belly and ventral surface of the head bright blue black and very bright red spots on the sides. Often there are 8 to 12 more or less conspicuous vertical bands or midlateral spots. Females are less brightly colored.

Size: This is a moderate-sized darter, reaching slightly more than 3 inches total length.

Habitat

According to Trautman, the bluebreast darter inhabits larger streams with low turbidity, where it occurs in fast-flowing sections with deep riffles over large cobbles and some sandy gravel. Apparently, they migrate upstream during the breeding season



and retreat to the lower reaches in the late fall or winter.

Distribution

Zorach presented a map of the known records for the bluebreast darter. Its total range is from tributaries of the Tennessee River from southern Tennessee and North Carolina, north through Kentucky, extreme eastern Illinois, Indiana, Ohio, West Virginia, and the Allegheny River and French Creek in northwestern Pennsylvania. It has only recently been collected in New York State. So far two specimens are known: The first (AMNH 55389) was collected 20 September 1973 by Dr. Steve Eaton and students and the second (AMNH 39292) was collected 25 October 1975 by American Museum field crews. Both specimens are from the Allegheny River near Westons Mills and Portville.

Life History

Mount studied the life history of the bluebreast darter in central Ohio. He was not able to observe the spawning act in the field but he did find breeding adults in riffle areas of moderately large streams and there were indications that the eggs were laid in fine gravel that had collected downstream of large rocks. Spawning occurred during the last 2 weeks of May and the first 2 weeks of June, sometimes to the end of June, when the water temperature ranged from 21 to 24 C. Males showed brighter coloration in April when the water temperature reached 13 to 15 C.

Mount was able to get the darters to spawn in an artificial stream, a rectangular trough with a divider down the middle and a paddle wheel that moved the water around the periphery of the trough. Rocks and the corners of the trough caused eddies that approximated conditions in stream riffles. Males set up poorly defined territories and defended them against intruding males, darting at them, and ramming them, and nipping at their fins, but never causing any real damage. The limits of the territories did not seem to be sharply defined and frequently a male would move to another rock. With approach of the spawning period, females also became pugnacious, darting at each other but without actual contact. During these conflicts, both sexes developed two black bands encircling the body just behind the pectoral fin.

Females appeared to select the spawning sites and to initiate spawning. They would entice the males by swimming close to the bottom in short spurts. The males would then follow, sometimes for an hour or more, during which time the pair would occasionally swim up toward the surface. Finally, the female would bury her head in the gravel and raise her body until it was nearly perpendicular. (Mount was not sure if this was a normal display or the result of the gravel in his tank being too shallow. In any case, it stimulated the male to mount her.) Finally, the female moved to the spawning site, a riffle behind a rock where the current was swift and the gravel was about 3 inches deep. Here she buried herself until her back was level with the surface

of the gravel. Then the male came to lie on top of her although the position of his lower fins could not be determined. The pair vibrated together vigorously as the eggs were released. They would frequently vibrate for 3 to 5 seconds, then rest for 3 to 5 minutes before another spawning episode. About 100 eggs were released, sometimes during a single spawning and sometimes over several episodes. Mount's studies suggested that most females spawned at least three times during the season. Spawning occurred throughout the day but most frequently during the afternoon and evening. At 21 to 24 C, the eggs hatched in about 10 days.

Food and Feeding

The food consists chiefly of benthic insects, especially dipteran larvae.

Notes.

The species is still rare in New York and it is not known if it is expanding its range or was merely missed by the Survey.

References

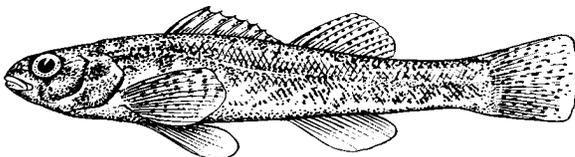
Zorach, 1972 (systematics). Mount, 1959 (spawning behavior). Trautman, 1981 (Ohio). Ross, 1973 (chromosomes).

Names

Camurus is Latin for blunt-headed.

Poecilichthys camurus Cope, 1870: 265 headwaters of the Cumberland River

Etheostoma camurum, Yochim, 1981: 14 Allegheny River



IOWA DARTER

Etheostoma exile (Girard, 1860)

Identification

The Iowa darter is a slender, nearly terete species with a blunt snout. It is generally rather dark brown with a conspicuous pale lateral line that ends below the spiny dorsal fin. The mature males have some red color in the fins and become brilliant during the breeding season.

The Iowa darter is most like the swamp darter, *Etheostoma fusiforme*, but the swamp darter is confined to the eastern part of Long Island and the Iowa darter in our state is limited to the Great Lakes drainage. Iowa darters do not have breeding tubercles, but the males are brightly colored. In the swamp darter the situation is reversed; the males do not develop bright color but they do have tubercles on the anal rays and the undersides of the pelvic fins.

Description

Body elongate, caudal peduncle slender, little compressed. Dorsal profile more arched than the ventral; body deepest ahead of the dorsal fin. Dorsal origin over basal half of the pectoral fin. Spiny dorsal arched, fourth spine longest. Dorsal fins well separated with scales crossing the interspace. Soft dorsal highest anteriorly with the last ray two-thirds the first. Interspinous membrane not deeply incised. Caudal square, its middle rays longer than the longest upper rays. Anal fin origin below third dorsal soft ray.

Anal convex, its third ray longest. Pelvic origin below dorsal origin. Pelvics pointed. Pectoral pointed, slightly asymmetrical, its base sloped. Gill membranes separate. Snout blunt, mouth low and horizontal. Frenum well developed. Maxillary reaching to below front of eye. Prepectoral and breast naked. Cheeks and opercles scaled. Lateral line ending below origin of second dorsal. Counts and proportional measurements are given in Table 34.

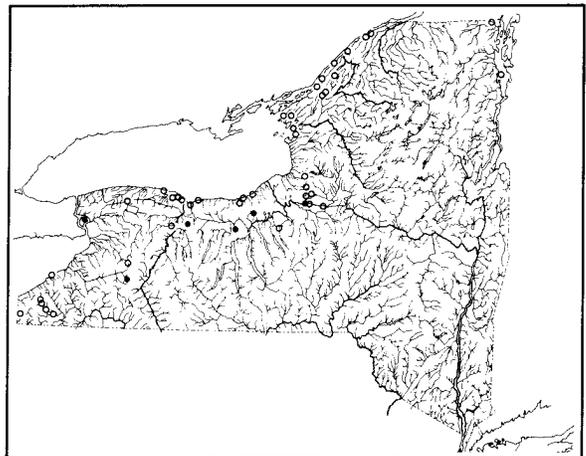
Color: Overall brownish, shading to yellow or white ventrally. Lateral line conspicuously pale. Midside with a row of 9 to 12 vertical bars. Middorsal region with about the same number of vague saddle-shaped blotches. Side of snout with a well-defined longitudinal stripe and a distinct teardrop mark below the eye. Spiny dorsal with ocellated blue spots on basal part of membranes. Males with a submarginal blue band. Soft dorsal, caudal, and pectoral with bands of dark spots. Anal and pelvics hyaline.

Juveniles and breeding adults: In breeding males, the bars become blue or green and the interspaces bright red, merging with a bright red streak along the lower sides below the ends of the vertical bands. Spiny dorsal with a broad orange band.

Size: Lutterbie reported Wisconsin specimens 69 mm standard length.

Habitat

The Iowa darter is a slow-water species that occurs among vegetation and often over flocculent bottom in lakes, ponds, or the slower sections of streams.



Distribution

This species occurs in a broad curving band from Alberta and Saskatchewan through southern Manitoba, southern Ontario and southern Quebec. It reaches the St. Lawrence drainage of New York and occurs in central Ohio, northern Illinois and central Nebraska. It lives in the Platte River in Wyoming and eastern Montana. In New York, there are scattered records in the western part of the state, Oneida Lake, and the St. Lawrence corridor.

Life History

In Whitmore Lake in southern Michigan, male darters established territories along undercut banks in late March or early April. Spawning occurred on fibrous roots, the females moving into the territories for spawning and then returning to deeper water. As in other darter species, the male mounted the female with his pelvic fins over her first dorsal and his caudal peduncle next to hers. Sometimes the females wriggled into the vegetation or gravel on which the eggs were to be laid; often they did not.

Food and Feeding

Turner found that young Iowa darters fed chiefly on entomostracans, and larger organisms were taken by larger fish. The diet also increased in complexity with increasing age and older individuals fed on amphipods, midge larvae, and other insect larvae.

Notes

This is a glacial species that appears to be holding its own in New York.

References

Collette, 1962 (systematics). Lutterbie, 1979 (age and growth). Gosline, 1947 (variation). Winn, 1958b (spawning). Turner, 1921 (food habits).

Names

Exile is Latin for slender.

Boleichthys exilis Girard, 1860: 103 Little Muddy River, Wisconsin

Poecilichthys exilis, Greeley, 1928: 101 Oswego drainage

Poecilichthys borealis Jordan, 1884: 477 Montreal

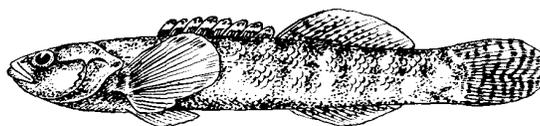
Etheostoma iowae Jordan and Meek, 1885: 10 Chariton River, Iowa

Poecilichthys iowae, Hankinson, 1924: 86 western New York

Boleichthys eos Jordan in Nelson, 1876: 34 Illinois

Boleichthys fusiformis eos, Bean, 1903: 521 Cape Vincent

Etheostoma boreale, Evermann and Kendall, 1902c: 240 St. Lawrence



FANTAIL DARTER

Etheostoma flabellare
Rafinesque, 1819

Identification

The fantail darter is a rather slender species with a pointed head, a terminal mouth, and a deep caudal peduncle. Its gill membranes are broadly joined across the isthmus; its tail is squarish or rounded; and its lateral line ends below the second dorsal fin. There is a conspicuous dark scale on the body behind the upper end of the gill opening, regular bars on the sides, and fine dark crossbands on the tail. In both sexes the dorsal spines are short and in the adult males the spines have fleshy knobs that are used to groom the eggs.

There is no other species in New York with which it is apt to be confused.

Description

Body elongate and somewhat compressed. Profiles nearly symmetrical and almost parallel. First dorsal low, arched, membrane somewhat incised between spines. Tips of spines lightly fleshy in females, decidedly so in males. Soft dorsal highest anteriorly, its fourth ray longest. Caudal rounded, its middle rays substantially longer than the longest upper rays. Anal origin below the third soft dorsal ray. Fifth or sixth anal ray longest. Pelvic insertion in advance of dorsal origin, below pectoral base. Pectoral base inclined backward. Gill membranes broadly united across isthmus. Snout pointed, mouth oblique and terminal, maxillary reaching to below the anterior edge of pupil. Lateral line straight, ending below middle of soft dorsal. Frenum present. Cheeks, opercles, breast, and prepectoral areas naked. Counts and proportional measurements are given in Table 34.

Color: Body ground color olive, shading to pale gray on the belly and ventral side of the head. Humeral scale prominent. Back with about 8 to 10 saddle-blotches between the nape and the upper caudal base. Sides with 10 to 12 or more dark vertical bars not connected with the dorsal saddles. First dorsal uniformly dusky, second dorsal with sloping rows of spots. Caudal with about five prominent, narrow, dark, vertical bars. Anal, pectorals, and pelvics pale.

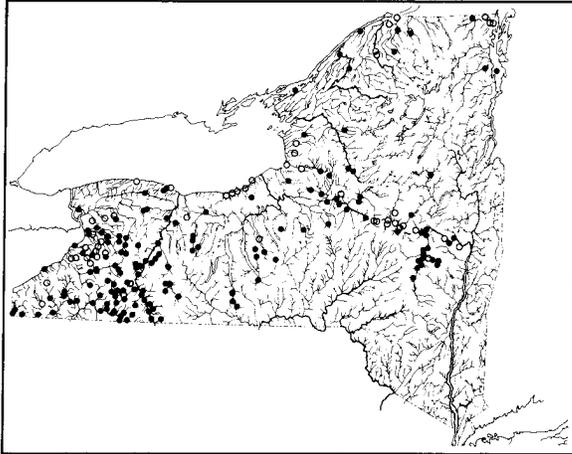
Juveniles and breeding adults: Breeding males are darker with bright orange knobs on the dorsal spines and a yellowish wash over the body. In large adults of both sexes the second dorsal, caudal, anal, and pelvics are spotted.

Size: Lutterbie (1979) recorded specimens up to

74 mm total length from Wisconsin. We have New York specimens up to 3.25 inches total length.

Habitat

Fantail darters occur in riffle areas of streams where there are cobbles and gravel. They are especially abundant in streams where there are chunks or slabs of limestone or shale.



Distribution

This species occurs from southern Minnesota and Wisconsin, east through the southern Great Lakes (excluding Lake Superior) to southern Quebec and New York State. It ranges south in the Mississippi Valley to the Ozarks of eastern Kansas, eastern Oklahoma, Missouri, and northern Arkansas. In the Tennessee basin, it reaches northern Mississippi and Alabama. On the upland parts of the Atlantic slope, it ranges from northern South Carolina to southern New York. In New York, it occurs in the western and northern parts of the state but is absent from the Lower Hudson.

Life History

Lake studied the life history of the fantail darter in Black Creek, near Rochester. Spawning occurred in late April to mid-June after the water temperature reached 60 F. Males moved onto the spawning grounds, areas of moderate current above riffles, and selected their nest sites. These were usually flat rocks with a space about one-half inch high beneath them. A male cleaned his nest by wriggling his body into the crevice. Other males were chased away from the site but a female was enticed into the nest by bunting and prodding. After circling each other, the female rolled over to apply her vent region to the roof of the nest and the male assumed a head to tail position, rolling on his side and twisting the posterior part of his body to bring his vent region into proximity with that of the female. The eggs were deposited in groups of 1 to 3 at intervals of 1 to 3 minutes until about 45 eggs had been deposited. Both parents vibrated vigorously as the eggs were released and fertilized. The female remained inverted but the male turned upright between spawning episodes. After spawning the female left and the male enticed other females to spawn until the nest contained as many as 562 eggs.

The male guarded the nest, periodically grooming the eggs with the fleshy tabs on his dorsal spines, until the eggs hatched: 30 to 35 days at 63 to 68 F, 21 days at 70 F, and 14 to 16 days at 74 F.

Dissections suggested that each female spawned 5 times and that a new crop of eggs developed by November. A 33-mm female contained 128 eggs; a 49-mm female contained 422 eggs. The eggs averaged 2.3 mm in diameter.

By fall, the young averaged 30 mm and they reached sexual maturity by the following summer. Lutterbie found that Wisconsin fantail darters averaged 23.4 to 32.2 mm at age I, 39.23 to 54.78 at age II, 36 to 63.4 at age III, and 60 to 72 at age IV.

Cooper described the eggs and larvae of laboratory-reared specimens from Elk Creek, Pennsylvania, a Lake Erie tributary. The eggs were 2.3 to 2.7 mm in diameter and often somewhat elliptical, with a single oil droplet 0.7 to 0.8 mm in diameter. The yolk was pale yellow and 2 mm in diameter. Newly hatched larvae were 6.2 mm long and still retained a large yolk sac that was 31 percent of the total length. The yolk sac was retained until most of the fin rays were complete but was completely expended 7 to 10 days after hatching.

Food and Feeding

Daiber reported on the winter food of the fantail darter and the mottled sculpin in Vandermark Creek, a headwater tributary of the Genesee River in Allegheny County. Both species consumed a variety of insects, including mayflies, caddisflies and dipterans, and copepods, but the darters ate more other kinds of invertebrates including cladocerans, amphipods, isopods, hydrachnids, and gastropods. Such groups, however, made up only a small part of the diet. Medium-sized fish ate the greatest variety of food.

Turner found that young fantail darters ate mayfly and midge larvae whereas larger fish ate mayfly and midge larvae and other larger insects. In Lake Erie, they ate amphipods but he found no amphipods in the stomachs of stream-dwelling fantail darters.

References

Jaffa, 1917 (breeding). Lake, 1936 (life history). Cooper, 1979 (eggs and larvae). Adams and Wissing, 1977 (food and feeding periodicity). Lutterbie, 1979 (age and growth). Karr, 1965 (ecology). Daiber, 1956 (food). Turner, 1921 (food). Ross, 1973 (chromosomes).

Names

The species name is from the Latin *flabellaris*, like a fan, in reference to the shape of the tail.

Etheostoma flabellare Rafinesque, 1819: 419 tributaries of the Ohio River

Etheostoma linsleyi Storer, 1851: 37 Wolcott, Wayne County, New York

Catonotus fasciatus Girard, 1860: 68 Madrid, New York; Grass River

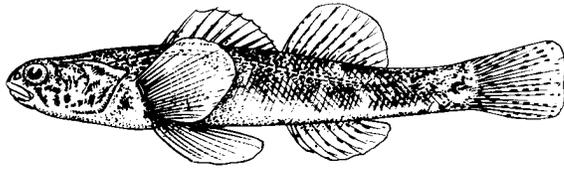
Catonotus flabellaris, Greeley, 1927: 64-65 Genesee River drainage

Catonotus flabellaris flabellaris, Greeley and Greene, 1931: 92 St. Lawrence drainage

TABLE 34
AVERAGE PROPORTIONAL MEASUREMENTS AND COUNTS OF
DARTERS (*Ammocrypta* and *Etheostoma*, in part)

All proportions are expressed in percentage of standard length.

	<i>Ammocrypta</i>			<i>Etheostoma</i>		
	<i>pellucida</i>	<i>blennioides</i>	<i>caeruleum</i>	<i>camurum</i>	<i>exile</i>	<i>flabellare</i>
ST. LENGTH (mm)	46.3	59.5	40.3	40.4	26.5	47.2
TOTAL LENGTH	116.4	120.6	121.1	116.0	120.8	118.1
FORK LENGTH	115.0	118.5	121.0	116.0	120.8	118.1
PREDORSAL	36.8	32.2	35.7	33.4	36.2	34.4
PREANAL	63.6	60.6	63.6	65.0	62.1	63.9
PREPELVIC	27.4	27.9	33.5	33.2	33.8	29.5
DORSAL BASE	40.6	52.2	52.5	49.2	40.0	47.6
ANAL BASE	12.9	13.3	13.9	13.0	12.4	14.9
BODY DEPTH	10.6	18.5	21.6	19.8	18.2	18.1
BODY WIDTH	9.6	14.7	13.8	12.8	13.0	13.2
C. PED. DEPTH	6.1	9.8	11.4	12.1	9.6	12.5
PECTORAL ALT.	7.0	11.3	13.7	11.4	11.7	10.7
HEAD LENGTH	24.3	24.5	30.2	28.0	29.8	28.7
SNOUT	7.0	7.5	7.8	6.4	7.0	6.2
EYE	5.9	6.9	6.9	7.4	8.5	5.2
MOUTH LENGTH	6.9	6.1	8.8	8.2	9.0	8.1
INTERORB	2.6	2.1	4.1	2.8	4.7	4.9
N (sample size)	5	5	5	5	5	5
COUNTS:						
DORSAL SPINES	X	XII-XIV	X-XI	XII	VIII-XI	VII-VIII
DORSAL RAYS	8-10	12-13	13-14	12-13	10-12	11-13
ANAL RAYS	II,7-11	II,8-9	II,6-7	II,7-8	II,7	II,7-8
PECTORAL RAYS	12-16	14-15	10-15	13-14	12-14	11-13
PELVIC RAYS	I,5	I,5	I,5	I,5	I,5	I,5
GILL RAKERS	12-15	8-10	9-11	12-13	7-11	11-13
VERTEBRAE	42-44	41-42	36-37	37-38	38-39	34
SCALES:						
ABOVE L. L.	0-7	7	4-7	7	4-5	6-8
LATERAL LINE	62-84	60-70	36-57	54-59	58-59	45-60
BELOW L. L.	2-10	8-10	6-10	7-8	8-9	8-10



SWAMP DARTER

Etheostoma fusiforme
(Girard, 1854)

Identification

The swamp darter is a slender fish with a short, arched lateral line that ends below the spiny dorsal fin. The snout is rather blunt, the infraorbital canal is incomplete, and the breast is completely scaled. Although it is quite variable in color, this is a somber species that never develops bright breeding colors. It leaves the overall impression that its head is small for the size of its body.

The swamp darter superficially resembles the Iowa darter but their geographical distributions are quite different and there is little danger of confusion. The swamp darter is confined to the lowlands of the Atlantic coast while the Iowa darter is a mid-continent species that reaches our state only in the St. Lawrence drainage.

About 10 percent of the swamp darters have weak serrations on the preoperculum.

Description

Body elongate, little compressed. Head blunt, dorsal profile more arched than the ventral. Dorsal origin over the basal third of the pectoral fin. Dorsal fins contiguous, no scales between them. Spiny dorsal arched, the fourth through the sixth spines longest, the membranes not incised. Soft dorsal margin convex, the last ray two-thirds the second and third rays. Caudal square with rounded corners, middle rays equal to longest upper rays. Anal origin under third dorsal soft ray. Anal margin convex, its third ray longest. Pelvic insertion under dorsal origin. Pelvics pointed, third ray longest. Pectoral base oblique, pectorals paddle-like, nearly symmetrical with rounded margin. Gill membranes broadly united across isthmus. Snout blunt, mouth only slightly inclined, lower jaw included. Maxillary ending below anterior third of eye. Body fully scaled. Cheeks and opercles scaled. Lateral line incomplete, arched anteriorly and ending below spiny dorsal. Counts and proportional measurements are given in Table 35.

Color: Generally brownish with various pale marblings on the back and sides. Midventral region from the isthmus to the caudal base pale with a few dark brown spots. Edge of shoulder girdle above pectoral base with a dark bar which sometimes continues downward to the pelvic base. Midside of body with nine short, broad, indistinct bars of which the anteriormost ones are vertical, the middle ones are squarish, and posterior ones horizontal. Base of caudal with three distinct dark spots in a vertical

row, the middle one quite variable in size and shape. Cheeks and lower sides of head spotted, with a well-developed teardrop bar. A dark line around the snout.

Juveniles and breeding adults. Breeding tubercles are developed on the pelvic fins. This species does not develop bright breeding colors.

Size: To at least 2 inches total length.

Habitat

This is a species of slow-moving or still waters and rarely occurs in flowing streams and then only in low abundance. Usually, it is found over mud and detritus bottom where there is abundant aquatic vegetation, but sometimes it occurs over open sand. In aquaria, swamp darters were seen to spend much of their time resting on plants such as *Elodea*. The swamp darter appears to be quite tolerant of low oxygen and low pH and there are documented cases of it becoming more abundant as its habitat became more acid.



Distribution

The subspecies *E. f. fusiforme* ranges from the southeastern tip of Maine southward along the Seaboard Lowland section of New England and the Atlantic Coastal Plain to the Waccamaw River in North Carolina. South of the Waccamaw, it is replaced by the subspecies *E. f. barrati*, which continues along the southern Atlantic and Gulf Coastal Plains, peninsular Florida, and the lower Mississippi Valley as far north as southern Illinois.

In New York, its distribution is limited to the eastern two-thirds of Long Island.

Life History

Fletcher and Collette have reported on the spawning behavior of this species. Specimens collected in late April from Lake Ronkonkoma began spawning activities in the aquarium almost immediately. The male approached from the rear and came to lie on top of its mate, fanning or beating with his pelvic fins. Females would accept this but males would move away. Later, when the females were ready to spawn, they would lead the male into floating vegetation near the top of the tank. They lay side by side and the female directed her genital papilla forward and upward into the vegetation. She would then

vibrate rapidly as the eggs were expelled, although the egg laying could not be seen. On Long Island and in New Jersey, the spawning occurred in early May. Only one age-class was present in fall collections and Collette concluded that most individuals do not live through their second summer.

Food and Feeding

Copepods have been found in the stomachs of swamp darters and Collette found that aquarium specimens would accept a variety of small items such as *Daphnia*, worms, and even dried food. Unfamiliar items were inspected visually, then mouthed cautiously before being swallowed or spit out.

References

Hubbs and Cannon, 1935 (systematics). Collette, 1962 (systematics). Fletcher, 1957 (spawning). Schmidt and Whitworth, 1979 (distribution and habitat).

Names

Fusiformis is a Latin word meaning spindle-shaped.

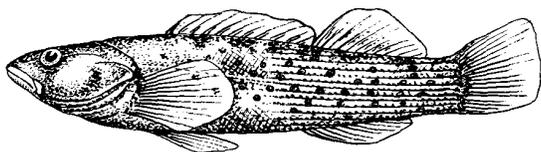
Boleosoma fusiforme Girard, 1854b: 41 Charles River, Massachusetts

Boleichthys fusiformis, Bean, 1903: 520-521 Long Island

Hololepis fusiformis, Greeley, 1939: 43 Long Island

Hololepis fusiformis fusiformis, Hubbs and Cannon, 1935: 77-81

Etheostoma fusiformis fusiformis, Collette, 1962: 150-172 (summary account)



SPOTTED DARTER

Etheostoma maculatum

Kirtland, 1841

Identification

This is a heavy-bodied, compressed darter, with a deep caudal peduncle and a striking color pattern of narrow, longitudinal, dark lines on the body. The head is especially compressed and the snout is quite sharp.

The spotted darter is quite similar to the bluebreast darter but has more lateral line scales (57 to 62 as compared with 53 to 58 in the bluebreast), a more pointed head, and a rounded rather than emarginate tail. The second dorsal, anal, and caudal fins of the bluebreast have conspicuous, dusky, submarginal bands but this is not true of the spotted darter, in which these fins have pale to white margins. The males of both species have red scales, with darker margins, scattered over the sides of the body. There are similar spots in the females of the

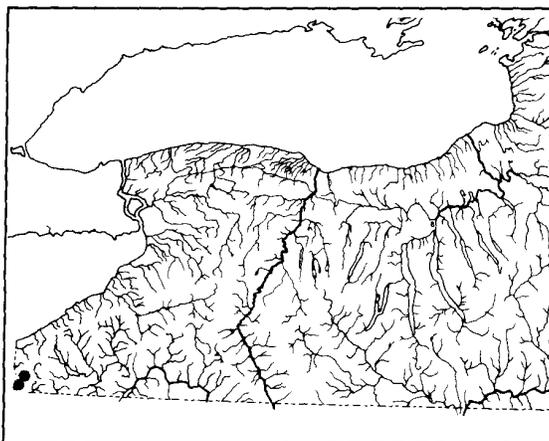
bluebreast but the female spotted darter has no red spots.

Description

Body compressed, rather elongate, and rectangular with a deep caudal peduncle. Profiles nearly symmetrical. Dorsal origin shortly behind the pectoral axil. Spiny dorsal arched, its seventh and eighth spines longest, interspinous membranes not incised. Dorsal fins contiguous. Second dorsal highest anteriorly, its margin convex, first and last rays about four-fifths the third, longest, ray. Caudal margin convex, the middle rays noticeably longer than the longest upper rays. Anal origin slightly ahead of the origin of the soft dorsal. Anal arched, its sixth or seventh ray the longest. Pelvics inserted below origin of the spiny dorsal, pointed, their third rays longest. Pectorals bluntly rounded, their bases nearly vertical. Pectoral bluntly and asymmetrically rounded. Gill membranes separate. Frenum present. Snout long and pointed, mouth terminal. Maxillary reaching level of anterior margin of the eye. Lateral line ending under end of second dorsal, a few scales with tubes on caudal peduncle. Predorsal, cheeks, prepectoral, and breast naked. Counts and proportional measurements are given in Table 35.

Color: Females and young fish have the body generally tawny with about nine dusky saddles. Midsides with about 10 vertical bars which are short and narrow anteriorly, becoming longer and broader until the last 4 or 5 connect with the dorsal saddles and the last 2 or 3 reach the midventral line. Spiny dorsal dusky at base, somewhat spotted distally. Soft dorsal with five rows of spots formed by concentrations of melanophores along the rays. Caudal with about five, and anal with about three, similar rows of spots. Pectoral with some spots, pelvic merely dusky. Indistinct dark lines radiating from the eye. Posterior part of the body with 11 narrow dark longitudinal lines that begin just in front of the anal origin and continue to the caudal base. Caudal base with two large white spots. Sides of males with scattered small red spots.

Juveniles and breeding adults: Breeding males are dark brown without spotting on the fins. Mar-



gins of fin bright greenish yellow. Red spots on sides brilliant.

Size: The spotted darter reaches lengths of approximately 4 inches total length.

Habitat

In French Creek, we collected this species only in the deepest and fastest parts of the riffles where the water was more than a foot deep and there were large rocks with abundant growths of filamentous algae.

Distribution

In New York, this species occurs only in French Creek where it was moderately common in 1975 and 1979.

The subspecies *Etheostoma maculatum maculatum* ranges southwest through the northern tributaries of the Ohio River. There is an old record from the Tippecanoe River in Indiana, but no specimens have been reported from that state since the turn of the century and it is now scarce and sporadically distributed in Ohio as well. It is present in the Green River in Kentucky but is now scarce. Zorach and Raney recognize two other subspecies: *E. m. sanguifluum* in the Cumberland River system of Kentucky and *E. m. vulneratum* in the Upper Tennessee River system in Tennessee, North Carolina, and Virginia.

Life History

The breeding habits of this colorful species were described by Raney and Lachner. Their observations were conducted in French Creek in Erie County, Pennsylvania. The spawning area was in a stream about 100 feet wide and the nests were located in water 6 inches to 2 feet deep, usually in quiet water at the head of a riffle. The minimum distance between nests was approximately 4 feet, suggesting territoriality. Breeding took place in May and early June when the water temperature had reached 17 C.

The eggs were deposited on the undersides of flat stones 3 to 9 inches in diameter. Usually the egg mass was somewhat squarish, with the eggs in 4 or 5 layers along one side and in 5 to 10 layers on the opposite side. The eggs were about 2 mm in diameter and yellow in color with a bright golden-yellow oil droplet. Most of the egg masses being guarded by males contained 288 to 352 eggs. Smaller masses usually had a female in attendance and were assumed to be incomplete.

The ovarian eggs mature in batches of about 65. Raney and Lachner suggested that females may spawn 2 to 4 times during the 5-week season. Ovaries of fish collected in March contained 200 eggs (in females 40 to 45 mm) to 400 eggs (females 50 mm).

The eggs are guarded exclusively by the males. The length of the incubation period was not determined but eyed eggs were collected in the field and kept until they hatched. The newly hatched young were 5 to 6 mm long. Spotted darters reach slightly less than 30 mm by the end of their first summer.

The sex ratio seemed to be unbalanced, 289 to 163 in favor of males, in a series of collections from various localities. Females first spawn at age II when they reach 44 mm and they average 50 mm at age III. Males reach 48 mm at age II and may live to age V. The largest male was 68 mm.

Food and Feeding

Raney and Lachner reported that 95 percent of the food of the spotted darter is aquatic insects, including dipterans (chiefly chironomids), stoneflies, mayflies, and beetles. Some water mites were eaten.

Notes

Kirtland made the following observation: "This species is readily distinguished by its flat compressed body, peculiar color, and especially its beautiful carmine maculations. It exceeds in beauty the speckled trout."

References

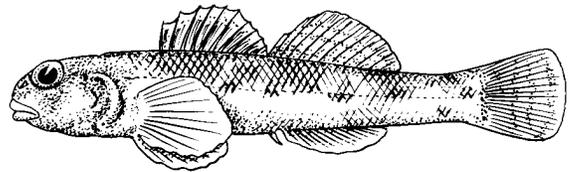
Zorach and Raney, 1967 (systematics). Raney and Lachner, 1939 (life history). Zorach, 1967 (systematics). Kirtland, 1841a (description).

Names

Maculatum is a Latin adjective meaning spotted.

Etheostoma maculata Kirtland, 1841a: 276 Mahoning River, Ohio

Poecilichthys maculatus, Greeley, 1938: 72 French Creek



JOHNNY DARTER

Etheostoma nigrum Rafinesque, 1820

Identification

As darters go, the johnny darter is a rather pale, slender species with a pattern of W- and X-shaped marks on the back and sides. Both the johnny and closely related tessellated darter are members of the subgenus *Boleosoma*, and characterized by the presence of only one anal fin spine. All of the other darters in New York normally have two anal spines. The johnny darter so closely resembles the tessellated darter that for a long time they were considered to be subspecies. Johnny darters, however, have blunter snouts than tessellated darters and also have the infraorbital sensory canal broken into two parts, an anterior section with four pores and a posterior segment with only two pores. In the tessellated darter, the infraorbital canal is complete.

Description

Body elongate, little compressed. Dorsal profile more arched than the ventral. Spiny dorsal fin originating over the basal third of the pectoral fin. Dorsal

fins separated by about two rows of scales. Spiny dorsal margin convex, the third or fourth spine the longest. Soft dorsal highest anteriorly, its last ray about three-fourths the second, longest, ray. Caudal margin slightly convex, the middle rays longer than the longest upper rays. Anal origin below the second or third dorsal soft ray. Pelvic insertion anterior to the dorsal origin. Pelvics pointed, the third ray the longest. Pectoral base slightly oblique. Pectoral pointed, its lower rays rather stout. Gill membranes united across the isthmus. Snout blunt, the mouth low and horizontal. Maxillary reaching to below a point between the front of the eye and the front of the pupil. Lateral line complete, nearly straight. Predorsal, breast, and prepectoral areas naked. No frenum. Counts and proportional measurements are given in Table 35.

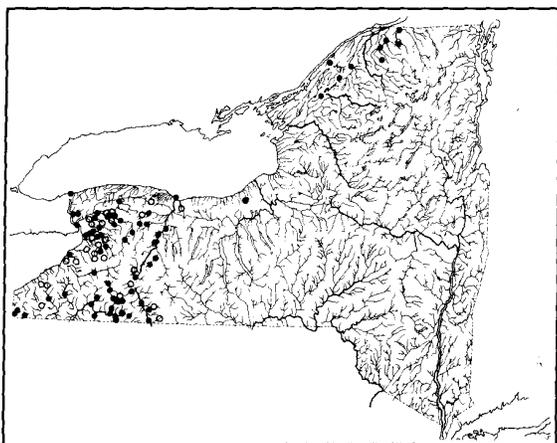
Color: Ground color pale sandy. Dark markings at the edges of the scales grouped to form X- or W-shaped marks, about 10 along the midside. Back crossed by about six squarish, saddle-shaped blotches. Teardrop mark poorly developed or absent. Snout with a dark line on each side extending forward from the eye but not meeting on the snout. Both dorsal and caudal fins with spots along the rays forming oblique lines. Five or six similar lines cross the caudal fin. Pectoral clear, anal and pelvics white.

Juveniles and breeding adults: Juveniles are quite hyaline with much less pigment than the adults. Breeding males become very dark, uniform gray to almost black with white knobs on the tips of the dorsal and anal spines and the lower pectoral rays.

Size: To about 3 inches total length.

Habitat

Johnny darters occur in a variety of habitats, ranging from streams with considerable current to standing waters, over a wide variety of bottom types. In general, they are darters of quieter areas rather than riffles.



Distribution

The johnny darter ranges from the Hudson Bay drainages of Ontario, Manitoba, and Saskatchewan south throughout the eastern parts of the Dakotas,

Nebraska, and eastern Colorado. It reaches the St. Lawrence drainage in Quebec, western New York, and western Pennsylvania and ranges south in the Mississippi Valley to the Tennessee River basin. It occurs in the Mobile Bay drainage of Mississippi and Alabama and on the Atlantic coast in Virginia and North Carolina.

Life History

Like the tessellated darter, the johnny darter lays its eggs on the undersides of rocks and other objects. Males move onto the spawning ground in April in southern Michigan and establish territories around rocks with a space under them. They clear off a site for the eggs by turning upside down and sweeping it with the caudal, anal, and pelvic fins. Females remain outside the territories until they are ready to spawn. As the female approaches the rock, the male comes out to meet her, relaxing his erect fins after recognizing her as a female. The male then leads the female into the nest, turns upside down and starts to move slowly over the surface. If the female is ready to spawn, she also turns upside down and begins to move over the surface, pausing now and then to deposit one or more eggs. Occasionally the female stops, and sometimes turns upright, whereupon the male prods her until she continues. A clutch of eggs is produced in about half an hour. After the eggs are laid, the female leaves and the male remains to guard the nest, fanning the eggs with his pectoral and occasionally turning upside down to move over the eggs, thus keeping them free of silt.

Individual females lay 5 or 6 clutches, each consisting of 30 to 200 eggs. Six size groups of ova in the ovaries indicate that a female can produce 180 to 1,200 eggs depending on her size.

Lutterbie reported the following back-calculated mean sizes for johnny darters in central Wisconsin: Age I - 36.35 mm, age II - 50.51 mm, age III - 66.00 mm.

Food and Feeding

Turner found that entomostracans and small midge larvae make up the diet of young johnny darters and that larger midge larvae and mayfly larvae were added to the diet as the fish got larger. Organic and inorganic debris was present in the stomachs at all ages. Fish from lakes and streams had similar diets.

References

Turner, 1921 (food). Stone, F. 1947 (species). Lutterbie, 1979 (food). Cole, 1965 (systematics). Karr, 1964 (age and growth). Cole, 1967 (systematics, distribution). Heimberger, 1913 (habitat), Winn, 1958b (comparative life history). Speare, 1960 (growth); 1965 (fecundity). McAllister, Jolicoeur, and Tsuyuki, 1972 (comparison). Ross, 1973 (chromosomes). Kott and Humphreys, 1978 (populations). Smart and Gee, 1979 (ecology). Underhill, 1963 (distribution). Grant and Colgan, 1982 (reproductive behavior).

Names

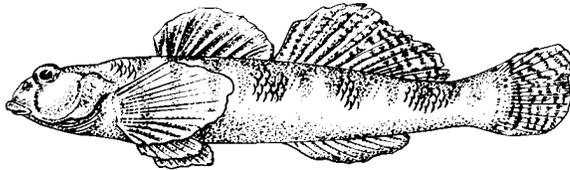
The species name is from the Latin *niger*, black.

Etheostoma nigra Rafinesque, 1820a: 37 Green River, Kentucky

Boleosoma nigrum, Greeley, 1927: 64 Genesee drainage

Boleosoma nigrum nigrum, Greeley, 1929: 177 Erie-Niagara drainage

Etheostoma nigrum, Cole, 1965: 8-13 (systematics)

**TESSELLATED DARTER*****Etheostoma olmstedii* Storer, 1842****Identification**

The tessellated darter was formerly considered a subspecies of the johnny darter, which it greatly resembles in general appearance. Both species are rather pale with small X- or W-shaped markings on the back and upper sides. Both have only a single anal fin spine whereas all other darters in our area have two.

Tessellated darters have somewhat sharper snouts than johnny darters, more dorsal soft rays, and more pectoral fin rays (see key). The suborbital sensory canal is complete in most tessellated darters, usually broken into two sections in the johnny darter.

Description

Body elongate, little compressed. Profiles nearly symmetrical, the upper a little more arched than the ventral. First dorsal origin over basal third of pectoral. Spiny dorsal arched, its fourth and fifth spines longest. Interspinous membranes not incised. In breeding males, the spines have fleshy knobs although they are not as well developed as in the fantail darter. Second dorsal contiguous with the first, highest anteriorly, its last ray about two-thirds the first, which is slightly shorter than the second and third. Caudal square, its middle rays slightly longer than the longest upper ray. Anal fin origin below third dorsal soft ray, its sixth and seventh rays longest. Tips of anterior rays with fleshy expansions. Pelvics inserted below dorsal origin. Pectoral pointed, its lowest five rays knobbed. Gill membranes fused across the isthmus. Mouth low and horizontal, the maxillary ending below the front of the eye. Lower jaw included. Body, cheeks, opercle, prepectoral, and breast scaled. Lateral line complete and slightly decurved. No frenum. Counts and proportional measurements are given in Table 35.

Color: General ground color pale sandy, shading to whitish ventrally. Some scales of the upper

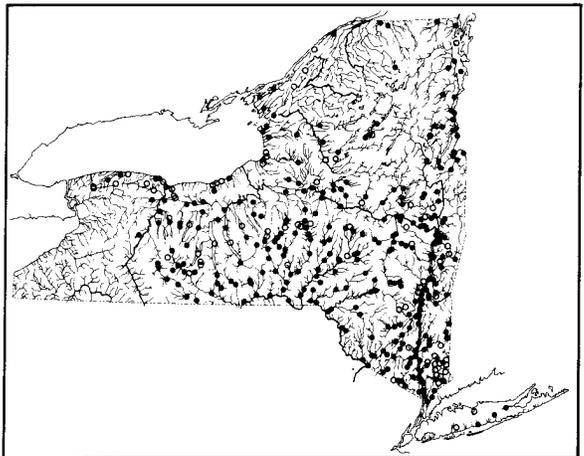
sides with dark margins forming wavy bars of varying lengths and different angles. Sides with X- and W-shaped marks, of which 9 to 11 are prominent, along the midside. Dorsal fin with a dark pigment spot on the first interradial membrane, rest of the fin clear or slightly dusky. Second dorsal and caudal with spots along the rays forming irregular narrow bars, usually about nine on the tail of large adults. Some spots on the pectoral, anal and pelvics clear. Snout with a dark line from each eye to the nostrils. Teardrop usually prominent.

Juveniles and breeding adults: Unlike the johnny darter males, which become uniform dark gray to black, the tessellated darter males develop 12 or 13 rather even vertical bands along their sides while losing the wavy lines and X-shaped markings as the scales of the upper sides become completely outlined in dark pigment. The membranes of all fins except the pectoral become quite dark with pale tips on the pectoral and pelvic fins. The unpigmented areas of the second dorsal, anal, and caudal fins stand out so that the fin has the appearance of having white bands on a dark background, which is a reversal of the appearance in non-breeding adults. In this color phase, they are sometimes mistaken for a species of *Percina*.

Size: New York specimens reach a total length of about 3.6 inches.

Habitat

The tessellated darter occurs in both flowing and standing waters but it shows a preference for quieter areas and, except during the breeding season, for sand or mud bottoms.

**Distribution**

Cole found three forms in the Hudson-Mohawk system. In the main Hudson below Troy, the species is characterized by having the nape, cheek, opercle, breast, and belly usually fully scaled. This form also occurs in the Lower Delaware and in the streams of the Chesapeake Bay drainage between the fall line and weakly brackish waters. Cole assigned these specimens to the subspecies *Etheostoma olmstedii atromaculatum*. A second form occurs in the Wallkill and in smaller tributary streams that flow directly into the ocean or are headwaters of larger streams from Cape Cod to North Carolina. Cole

calls the latter form *E. o. olmstedii* and it has the nape usually naked, the cheek variously scaled, the breast usually naked, and the belly moderately scaled. In the Upper Hudson and Mohawk, as well as in Lake Ontario, Lake Champlain, the St. Lawrence drainage, Long Island, and the Delaware and Susquehanna tributaries, the fish are intermediate and Cole recognizes these as intergrades. Cole believes that this pattern suggests that the coastal fish became isolated during the Pleistocene and differentiated. With the retreat of the glaciers, the area that is now central New York was reinvaded from the south through the Susquehanna and Delaware Rivers and from the east through the Hudson.

The overall range of the tessellated darter is from the St. Lawrence drainage in southern Quebec, the southern tributaries of Lake Ontario, the Connecticut River and coastal streams from Massachusetts to the Altamaha River in Georgia. It also occurs as a disjunct population in the Oklawaha River in Florida.

Life History

Atz described the nesting and spawning of tessellated darters in the New York Aquarium, 24 May through 9 June 1939. The fish, which originally came from northern New Jersey, laid their adhesive eggs on the underside of an unusually large mussel shell that was lying with the concave side upward. The spawning pair turned upside down and the female vibrated as she deposited the eggs, which were then fertilized by the male as he moved slowly over them. Usually, the partners assumed a side-by-side position either head to tail or head to head but there was no clasping or mounting, although the male's body sometimes crossed that of the female. Spawning was frequently interrupted by the approach of another fish as the male broke away to give chase to the stranger. Spawning appeared to be triggered by one partner turning over; most often it was the male.

After spawning, the female abandoned the nest and the male remained to guard and aerate the eggs either by fanning the water with his tail while holding his position under the eggs with his pectoral fins, or by swimming upside down over the eggs and brushing them with his pectorals. Hatching took place after about 21 days at 65 F.

Usually, only one male will nest under a single stone but Raney and Lachner noted as many as three using the same stone where nesting sites were scarce. Sometimes the eggs were laid on the tops and sides of rocks in crowded conditions.

Food and Feeding

The diet of the tessellated darter is assumed to be similar to that of the johnny darter, dominated by entomostracans and small insects while the fish are small, gradually shifting to larger insects as the fish get bigger.

Notes

The distinctness of the johnny darter and the tessellated darter has been questioned by Scott and

Crossman who note that the johnny darter is extremely variable and that some Canadian populations seem to be intermediate.

References

Cole, 1965 (systematics). McAllister et al., 1972 (characters), Cole, 1967 (characters, distribution). Raney and Lachner, 1943 (life history). Atz, 1940 (spawning). Stone, 1947 (two species). Layzer and Reed, 1978 (food, age and growth). Tsai, 1972 (life history). Zorach, 1971 (subspecies). Roberts and Winn, 1962 (feeding). Scott and Crossman, 1973 (status in Canada). Constanz, 1979 (social dynamics).

Names

The species was named for Charles H. Olmsted who studied the fishes of the Connecticut River in the early 1800s.

Etheostoma olmstedii Storer, 1842: 61 Hartford, Connecticut

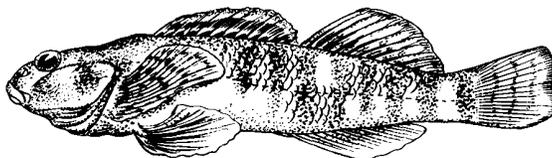
Boleosoma tessellatum DeKay, 1842: 20 New York streams

Boleosoma nigrum olmstedii, Greeley, 1928: 101 Oswego drainage

Estrella atromaculata Girard, 1859: 66 Potomac River

Etheostoma olmstedii olmstedii, Cole, 1967: 35-59 (systematics)

Etheostoma olmstedii atromaculatum, Cole, 1967: 28 (systematics)



VARIEGATE DARTER

Etheostoma variatum

Kirtland, 1838

Identification

The variegated darter is one of our larger and more spectacular species. In life, its ground color is a rich tawny with a sloping dark bar from the dorsal origin to the gill opening. The region behind this bar and below the dorsal fin is unmarked; the posterior part of the body is crossed by vertical bands. It has no close relatives in our state. The gill membranes are joined across the isthmus and the lateral line is complete.

Description

Body elongate, moderately compressed. Dorsal profile more arched than the ventral. Dorsal origin over basal half of the pectoral. Dorsal fin rather squarish, with spines II through X about equally long. Dorsal fins contiguous. Second dorsal margin convex with the last ray about two-thirds the longest (third) ray. Corners of the second dorsal rounded. Caudal slightly emarginate, its middle rays slightly

longer than the longest rays of the upper lobe. Anal origin below or slightly behind origin of the second dorsal. Anal margin nearly straight or slightly convex, its corners rounded. Pelvic fins inserted ahead of the dorsal origin. Pelvic pointed with its third ray longest. Pectoral base sloped backward. Pectoral large, pointed. Gill membranes broadly united across the isthmus. Mouth low, reaching to below front of eye. Frenum present but narrow. Lateral line complete, slightly decurved anteriorly. Cheeks, opercles, breast, and prepectoral naked but there is a patch of scales between the pelvic bones. Counts and proportional measurements are given in Table 35.

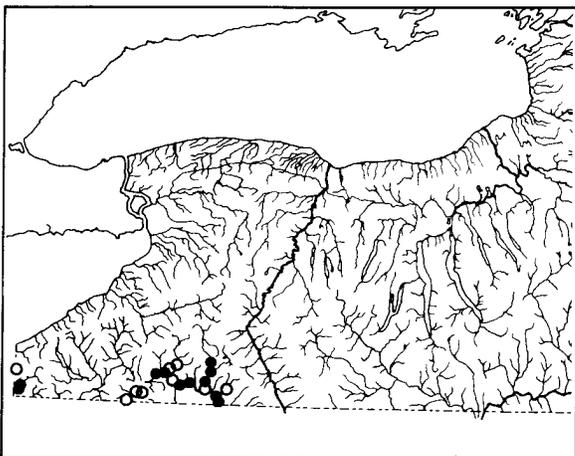
Color: Ground color grayish above with yellow overtones, shading to tawny white ventrally. Anterior part of body nearly uniform with a dark bar sloping downward and forward from the nape to the gill opening and above the pectoral base. Conspicuous saddle-shaped marks below the last rays of the first dorsal, the middle of the second dorsal, and on the middle of the caudal peduncle. Beginning above the anal origin, there are five or six, more or less, prominent vertical bars. First dorsal of adult males with a row of dark spots along its base, then a clear area, a dusky band, a second clear area, and an orange marginal band. Second dorsal generally orange with dark pigment near its base and a dusky marginal band. Caudal orange with about four dusky crossbands. Anal with some dark pigment of the basal halves of the membranes. Cheeks tawny, teardrop and snout bars indistinct.

Juveniles and breeding adults: Breeding males are extremely colorful. Head, anterior dorsal region, and pelvic fins dark greenish to black. Upper sides dark brown, lower sides and belly red orange or salmon. Anal fin and the vertical bars green, the interspaces with a red center, flanked by white. Second dorsal greenish black. Females grayish above, tawny ventrally, with greatly enlarged genital papilla surrounded by a swollen area.

Size: According to Trautman this species reaches 4.3 inches in Ohio.

Habitat

The variegate darter is a fish of moderate-sized



streams. In the winter, it occurs in deeper pools and in the spring it moves into riffle areas to spawn.

Distribution

The variegate darter is restricted to the Ohio River drainage, from southern Indiana, Kentucky, and West Virginia to the Allegheny system in western Pennsylvania and New York.

Life History

May found that during the colder parts of the year, when the water temperatures were below 35 F, the variegate darters moved into deeper pools. As the water warmed in late February, March, and April, the fish became sexually active, the males at about 40 F and the females at 50 F. Spawning took place in the upper parts of riffles, usually by larger rocks. In the laboratory, the males defended territories against other males and established dominance hierarchies. When a female was ready to spawn, she moved into the males' territories, swimming in short bursts, sometimes moving up in the water column to the surface. The males then followed the female who moved into an area with a sandy bottom and burrowed her head and the front of her body into the sand. The male then moved over her and clasped her with his pelvic fins anterior to her dorsal fin. The female then vibrated for up to 30 seconds. The pair then separated and the female moved away, returning later to spawn again. One female was observed to spawn four times in 2.5 hours. At each spawning, the female released 20 to 40 eggs, sometimes as many as 70. Females of age II and III contained 70 to 100 eggs.

The eggs hatched in 13 or 14 days when they were kept at 50 to 60 F for the first 10 days and at 70 F for the last 3 or 4 days.

Food and Feeding

Turner found only midge larvae in six specimens that he examined from Ohio.

Notes

Trautman (1957) noted that in some areas of Ohio the variegate darter has become extremely abundant, although it does not seem to be expanding its range. Attempts to introduce it into apparently similar habitat have been unsuccessful.

References

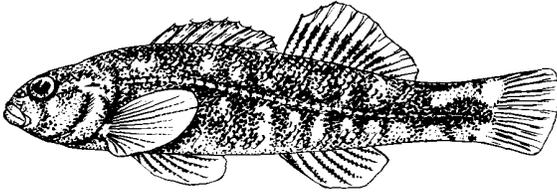
Hubbs and Black, 1940 (systematics). Lachner et al., 1950 (age and growth). May, 1969 (breeding behavior and development). Nemacek, 1980 (ecology). Turner, 1921 (food).

Names

Variatus is the Latin word for variegate.

Etheostoma variata Kirtland, 1838: 168, 192 Mahoning River, Ohio

Poecilichthys variatus, Greeley, 1938: 72 Allegheny drainage



BANDED DARTER

Etheostoma zonale (Cope, 1868)

Identification

The banded darter is a rather small species with broadly joined gill membranes, a declivitous snout, and a complete lateral line with 42 to 53 scales. The ventral surface of the head is rather flat. The most conspicuous color pattern is a series of distinct vertical bands along the sides. Its most diagnostic color feature is the presence of two broad marks in front of the dorsal fin. The marks are the upper ends of vertical bars and, seen from above, they fall short of meeting in the midline so that their rounded ends suggest that the fish had been marked by two tiny thumbs pressing down on the predorsal area.

The banded darter resembles a young rainbow darter but the banded darter is more slender and the rainbow has an incomplete lateral line. The rainbow darter also lacks the thumbprint marks.

Description

Body elongate, somewhat compressed, profiles nearly symmetrical. Head blunt, snout steep. Dorsal origin over basal half of pectoral. Spiny dorsal lower than soft dorsal, its margin arched, membranes not deeply incised. Dorsal fins contiguous. Soft dorsal highest anteriorly, its margin convex, its corners rounded. Last dorsal ray a little longer than half the second longest rays. Caudal emarginate, its middle rays about equal to the longest upper rays. Anal fin origin below origin of second dorsal. Anal margin convex. Pelvic insertion anterior to dorsal origin. Pelvics pointed. Pectoral base sloping slightly backward. Pectoral pointed, nearly symmetrical, with the lower rays thicker. Gill membranes broadly united across the isthmus. Mouth low, horizontal, maxilla reaching to below the front of the eye. Lateral line complete, slightly arched anteriorly. Cheeks, opercles, and prepectoral regions scaled. Breast with a few scattered scales. Frenum present. Counts and proportional measurements are given in Table 35.

Color: The banded darter has a yellowish ground color with dark brownish to black markings. There are six or seven dark saddle-shaped dorsal blotches, the anteriormost on the nape broken at the midline. Upper sides with many irregular dark markings, midsides with 6 to 13 vertical bars, some of which encircle the caudal peduncle and the posterior part of the abdomen. Teardrop present and there is a line from the eye to the upper lip on each side of the frenum. First dorsal with reddish basal blotches on the membranes and a broad dusky submarginal

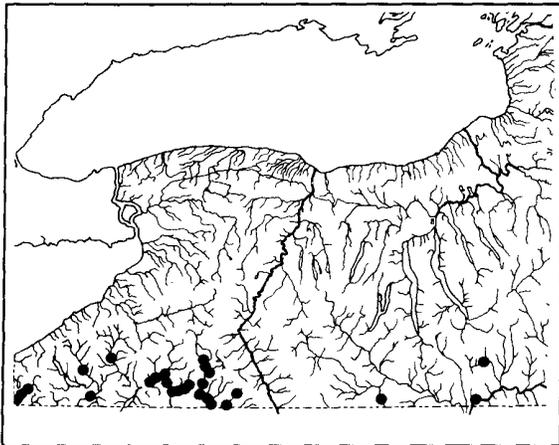
band. Caudal crossed by two irregular bands, pectorals with four or five bands. Pectorals and anal dusky at the base. In females, the markings are less regular.

Juveniles and breeding adults: Juveniles are miniature adults. Breeding males become blackish green with the lower ends of the bars on the sides bright green. The spots at the base of the membrane of the spiny dorsal become bright red and this color is emphasized by the pale spines.

Size: Tsai and Raney reported the maximum size of the banded darter as 62 mm standard length for males and 54 mm for females.

Habitat

The banded darter lives in moderate-sized streams and small rivers where the current is moderate to swift. In the spring, it moves into smaller streams to spawn. It is usually found among gravel, cobbles, or boulders but sometimes it is found on mud or sand.



Distribution

The banded darter is widespread in the Mississippi watershed from southern Minnesota, Wisconsin and the Upper Peninsula of Michigan to northern Illinois, and from eastern Oklahoma, Arkansas, Louisiana, and Mississippi north through Ohio and Tennessee to western New York. It has been introduced into the Susquehanna and Savannah Rivers on the Atlantic coast. It spread rapidly through the Susquehanna in Pennsylvania and is now abundant in the southern part of the east branch of the Susquehanna River in New York.

Tsai and Raney recognized several races, of which the Ohio race, characterized by a naked breast and relatively low scale counts, occurs naturally in the Allegheny drainage of New York.

Life History

In spite of the wide distribution of the banded darter, its life history has received little attention. Lutterbie found banded darters in Wisconsin attained an average length of 36.5 mm at age I, 50.2 at age II, 55.1 at age III, and 61.3 at age IV.

Food and Feeding

Not reported.

References

Lachner, Westlake, and Handwerk, 1950 (age and growth). Page and Whitt, 1973 (systematics). Tsai and Raney, 1974 (systematics). Denoncourt, Hocutt, and Stauffer, 1975b (Susquehanna River). Nemacek, 1980 (ecology). Greenberg, 1983 (New York records). Lutterbie, 1979 (age and growth).

Poecilichthys zonalis Cope, 1868: 212 Holston River, Virginia

Poecilichthys zonalis zonalis, Greeley, 1938: 72 Allegheny drainage

Etheostoma zonale zonale, Tsai and Raney, 1974: 11-18 (systematics, distribution)

Names

The trivial name *zonale* comes from the Latin word for banded.

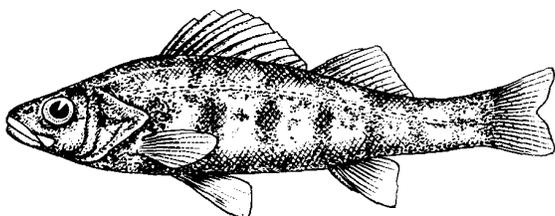
TABLE 35
AVERAGE PROPORTIONAL MEASUREMENTS AND COUNTS OF DARTERS
(*Etheostoma*, in part)

All proportions are expressed in percentage of standard length.

	<i>fusiforme</i>	<i>maculatum</i>	<i>nigrum</i>	<i>olmstedii</i>	<i>variatum</i>	<i>zonale</i>
ST. LENGTH (mm)	30.7	62.0	40.7	43.9	69.3	37.3
TOTAL LENGTH	123.5	120.2	120.8	121.6	118.8	120.5
FORK LENGTH	123.5	120.2	120.8	121.6	117.0	118.6
PREDORSAL	35.0	34.6	32.8	35.5	34.0	33.1
PREANAL	61.9	65.3	59.1	61.3	63.4	60.4
PREPELVIC	34.6	30.6	28.3	31.0	29.2	28.9
DORSAL BASE	41.2	55.6	44.9	48.9	50.7	50.0
ANAL BASE	12.0	17.0	12.2	14.0	14.5	12.6
BODY DEPTH	18.8	22.0	18.1	19.2	21.3	22.7
BODY WIDTH	11.7	12.1	14.3	16.9	15.2	16.5
C.PED. DEPTH	10.4	12.1	9.5	9.6	9.4	11.4
PECTORAL ALT.	11.6	12.1	12.4	12.9	10.9	12.2
HEAD LENGTH	30.3	29.1	25.0	27.4	27.8	25.1
SNOUT	5.8	5.6	6.6	8.7	7.6	6.4
EYE	6.9	6.5	6.6	6.9	8.0	6.8
MOUTH LENGTH	7.8	8.1	7.5	8.4	8.0	6.4
INTERORB	3.5	3.2	8.6	10.5	3.3	3.7
N (sample size)	5	2	4	5	4	5
COUNTS:						
DORSAL SPINES	IX-XI	XII-XIII	XI-XIII	XIII-XVI	XII-XIII	IX-XI
DORSAL RAYS	11	11-12	10-13	11-15	12-1	10-12
ANAL RAYS	II,7-9	II,8	II,7-8	II,6-9	II,8-9	II,6-7
PECTORAL RAYS	11-13	12-15	10-14	9-15	14-16	14-16
PELVIC RAYS	I,5	I,5	I,5	I,5	I,5	I,5
GILL RAKERS	7-8	13-14	7-8	7-8	12	8-10
VERTEBRAE	38-39	37-38	37-38	37-38	40-41	38
SCALES:						
ABOVE L. L.	3	4-9	2-7	3-7	6	4
LATERAL LINE	51-54	51-68	35-36	34-64	51-56	45-51
BELOW L. L.	7-10	8-12	4-9	6-10	6-7	4-6

Perca

The yellow perch and a similar species (or subspecies) in Europe belong to the genus *Perca*. This is a midwater species with a well-developed swim bladder and strongly serrated preopercle and well-developed anal pterygiophores. It has no large canine teeth like those of the members of the genus *Stizostedion*.



YELLOW PERCH

Perca flavescens (Mitchill, 1814)

Identification

The yellow perch is an elongate, slightly compressed fish with a bold pattern of five to nine vertical, blackish bars on a yellow or greenish-yellow background. Unlike the darters, the preopercle is strongly serrated on both limbs. Young perch develop the banded color pattern quite early, so they would not be confused with any darters. Yellow perch can be distinguished from small walleyes by shape and by color pattern. Walleyes have indistinct oblique bars in contrast to the well-defined vertical bars of the yellow perch. Also, the walleyes and saugers have conspicuous canine teeth in the jaws, and perch do not.

Description

Body elongate and somewhat compressed, its profiles symmetrical. Dorsal origin slightly behind pectoral base. Spiny dorsal larger than the second dorsal, the two fins clearly separate but close together. Third or fourth dorsal spine longest, the interspinous membranes not deeply incised. Soft dorsal highest anteriorly, its margin straight, its corners rounded. Caudal moderately forked, its middle rays four-fifths the longest upper rays. Anal origin below third dorsal soft ray. Anal margin slightly convex, corners rounded. Pelvic insertion slightly behind the dorsal origin. Pelvics larger than pectorals, second pelvic ray longest, last pelvic ray not bound to the body by membrane. Pectoral fin pointed, its base oblique. Preopercle serrate on both limbs. Gill membranes separate, overlapping at the junction. Mouth terminal, maxillary reaching to below front of eye. Body completely scaled, top of head naked. Lateral line complete, arched, parallel to dorsal profile. Counts and proportional measurements are given in Table 37.

Color: The yellow perch is generally yellowish on the sides, shading to olive or brownish above and abruptly white on the breast and belly. Sides with 7 to 10 prominent, rather even, dark, vertical bars ex-

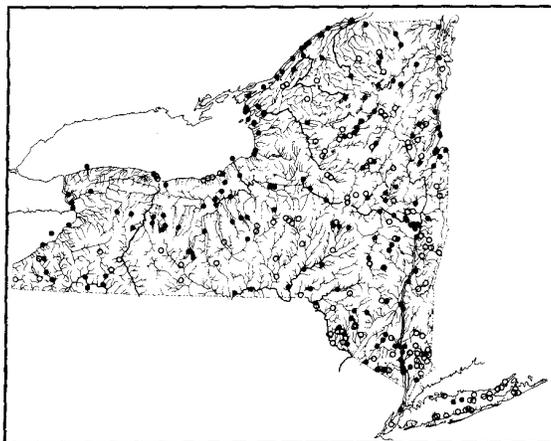
tending from the dark dorsal region to the lower sides. First dorsal dusky with the spines darkly pigmented and with a conspicuous dark blotch on its last spines. Pectorals clear, pelvics and anal red, the color more intense on the anterior parts of the fins.

Juveniles and breeding adults: There are no special breeding colors although the males develop more intense colors during the spawning season. Juveniles tend to be more greenish, without the conspicuous red lower fins.

Size: Adults generally run 10 to 12 inches, sometimes a little larger. The IGFA all-tackle record is a 4-pound 3-ounce fish from Bordentown, New Jersey. The New York record is a 3-pound 8-ounce fish from Lake Erie taken in 1982 by George Boice.

Habitat

Yellow perch often travel in schools. They are most abundant near vegetation in lakes of moderate fertility, but they also occur in streams, sometimes in areas where there is considerable current. They feed most actively during the day and often rest motionless at night. Adult perch usually occupy deeper waters than juveniles do. Yellow perch feed throughout the year and are a popular target for ice fishermen.



Distribution

The original range of the yellow perch was a broad curved band from the Mackenzie River basin of northwestern Canada to the Maritime Provinces. The southern limits of the band were from northeastern Nebraska and northern Missouri through southern Illinois, Indiana, and Ohio to Pennsylvania. On the Atlantic coast, it ranged south to the Santee River in South Carolina. It occurs in all parts of New York State.

Life History

Spawning takes place in the spring, April or May in our waters, when the temperature reaches 45 to 52 F. Perch spawn after walleyes and at about the same time as white suckers. Males move into the shallows before the females and remain there after the females have left. Spawning occurs in water 5 to 10 feet deep over sand, gravel, rubble, or vegetation. The eggs of the perch are laid in zigzag rows cemented together in a gelatinous band a couple of

inches wide and 2 to 7 feet long. These bands are often draped over logs or vegetation. Sometimes they break loose and get washed up on shore. Hatching takes place in about 8 to 10 days, depending on temperature.

Yellow perch can live as long as 9 years. The growth rate is variable and has been studied in many areas.

Food and Feeding

Cladocerans, ostracods, and chironomid midge larvae make up much of the diet of small perch. As the fish get larger, they shift to an insect diet; large perch eat a substantial number of crayfish, small fish, and odonate nymphs. Perch are rather generalized feeders and can obtain food from the bottom as well as in midwater.

Notes

This species is an important sport fish and also the object of the commercial fishery in the Great Lakes and larger bodies of water such as Oneida Lake where they have been studied intensively by Forney and his co-workers.

Although they are an excellent panfish, perch can be extremely detrimental to trout populations. Fraser gives a case history of a lake that was monitored for 6 years before and 6 years after the introduction of perch. There was a drastic change in the food habits of the planted brook trout, splake, and rainbow trout. Brook trout switched from fish, leeches, and odonates to trichopterans. Splake switched from fish and leeches to trichopterans and rainbows changed from a broad diet to dipterans, trichopterans, and entomostracans. In the same lakes, the yellow perch became stunted. Growth rates declined and the yield per kg of brook trout, splake, and rainbow trout planted dropped from 3.3, 6.8, and 6.1 kg to 0.4, 0.9, and 0.8 kg, respectively.

References

Herman et al., 1959 (general summary). Keast and Webb, 1966 (feeding). Keast, 1977 (feeding). Forney, 1974 (interaction with walleye). Helfman, 1979 (activity cycles). Clady and Hutchinson, 1976 (food). Elrod et al., 1981 (food). Maloney and Johnson, 1957 (life history, Minnesota). Robins, 1970 (bibliography). Mansueti, 1964 (early development). Reynolds and Casterlein, 1979 (thermoregulation). Tsai and Gibson, 1971 (fecundity, Maryland). Siefert, 1972 (first food). Hart, 1933 (blue specimen). Burdick, Dean, and Harris, 1957 (lethal oxygen concentrations). Fraser, 1978 (interaction with trout). Jobes, 1952 (life history, Lake Erie). Lin, 1983 (Oneida Lake).

Names

The species name *flavescens* is Latin, meaning becoming yellow.

Morone flavescens Mitchill, 1814: 18 New York

Perca notata Rafinesque, 1818b: 205 Lake Erie

Perca serrato-granulata Cuvier in Cuvier and Valenciennes, 1828: 48 New York

Perca granulata Cuvier in Cuvier and Valenciennes, 1828: 48

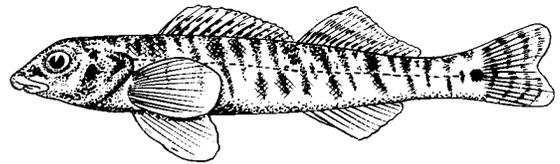
Perca acuta Cuvier in Cuvier and Valenciennes, 1828: 49 Lake Ontario

Perca gracilis Cuvier in Cuvier and Valenciennes, 1828: 50 Skaneateles Lake

Perca flavescens, Greeley, 1927: 64 Genesee drainage

Percina

This genus contains 31 described species and possibly 8 more that have not been named yet. All share a common feature, the presence of large star-shaped scales on the midline of the breast of males at least and the breast of most females as well. The males of most species also have a midventral row of similarly modified scales. *Percinas* are usually not as colorful as the *Etheostomas*.



LOGPERCH

Percina caprodes (Rafinesque, 1818)

Identification

The logperch is the easiest of our darters to recognize because both its color pattern and its shape are distinctive. The color pattern is basically a series of more or less alternating long and short, narrow, vertical bars along the sides of the body. The most distinctive shape feature is its long conical snout which overhangs the mouth. There is a frenum connecting the upper lip with the snout. The logperch has small scales and is rather large for a darter, commonly reaching 5 to 6 inches.

Description

Body elongate, nearly terete. Dorsal profile a little more arched than the ventral. Dorsal fins close together, without a scaled interspace between. Margin of the dorsal arched, third dorsal spine longest, followed by progressively shorter spines. Interspinoous membranes not incised. Second dorsal highest anteriorly, its margin nearly straight. Caudal emarginate with the middle rays longer than the longest upper rays. Anal origin below origin of second dorsal, anal fin margin convex. Pelvic insertion a little ahead of the dorsal origin but well behind the pectoral base. Pelvic pointed, second ray longest. No pelvic axillary process. Pectoral bluntly rounded, its base nearly vertical. Mouth low and horizontal, maxillary not reaching the front of the

eye. Snout overhanging mouth, pointed. Cheeks and opercles scaled. Gill membranes slightly joined. Prepectoral, breast, and anterior belly naked. Ventral midline with modified scales. Lateral line complete, straight. Counts and proportional measurements are given in Table 36.

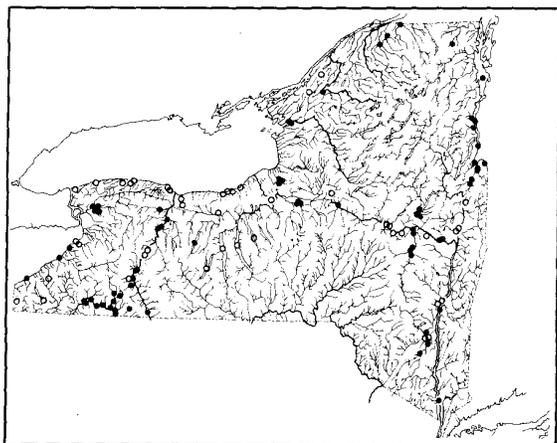
Color: Body pale straw color shading to pale olive dorsally and to white ventrally. Body crossed by about 8 long, vertical, dark bars alternating with 9 or 10 shorter ones, all extending ventrally from the middorsal line. A small round, distinct spot at caudal base. Circumorbital area with a dusky expansion but no definite teardrop. Spiny dorsal with two or three dusky bands. Second dorsal with two or three, and caudal with one or two, rows of spots, the other fins clear. Lateral line paler than the background.

Juveniles and breeding adults: Juveniles have less pigment but a more conspicuous caudal spot than adults. Sometimes there is an orange tinge around the caudal spot but the species does not develop bright breeding colors.

Size: Trautman (1981) records specimens up to 7.5 inches long from Buckeye Lake, Ohio.

Habitat

The logperch inhabits slower water of streams and lakes.



Distribution

The logperch ranges from the Hudson Bay drainage south in the Mississippi watershed to Louisiana. It occurs in the Tennessee River basin, the Great Lakes east to the Ottawa River, and Lake Champlain. Related undescribed species occur on the gulf coast.

Two subspecies are said to live in New York State: The Ohio logperch, *Percina caprodes caprodes*, and the northern logperch, *Percina c. semifasciata*. The Ohio logperch has the nape entirely scaled and the bars even throughout their length; the northern logperch has the nape naked and the bars expanded at their lower ends, almost forming a row of blotches. I have not found a consistent pattern of the occurrence of these two forms in New York.

Life History

Winn (1958b) studied two populations of logperch

in Michigan. One spawned in a swift stream at the outlet of Portage Lake and the other spawned over sandy shoals in Douglas Lake. The males moved into shallow water in late June, followed soon afterward by the females. The males formed compact schools that milled around in water 4 to 12 inches deep. Some of these schools contained several hundred individuals. Females generally remained outside the group. When a female was ready to spawn, she swam through the school of males, some of which then pursued her. The female settled to the bottom and one of the males mounted her with his pelvic fins ahead of her dorsal fin and his caudal peduncle alongside her tail. Both fish vibrated vigorously, stirring up the sand. Usually, other males joined the pair and vibrated with them. After spawning, the female returned to deeper water until she was ready to spawn again. Spawning took place during the daylight hours.

In the stream population, the fish maintained themselves in swift current over boulders and gravel while the females concentrated in a pool-like area at the base of the riffle. When a female was ready to spawn, she would move up into the riffle where she was joined by a male. Together the pair moved to a gravelly area where they spawned like those in the lake.

Lutterbie (1979) calculated the following sizes at the time of annulus formation: I-64 to 76 mm, II-95 to 110 mm, III-116 to 122 mm, IV- 125 to 132 mm.

Food and Feeding

Turner found that, in Ohio, young logperch fed on entomostracans, those of intermediate size fed on insects and entomostracans and the larger fish fed mostly on insects. Several observers have reported that the logperch feeds by flipping over pebbles with its conical snout to get at the invertebrates underneath. During spawning, groups of males search out and eat the eggs as they are laid.

References

Jenkins, 1976 (systematics). Reighard, 1913 (breeding habits). Will, 1931 (age at spawning, Michigan). Cooper, 1978a (eggs and larvae). Morris and Page, 1981 (variation). Turner, 1921 (feeding).

Names

The name *caprodes* comes from the Greek *kapros* — a wild boar — and *oides*, a contraction of the Greek *o* plus *eidos*, likeness of form, in allusion to the conical (pig-like) snout.

Sciaena caprodes Rafinesque, 1818c: 354 Ohio River

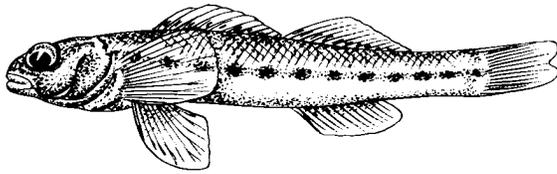
Percina caprodes caprodes, Greeley, 1938: 72 Allegheny River

Pileoma semifasciatum DeKay, 1842: 16 Lake Champlain at Westport

Pileoma zebra Agassiz, 1850: 308-310 Lake Superior

Percina caprodes zebra, Greeley, 1928: 101 Oswego drainage

Percina caprodes semifasciata, Greeley and Greene, 1931: 91 St. Lawrence drainage



CHANNEL DARTER

Percina copelandi (Jordan, 1877)

Identification

In general appearance, the channel darter looks somewhat like a johnny darter. The two are similar in shape and in having numerous X-shaped markings on the dorsal surface. The channel darter, however, has a row of 12 to 18 elongate dark blotches along its midside and these are connected by a narrow brownish or blackish midlateral stripe. Star-shaped scales on the midventral line of males and between the pelvic fins of both sexes reveal that it is a *Percina* but, unlike most members of that genus, the channel darter has a rudimentary, rather than well-developed swim bladder.

Description

Body elongate, slightly compressed, with the dorsal profile more arched than the ventral. Dorsal origin over basal half of the pectoral fin. Dorsals separate with scales across the interspace. Membranes of the first dorsal not incised. Soft dorsal highest anteriorly, its margin nearly straight. Caudal only slightly emarginate, its middle rays longer than the longest upper rays, its lobes rounded. Anal origin slightly behind origin of second dorsal. Margin of anal fin arched, with the fourth to sixth rays longest. Pelvic insertion anterior to dorsal origin. Pelvics pointed, their third rays longest. No pelvic axillary process. Pectorals bluntly pointed, their bases nearly vertical. Gill membranes separate. Mouth horizontal, small, the maxillary reaching to below the front fourth of the eye. Snout blunt, no frenum. Breast and prepectoral naked, belly scaled, predorsal partly scaled. Lateral line complete, paralleling the dorsal outline. Counts and proportional measurements are given in Table 36.

Color: Winn described the breeding coloration of the channel darter. The females have translucent fins with some gray spots on the dorsal fins and gray at the base of the other fins. The bases of the pectorals and the posterior three or four rays of the pelvics are cream color. The lower half of the body from the chin to the caudal peduncle is white. There are 10 to 12 midlateral blotches, of which the anterior three are smaller and less distinct. The dorsal scales are outlined in black with some local intensification producing a mottled effect. There are three to six faint saddles, the most obvious ones being at the front of the first dorsal, between the fins, and at the middle of the second dorsal. There is a glistening gold spot on the lower part of the operculum, in front of which the cheek is white with gray speckles.

There is a faint gray and yellow suborbital bar and a black bar running downward and backward from the eye.

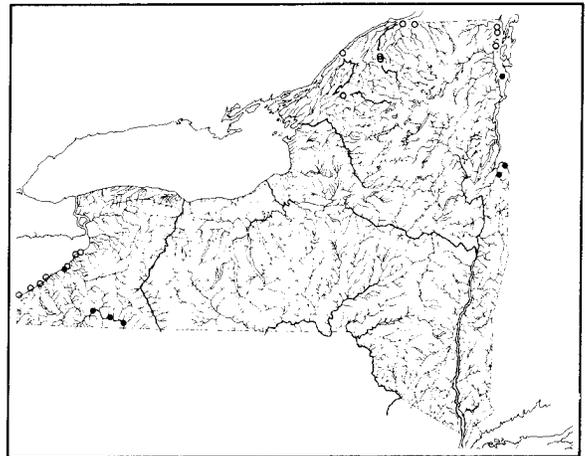
In the male, the lateral blotches are almost fused, with no creamy interspace. The lateral band has a pale blue-green cast, especially at the base of the pectorals and near the gill opening. This shades to olive green below and this color almost reaches the midline in front of the anus. The basal part of the anal fin is almost black. The pelvic membranes are very dark but the outer margin of the fin is white. The dorsal fin is dark gray, darkest basally, then a lighter band, a narrow darker band, and a white edge. The ventral part of the body is speckled gray, especially from the base of the pelvics to the tip of the lower jaw. The most highly colored males have a milky blue chin, dotted with gray, and two black spots in front of the branchiostegal membrane.

Juveniles and breeding adults: There are no special juvenile features.

Size: This is a small *Percina*, reaching a little more than 3 inches.

Habitat

The channel darter is essentially a bottom-dwelling, lake or large-stream species, where it is most common over sandy or gravelly shoals off beaches. Apparently, it stays in deeper water during the day and moves into shallows at night. It spawns in the lower reaches of streams.



Distribution

Percina copelandi occurs from the Tennessee River, the Ohio River system and Lakes Huron, Erie, and Ontario to the St. Lawrence River and Lake Champlain. A disjunct population occurs in the Red and Arkansas Rivers in Kansas, Oklahoma, Arkansas, and northern Louisiana.

Life History

In the Cheboygan River, in the northern part of the Lower Peninsula of Michigan, Winn found channel darters spawning below a dam where the water was 18 inches to 5 feet deep. Most of the spawning took place where the water was 2 to 3 feet deep and there was a swift current (1.4 feet per second at the surface and 0.95 feet per second near the bottom). Spawning took place 9-23 July, when the tempera-

ture was between 69 and 72 F. Males established territories behind rocks about 4 inches in diameter and larger, defending them against other male channel darters but not against logperch.

Usually, males did not stray more than 3 or 4 feet from the territories and then only for brief periods. Receptive females entered the territories and were mounted by the male. The pair vibrated together vigorously in the gravel below or between the rocks. Winn thought 4 to 10 eggs were laid during each spawning episode. The eggs were slightly adhesive, demersal, somewhat flattened, with an average diameter of 1.4 mm. There was considerable variation in size. The eggs were mostly transparent with an orange-colored oil droplet.

Food and Feeding

In the eight specimens examined by Winn, chironomids dominated but caddisfly larvae were also present. Turner (1921) found midge larvae and mayfly larvae in the stomachs of channel darters from the Bass Islands in Lake Erie. The darters had also consumed appreciable amounts of algae and bottom detritus. Young and old darters ate about the same things.

References

Starnes et al., 1977 (distribution). Winn, 1953 (life history).

Names

This species was named for Herbert Edward Copeland, a close friend and colleague of David Starr Jordan, who died after falling into the White River in Indiana in January 1876.

Rheocrypta copelandi Jordan, 1877c: 9 White River near Indianapolis, Indiana

Rheocrypta copelandi, Greeley, 1929: 176 Lake Erie

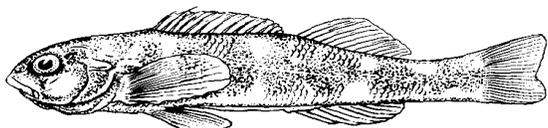
Cottogaster copelandi, Greeley, 1930: 84-85 Lake Champlain

Cottogaster putnami Jordan and Gilbert, 1883: 498 Westport Brook, Lake Champlain

Cottogaster cheneyi Evermann and Kendall, 1898: 129 Raquette River near Norfolk

Hadropterus copelandi, Hubbs and Lagler, 1958: 107 (distribution)

Percina copelandi, Hubbs and Lagler, 1964: 107 (distribution)



GILT DARTER

Percina evides
(Jordan and Copeland, 1877)

Identification

This is a moderate-sized darter with a well-developed frenum, a complete lateral line, narrowly

connected gill membranes, and a terminal mouth. It has a distinctive "neat" appearance, with a row of squarish dorsal blotches directly over the equally square midlateral blotches. In breeding males, these unite to form a row of regular, vertical, blue-green bands. No other *Percina* in our state has red or blue breeding colors.

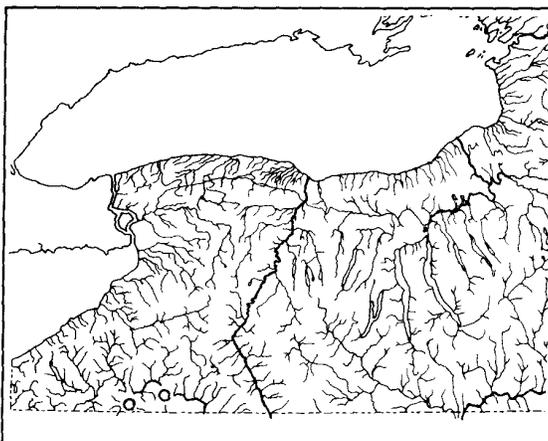
Description

Body elongate, slightly compressed, dorsal profile more arched than the ventral. Dorsal origin over basal half of the pectoral fin. Spiny and second dorsals separate but no scales crossing the interspace. Spiny dorsal margin arched, fifth spine the longest. Second soft dorsal ray longest, about twice the last ray. Caudal slightly forked, the middle rays about four-fifths the longest lower ray. Caudal lobes rounded. Anal origin below origin of second dorsal. Fifth and sixth anal rays longest. Pelvic insertion slightly ahead of dorsal origin. Pelvic pointed, its third ray longest, its last ray not connected to the body by membrane. No pelvic axillary process. Pectorals pointed, nearly symmetrical, their bases almost vertical. Gill membranes slightly joined anteriorly. Mouth terminal, maxillary reaching to below front of eye. Frenum present. Breast, belly, except for the specialized scales in the midline, and prepectoral regions naked. Nape partly scaled. Lateral line complete, parallel to dorsal profile. Counts and proportional measurements are given in Table 36.

Color: The pattern of the gilt darter is dominated by about eight squarish blotches along the midside, separated by somewhat shorter interspaces. These blotches are aligned with squarish dorsal saddle blotches and separated from them by a narrow pale space. Teardrop distinct; fins without prominent markings.

Juveniles and breeding adults: Breeding males are brilliant. The dark saddles become blue green and unite with similarly colored lateral blotches to form vertical bars. The interspaces and ventral parts of the body become bright red and two round orange spots develop on the caudal base. The dorsal fins are red orange and the anal and pelvics blue black. Males develop breeding tubercles over much of the ventral surface.

Size: To about 3 inches.



Habitat

The gilt darter is restricted to moderately-fast, deep runs and slow riffles in larger streams. It is apparently intolerant of slow water and silt and shows a preference for areas with loose gravel and boulders.

Distribution

This species occurs from Arkansas and southeastern Missouri to the Tennessee drainage. In the Mississippi Valley, it reaches eastern Minnesota. It occurs in the Wabash and in tributaries of the Ohio to the Allegheny in New York. Its only occurrence in the Great Lakes basin was in the Maumee River in Ohio.

In New York, the Survey took it from three large riffles in the Allegheny River near Carrollton.

Life History

Little is known of its life history except that it is a spring spawner. In Wisconsin, Lutterbie calculated the average size at the time of annulus formation as follows: I - 39.9 mm, II - 61.3 mm, III - 71.0 mm, IV - 75.5 mm.

Food and Feeding

Not reported.

Notes

There have been no reports of this species in New York waters since the Survey in 1937. Because it is so difficult to sample the fast deep waters of the Allegheny River it may still be present in small numbers, although the hope of its survival is diminishing each year.

References

Lutterbie, 1979 (age and growth). Page, 1974 (systematics). Page, 1976a (systematics). Page and Whitt, 1973 (systematics). Denoncourt, 1969 (systematics). Page, Retzer, and Stiles, 1982 (spawning behavior).

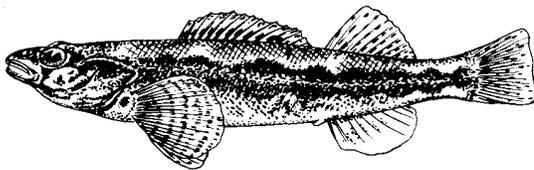
Names

The species name is from the Greek *euides* (*eueides*), comely.

Alvordius euides Jordan and Copeland in Jordan, 1877b: 51 White River near Indianapolis

Hadropterus euides, Greeley, 1938: 72 Allegheny River

Percina euides Hubbs and Lagler, 1964: 107 Great Lakes

**LONGHEAD DARTER*****Percina macrocephala*
(Cope, 1869)****Identification**

The longhead darter is aptly named, for its out-

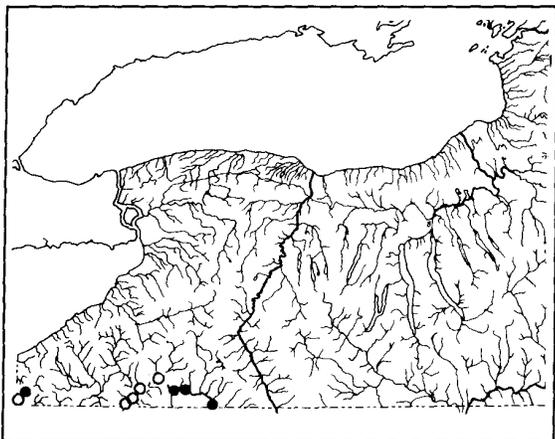
standing characteristics are its long head and long pointed snout. It resembles the blackside darter but differs in having smaller scales (74 to 80 in the lateral line) and in having the gill membranes united for a greater distance. A distinctive feature is the presence of one to three dusky spots on each side of the ventral surface of the head. The last of these is sometimes connected to the suborbital (teardrop) bar. Such spots are not present in the blackside darter. The longhead darter has more than 12 dorsal saddles and the blackside has fewer. In the longhead darter, the squarish midlateral blotches are somewhat connected but in the blackside they are mostly separate.

Description

Body elongate, little compressed, profiles even and symmetrical. Dorsal origin over middle of pectoral fin. Dorsal fins separate, the interspace scaled but the scales do not cross the midline. Spiny dorsal margin arched, fourth spine longest, the interspinous membrane not incised. Soft dorsal highest anteriorly, its margin straight. Caudal margin straight, longest middle rays a little longer than longest upper rays, Corners of the caudal angled. Anal origin below origin of second dorsal. Anal margin rounded, its fourth and fifth rays longest. Pelvic insertion between level of pectoral base and dorsal origin. Pelvic pointed, its last ray not bound to the body wall. Pectoral rounded, paddle shaped. Pectoral base vertical or slightly inclined backward. Gill membranes united anteriorly. Head long, mouth terminal, maxilla reaching to below front of eye. Frenum present. Predorsal scaled; breast, prepectoral, and anterior belly naked. Cheeks and opercles scaled. Lateral line complete, straight. Counts and proportional measurements are given in Table 36.

Color: The color pattern of the longhead is dominated by a midlateral stripe that alternately widens and narrows, the wider areas corresponding to the blotches on other species of *Percina*. The dorsal edge of the midlateral stripe is marked by a pale sand-colored line that grades into light olive over the back. The sides below the stripe are marbled with irregular sooty marks. The belly is white. The spiny dorsal is clear, with a basal row of dark spots on the membrane, and a dusky submarginal band. The second dorsal is clear, with three rows of dark spots, and the caudal has four rows of similar spots. The anal and pelvic fins have a few irregular dark spots, otherwise they are clear. There are six rows of dark spots crossing the pectoral fin. There is a preorbital stripe and a distinct suborbital bar. The upper lip is dark, the preopercle has dark spots, and the operculum is mostly dark. There are one to three dark spots on the lower side of the head. Some individuals have a conspicuous dark spot on the otherwise white pectoral base. There is a conspicuous basicaudal bar, with a dark bar below it.

Juveniles and breeding adults: The longhead darter does not have bright breeding colors. Young individuals have the midlateral stripe more divided into distinct blotches.



Size: This is a moderately large species of darter, reaching more than 4.75 inches total length. Page gives the maximum standard length as 102 mm.

Habitat

The longhead darter lives in moderate-sized to large, clear streams over gravel and cobbles. It appears to be a midwater species that is difficult to collect by the usual seining methods. Dr. Wayne Hadley and his students have had good success using a large number of people to drive the fish downstream into a seine set across the current. Page describes its habitat as pools with considerable current.

Distribution

The longhead darter has a rather restricted range in the Upper Tennessee River and the southern tributaries of the Ohio River. It occurs in the Scioto River in Ohio and the Allegheny River in New York and Pennsylvania. Recent collections have been made near Portville and Westons Mills.

Life History

Page postulated a spring spawning period; March, April, or May in the Green River in Kentucky. In New York, the season would probably be somewhat later. Page did not find clear annuli, but the scales seemed to indicate a maximum age of about 4 years.

Food and Feeding

This species is said to feed on crayfish to a greater extent than most darters. Page found only crayfish and mayflies in their stomachs.

Notes

The populations of the longnose darter should be monitored carefully. It is one of the most spectacular darters in the state but it has stringent habitat requirements.

References

Page, 1974 (systematics); 1978 (ecology).

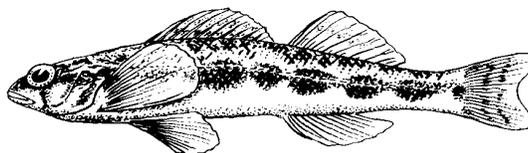
Names

Macrocephala is from the Greek *makro*, long and *kephalos*, head.

Etheostoma macrocephala Cope, 1869b: 400
Youghiogheny River, Pennsylvania

Hadropterus macrocephalus, Greeley, 1938: 72
Allegheny River

Percina macrocephala, Eaton et al., 1982: 194
Allegheny River



BLACKSIDE DARTER

Percina maculata (Girard, 1860)

Identification

The blackside darter is a rather typical *Percina*, with a conspicuous row of large, rectangular, black blotches along the side of the body. It resembles the longhead darter but that species has a longer, more pointed head, smaller scales, blotches that tend to fuse into a solid stripe, and characteristic spots on the underside of the head. The blackside darter looks most like the shield darter, but has scales on the cheeks which are not present in New York populations of the shield darter. The shield darter lives in the eastern part of the state, whereas the blackside is found only in the western part of the state.

Description

Body elongate, slightly compressed, dorsal profile more arched than the ventral. Dorsal origin over middle of pectoral fin. Dorsal fin completely separate, the interspace scaled. Base of second dorsal about half length of base of spiny part. Margin of first dorsal arched, the fourth through sixth spines longest. Second dorsal highest anteriorly, third and fourth rays longest. Last dorsal ray about two-thirds the longest. Margin of second dorsal straight, corners rounded. Caudal a little emarginate, the middle rays slightly shorter than the longest upper rays. Anal origin below origin of second dorsal. Fifth and sixth anal rays longest. Pelvics inserted a little ahead of the second dorsal, pointed, their second and third rays longest. Pectorals symmetrically pointed, their bases nearly vertical. Gill membranes separate. Mouth subterminal, maxillary reaching to below front of pupil. Frenum present. Cheeks and opercles scaled, breast, prepectoral and belly naked except for the stellate scales characteristic of the genus. Lateral line complete, parallel to dorsal profile. Counts and proportional measurements are given in Table 36.

Color: The ground color is pale straw yellow, shading to white ventrally. Dorsal midline with 6 to 11 quadrate, saddle-shaped blotches. A midlateral row of about eight squarish blotches more or less interconnected. A separate, vertically elongate spot at the base of the tail. Above the lateral blotches, there are short, irregular, dark lines consisting of X-shaped marks formed by pigment along the edges of the scales. Upper part of opercle black. Nasal stripe prominent, teardrop indistinct. Dorsal and

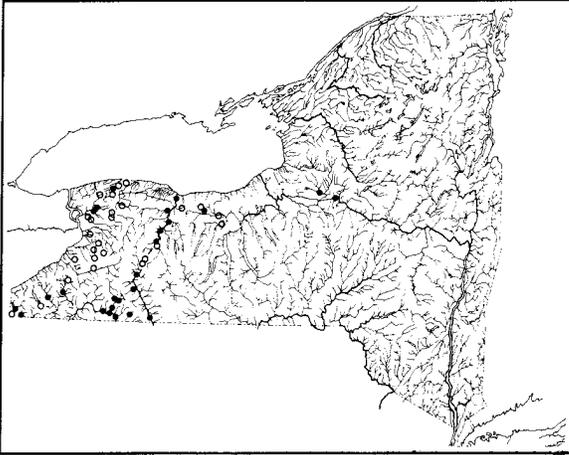
caudal fins with rows of spots; anal, pelvics, and pectorals clear.

Juveniles and breeding adults: This species does not develop bright breeding colors. Juveniles have less pigment than adults.

Size: The blackside reaches slightly more than 4 inches total length.

Habitat

The blackside darter lives in small- to moderate-sized streams with some current and considerable shelter such as brush, vegetation, or overhanging banks, and sand or gravel bottom.



Distribution

The blackside darter ranges from southeastern Saskatchewan in a band through the southern part of the Great Lakes to western New York. It occurs south in the Mississippi Valley to eastern Oklahoma and Louisiana and east on the gulf coast to the Mobile Bay drainage.

Life History

The life history of this species was studied in central Michigan by Petravicz and confirmed by Winn. Spawning began in May when the water temperature reached 16.5 C. Spawning sites were over sand where the water was about 1 foot deep, or 2 feet in swifter raceway-like areas to which the fish migrated in March or April. Males pursue the females into the spawning areas where the female settles to the bottom. A male then comes to lie next to her with his pelvic fins across her back. The two vibrate together and press themselves into gravelly or sandy depressions where the eggs are deposited. Petravicz thought that the anal and caudal fins of the male were on opposite sides of the female but Winn doubted this. After spawning, they rest a few minutes, then spawn again. The eggs are about 2 mm in diameter. Hatching takes place in 142 hours and the newly hatched larvae are 5.75 mm long. Soon after hatching they rise to the surface and, within 3 weeks, take up a benthic existence.

Lutterbie reported the following average lengths at the time of annulus formation: I- 47.7 mm, II- 70.1 mm, III-80.0 mm, IV-92.6 mm.

Food and Feeding

Apparently, the blackside is an opportunistic hunter

that often feeds in midwater. Trautman reported that it occasionally leaps into the air after flying insects. Turner found midge and mayfly larvae, coxixid nymphs, copepods, and small fish in the stomachs. Fish 34 mm long had approximately the same diet as those 67 mm.

References

Page, 1974 (systematics); 1976b (hybrids). Moore and Reeves, 1955 (ecology). Karr, 1964 (age, growth, food). Smart and Gee, 1979 (ecology). Lutterbie, 1979 (age and growth). Turner, 1921 (food). Trautman, 1957 (Ohio). Petravicz, 1938 (life history). Winn, 1958b (life history).

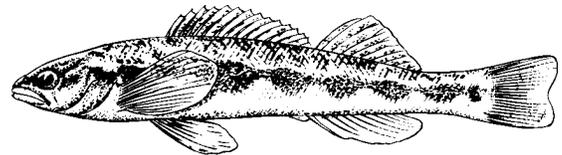
Names

Maculatus is the Latin word for spotted.

Alvordius maculatus Girard, 1860: 68 Fort Gratiot, Michigan

Hadropterus maculatus, Greeley, 1927: 64 Genesee drainage

Percina maculata, Hubbs and Lagler, 1974: 106 (distribution)



SHIELD DARTER

Percina peltata (Stauffer, 1864)

Identification

The shield darter is a rather ordinary species of *Percina* and can be recognized as such by its having a row of modified star-shaped scales on the midline of the belly, and by its conspicuous pattern of a line of partly connected, rectangular, black blotches along the side. The shield darter most resembles the blackside darter but the blackside darter has scales on the cheeks. New York populations of the shield darter do not. Furthermore, the two species have complementary ranges — the shield darter occurs only in the eastern part of the state and the blackside darter is a midwestern species living only in the western part of the state.

Description

Body elongate and slightly compressed, profiles even and symmetrical. Dorsal fin originating over middle of the pectoral fin. Dorsal fins separate, with scales in the interspace and a ridge of membrane forming a low superficial keel. Margin of the first dorsal arched, its fourth and fifth spines longest, its membrane little incised. Second dorsal highest anteriorly, its third ray longest, its margin straight. Caudal somewhat forked, its middle rays four-fifths the longest upper rays. Anal origin under origin of second dorsal. Anal margin arched, the fourth to sixth rays longest. Pelvic origin ahead of dorsal origin and behind base of pectoral fin. No pelvic axillary process. Pelvic fin pointed. Pectoral bluntly

pointed, its base nearly vertical. Gill membranes separate, overlapping anteriorly. Mouth low, terminal, the maxillary reaching to below the front of the eye. Frenum present. Cheeks, opercles, prepectoral, breast and midline of belly naked (except for the row of stellate scales in males). Lateral line complete, nearly straight. Counts and proportional measurements are given in Table 36.

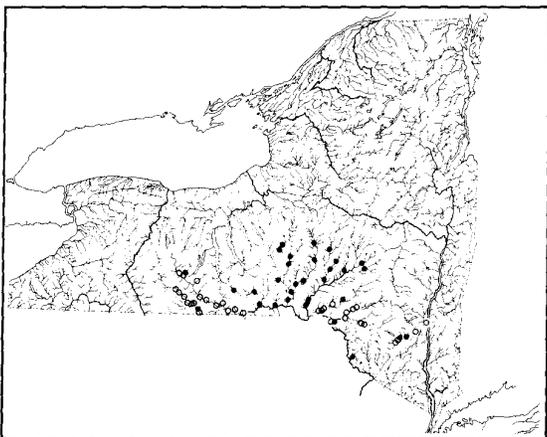
Color: Ground color pale straw yellow. Back crossed by blackish saddles that interconnect to enclose pale oval areas. Dark blotch on nape with pale oval center. Sides with a row of quadrate blotches of varying sizes. Caudal base with a dark spot on its lower half. First dorsal with a row of dark crescents on the basal parts of the membranes and a dark submarginal band. Second dorsal with concentrations of pigment forming irregular rows of indistinct spots. Caudal similar. Anal, pectorals, and pelvics clear, with some dark spots. Teardrop suborbital bar well developed, a dark spot behind the chin, and discrete dark spots on the breast.

Juveniles and breeding adults: The species does not develop bright breeding colors nor does it have breeding tubercles.

Size: The shield darter reaches slightly more than 3 inches total length.

Habitat

Clear moderate-sized creeks, with gravel and rubble bottom, and considerable current seem to be the requirements of the shield darter. Greeley (1936) remarked that "It is extremely agile and usually difficult to seine so that it is apt to be regarded as scarcer than it really is."



Distribution

The shield darter is an Atlantic coast species that ranges from the Hudson River to the Neuse River in North Carolina. In New York, it is found in Rondout Creek, the Delaware, and the Susquehanna systems. It occurs in Cayuta Creek, and Greeley recorded it from the Chemung drainage.

Mayden and Page compared southern population of the shield darter with its relatives, *Percina roanoka* and *Percina crassa*, and noted that southern populations of the shield darter have scales on the cheeks. They regarded the presence of scales on the cheeks, larger size, slender body, and lack of

bright colors as unspecialized features relative to the opposite conditions in the other two species.

Life History

New described the breeding behavior of this species in Otego Creek and other localities and supplemented his data with observations made on captive fish. Apparently, there is little or no migration as the year-round habitat provides the necessary spawning sites. Spawning takes place over fine gravel but large rocks must also be present. Spawning was observed in daylight and once at night. The breeding season begins around mid-April and extends through May. Males became ripe in September and spawning was earlier than in *Etheostoma olmstedi*. Males established territories on the downstream sides of rocks where there was a deposit of fine gravel. Conspecific males were driven away and chased for 2 or 3 feet, sometimes as much as 10 feet. The size of the territories was not determined but the defense seemed to be most intense within 2 feet of the sheltering rock. When intruders approached, the defender would first display, turning his body parallel to the intruder. If there was no retreat, he would strike with his mouth open and his fins erect. Fights seldom lasted more than 15 or 20 seconds, with rest periods of 3 to 5 seconds, until one fish was driven off. Sexual dimorphism is not pronounced in this species and sex recognition seems to be on the basis of behavior patterns. Frequently, males attempted to spawn with other males, particularly if the second male was lying on the bottom with the dorsal fin depressed.

When ready to spawn, a female would enter a male's territory and come to rest on the bottom with her body slightly curved. The male would mount her with his head and isthmus against her nape and his body parallel to, and over, hers. The pair would quiver vigorously for 10 to 15 seconds, ploughing through the gravel so that the eggs were released below the surface. Usually, the male's anal fin and caudal fin were on opposite sides of the female with the female's erect second dorsal on the same side as the male's anal fin.

Food and Feeding

The food habits do not seem to have been studied.

Notes

Loos and Woolcott found one hybrid between *Percina peltata* and *P. notogramma* in the York River in Virginia. Their study indicated that *P. peltata* usually spawned in faster current and was less ritualistic in its behavior than *P. notogramma*, and they suggested that this may be why hybrids are uncommon.

References

Collette, 1965 (systematics). Page, 1976a (characters). Loos and Woolcott, 1969 (hybridization). New, 1966 (reproductive behavior). Mayden and Page, 1979 (systematics). Greeley, 1936 (Delaware and Susquehanna drainages).

Names

The species name is the Latin word meaning shielded.

Etheostoma peltatum Stauffer in Cope, 1864:
233 Conestoga Creek, Pennsylvania

Hadropterus peltatus, Greeley, 1936: 86 Delaware and Susquehanna drainages

Percina peltata, Bailey et al., 1960: 29 (nomenclature)

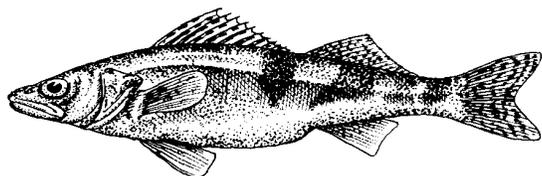
TABLE 36
AVERAGE PROPORTIONAL MEASUREMENTS AND COUNTS OF DARTERS (*Percina*)

All proportions are expressed in percentage of standard length.

	<i>caprodes</i>	<i>copelandi</i>	<i>evides</i>	<i>macrocephala</i>	<i>maculata</i>	<i>peltata</i>
ST. LENGTH (mm)	61.9	36.0	44.2	62.1	47.3	67.7
TOTAL LENGTH	117.7	117.5	116.3	115.9	119.0	119.3
FORK LENGTH	116.1	116.4	113.8	113.7	116.8	115.4
PREDORSAL	32.7	33.1	34.2	37.5	36.5	34.2
PREANAL	65.1	61.9	63.9	67.3	65.1	64.5
PREPELVIC	31.1	28.6	30.4	32.9	30.3	28.0
DORSAL BASE	52.1	45.3	49.6	47.3	47.7	49.6
ANAL BASE	14.1	14.4	15.1	14.0	14.3	15.1
BODY DEPTH	17.6	15.0	17.8	16.7	17.3	17.6
BODY WIDTH	12.3	12.8	14.1	12.4	13.1	14.3
C. PED. DEPTH	8.2	8.3	8.3	7.8	8.4	8.2
PECTORAL ALT.	10.9	9.7	10.5	10.5	11.3	10.4
HEAD LENGTH	28.3	11.9	27.5	30.8	25.8	26.1
SNOUT	8.8	6.1	7.6	8.7	6.8	7.4
EYE	6.9	6.7	6.4	7.4	8.1	5.9
MOUTH LENGTH	8.1	7.2	7.9	9.1	8.2	8.0
INTERORB	4.5	2.5	4.1	3.7	8.6	4.7
N (sample size)	5	1	5	2	3	5
COUNTS:						
DORSAL SPINES	XIV-XVI	XI	XI-XIII	XIV-XV	XIV-XV	XII
DORSAL RAYS	15-16	10-12	10-14	12-13	12-14	13
ANAL RAYS	II,6-7	II,10-11	II,5-10	II,9	II,9-11	II,9-10
PECTORAL RAYS	12-16	14-15	11-16	14	13-14	14
PELVIC RAYS	I,5	I,5	I,5	I,5	I,5	I,5
GILL RAKERS	13	16-17	16	12-15	—	—
VERTEBRAE	43-45	38-39	37-42	43-44	43-44	43-44
SCALES:						
ABOVE L. L.	7-10	5	7-9	7-8	6-8	6-7
LATERAL LINE	67-100	48	55-60	75-78	65-70	53-57
BELOW L.L.	12-17	6	8-12	12-13	8-10	9-10

Stizostedion

This genus includes the sauger, walleye, and one or two European species. They are large, rather elongate fishes with toothed preopercles and large canine teeth. The anal fin supports are only weakly developed.



SAUGER

Stizostedion canadense (Smith, 1834)

Identification

Sauger and walleyes are the largest members of the perch family. They both differ from the yellow perch in color and in having large canine teeth in the jaws which the perch does not have. They differ from all of the darters in their large size and in the fact that their preopercles are serrated while those of the darters are smooth, or nearly so. It is easy to confuse the sauger with the walleye, but saugers have oblique rows of definite spots on the first dorsal whereas the first dorsal of the walleye has only diffuse markings. The walleye also has a definite dark blotch at the end of the spiny dorsal which is wanting in the sauger. The sauger has five to eight pyloric caeca which are shorter than the stomach; the walleye has three that are longer than the stomach.

Description

Body elongate and slab sided, profiles even and symmetrical. Dorsal fin origin over pectoral base, spiny dorsal margin arched, its third through fifth spines longest. Dorsals separate. Second dorsal highest anteriorly, its margin straight, its corners angulate. Caudal forked, its middle rays shorter than the longest upper rays. Anal origin below anterior half of second dorsal, its third ray longest, its margin straight. Pelvics large, bluntly pointed, inserted below basal one-fourth of the pectoral. Pectoral asymmetrically pointed with its base nearly vertical. Gill membranes separate and free from the isthmus. Preopercle serrate on both limbs, the dentations of the lower limb large and antrorse. Mouth large, with strong canine teeth on the jaws, maxillary reaching to below rear of the eye. Eye large. Lateral line complete, paralleling dorsal profile. Counts and proportional measurements are given in Table 37.

Color: Generally brownish gray with yellow wash, shading to white ventrally. Body crossed by three or four irregular saddle-shaped blotches, some of which extend onto the sides as sloping bars. First dorsal with rows of distinct spots on the

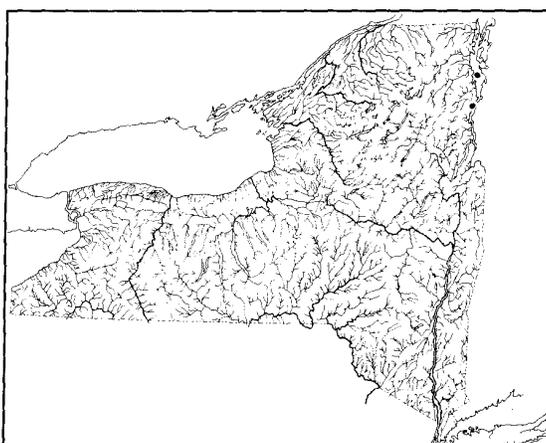
membranes and no black blotch at the back. Second dorsal with two or more rows of spots, its margin dusky. Caudal similar to second dorsal. Pectorals, pelvics, and anal fin light with a few dark spots, anal sometimes with a white anterior tip. Pectoral base with a dark blotch. Sides of head marbled.

Juveniles and breeding adults: Juveniles are somewhat more distinctly marked. There are no conspicuous breeding colors.

Size: Usually about 12 to 14 inches. The IGFA record is 8 pounds 12 ounces from Lake Sakajawea, North Dakota.

Habitat

The sauger is a big-water fish of lakes, reservoirs, and large rivers. It is apparently more tolerant of turbidity than the walleye.



Distribution

The sauger originally ranged through the Mississippi drainage from Louisiana north to Montana and central Alberta, east to James Bay and Lake Champlain. It occurred throughout much of the Tennessee and Ohio River basins. It has now been introduced in several gulf and Atlantic coast drainages. It was formerly a commercial fish in Lake Erie but became commercially extinct there in the 1930s. It is still reasonably common in Lake Champlain.

Life History

Sauger spawn in May or June, usually after walleyes, when the temperature reaches 39 to 43 F. Males move onto the gravelly spawning shoals before the females. Spawning takes place at night in water 2 to 12 feet deep. The eggs are scattered over the gravel with no nest preparation and no parental care. Females lay 15,000 to 40,000 eggs and leave the area soon after spawning. The eggs are adhesive and stick to the gravel or rock bottom. In the laboratory, the eggs hatch in 21 days at 47 F and 9 to 14 days at 55 F.

Food and Feeding

Dendy reported that saugers in Norris Reservoir ate primarily gizzard shad, crappies, and bass. Elsewhere, they might be expected to eat other species but they are primarily piscivorous. Young-of-the-year in Lewis and Clark Reservoir fed on *Cyclops*

first, switching to *Daphnia* and *Diaptomus* later, and to fish when they reached 70 to 100 mm total length.

Notes

Recent attempts to reestablish the sauger in Lake Erie are apparently meeting with some success.

References

Dendy, 1946 (food). Greeley, 1964 (popular account). Kendall, 1978 (management). Nelson, 1968a (life history); 1968b (embryology, hybridization). Rawson and Scholl, 1978 (reestablishment in Lake Erie).

Names

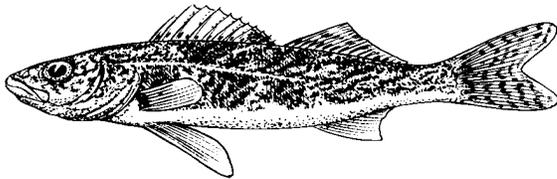
The sauger is named for the country from which it was first described, Canada.

Lucioperca canadensis Smith in Cuvier, 1834: 275 Canada

Lucioperca grisea DeKay, 1842:19 New York

Stizostedion canadense griseum, Greeley, 1929: 176 Lake Erie

Stizostedion canadense, Greeley, 1930: 84 Lake Champlain



WALLEYE AND BLUE PIKE

Stizostedion vitreum vitreum (Mitchill, 1818)

and *S. v. glaucum* Hubbs, 1926

Identification

The walleye is a large slender percoid that differs from the yellow perch in having large caniniform jaw teeth, and in lacking the regular vertical bars of the perch although walleyes have markings that sometimes appear as rather unorganized oblique bars. Like the yellow perch, they have a dark blotch at the back of the first dorsal fin.

Walleyes are difficult to distinguish from saugers but saugers lack the black blotch at the end of the first dorsal fin and also have distinct spots on the first dorsal whereas the walleye lacks the spots and has the blotch. The walleye has three pyloric caeca that are longer than the stomach; the sauger has five to eight caeca that are shorter than the stomach.

Description

Body elongate, streamlined, little compressed. Profiles symmetrical. Dorsal origin over base of pectoral. Dorsal fins separated by a scaled space. Spiny dorsal margin arched, interspinous membrane not incised. Soft dorsal highest anteriorly, its margin straight. Caudal forked, its middle rays two-thirds the longest upper rays. Anal origin under fourth

dorsal soft ray. Anal highest anteriorly, its margin straight. Pelvic inserted below second dorsal spine. Pelvics retrogressive, last ray two-thirds the first. Pectoral fin blunt, shorter than the pelvic, pectoral base oblique. Gill membranes separate, overlapping anteriorly. Mouth terminal, maxillary reaching to below posterior edge of pupil. Preopercles strongly serrated. Body completely scaled except the breast is naked, with a triangular patch of scales in front of the pelvic fin. Prepectoral scaled. Lateral line complete, straight. Counts and proportional measurements are given in Table 37.

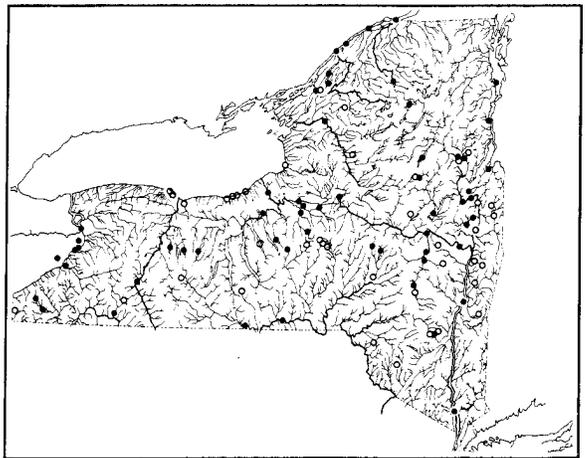
Color: Although its color is highly variable, the walleye is basically brownish yellow to grayish yellow, shading to white on the ventral surface. Young walleyes show vague saddle-shaped oblique bands on the body. There is a blackish spot on the pectoral base and another on the membranes at the back of the first dorsal fin. The second dorsal and the caudal base are crossed with irregular lines of spots. The tip of the lower lobe of the caudal and the tip of the anal fin are white. Pectoral, pelvic and anal fins clear, with a few dark spots.

Juveniles and breeding adults: Juveniles are more conspicuously marked. There are no special breeding colors.

Size: The IGFA record is a 25-pound fish from Old Hickory Lake in Tennessee. The New York State record is 15 pounds 3 ounces from the Chemung River.

Habitat

Walleyes occur in lakes and larger rivers. Most of the time, they hover near the bottom in loose aggregations during the day and move into shallows to feed at night. They are active during the winter.



Distribution

The walleye has a wide distribution through the central part of North America from the Mackenzie River to Quebec and south to northern Texas, Alabama, and Georgia. The original range has been expanded by introductions on the Atlantic and gulf coasts and elsewhere.

Life History

Walleyes spawn in the spring just after the ice goes and the water temperatures reach 35 to 44 F. The

spawning sites are usually gravel bars in streams or shoals in lakes where there is considerable water movement over rocks, gravel, or even sand. Walleyes do not build nests. The males move onto the spawning area first. During the day, they remain in deep water and after dark they move into the shallows for spawning. A female accompanied by one or more males moves onto the bar and the fish vibrate and roll together as the eggs and sperm are broadcast over the gravel. Usually, the spawning site has water less than 2 feet deep and seldom more than 4 feet. Females lay 35,000 to more than 600,000 eggs. Hatching time varies according to temperature, requiring 7 days at 51 F and 26 days at 40 F. Males mature at age II or III when they are 12 to 13.5 inches long; females mature at ages IV or V when they are 17 inches long. Males tend to remain on the spawning beds longer than the females but there is no parental care.

Food and Feeding

Walleyes are opportunistic predators. Very small walleyes feed first on planktonic crustaceans, then switch to insects. By the time they are 3 inches long, they feed on fish and other larger items.

Notes

There is an enormous literature on the walleye. It is one of our most important game and commercial species and its growth rates and habits are variable, as one would expect of a widespread and successful species.

The blue pike was originally described from Lake Erie by Hubbs (1926). It was an important commercial fish as late as the early 1970s but is now probably extinct. The blue pike was distinguished from the walleye by its lack of yellow pigment and by its larger eye and narrower interorbital distance. In the walleye, the interorbital distance was contained 1.1 to 1.4 times in the eye diameter in young, about 1.0 in adults. In the blue pike, the interorbital was 1.4 to 2.0 in the eye diameter.

Bluish walleyes were also present in Lake Ontario, but several workers have expressed doubts that they were the same as the Lake Erie walleye. Overfishing and genetic swamping (interbreeding with the more abundant walleye) have been cited as reasons for the disappearance of the blue walleye.

References

Robins, 1970 (bibliography). Eschmeyer, 1950 (life history). Raney and Lachner, 1942 (ecology). Niemuth, Churchill, and Wirth, 1959 (summary). Zilliox, 1962 (Lake Champlain). Regier et al., 1969 (Lake Erie). Li and Ayles, 1981 (feeding of fingerlings). Forney, 1967, 1975, 1976, 1977a, 1977b (ecology and management in Oneida Lake). Galligan, 1960 (winter food). Wolfert, 1977 (growth). Wolfert and Van Meter, 1978 (movement). Wolfert, Busch, and Baker, 1975 (egg predation). Buynak and Gurzynski, 1978a (disease).

Names

Vitreum is the Latin word for glass, in reference to the glassy appearance of the eye.

Perca vitrea, Mitchill, 1818a: 247 Cayuga Lake
Lucioperca americana Cuvier in Cuvier and Valenciennes, 1828: 122 New York

Stizostedion vitreum, Greeley, 1927: 64 Genesee drainage

Stizostedion glaucum Hubbs, 1926: 58 Lake Erie

Stizostedion vitreum vitreum, Hubbs and Lagler, 1974: 106

Stizostedion vitreum glaucum, Greeley, 1940: 80 canal in Ontario drainage

TABLE 37
AVERAGE PROPORTIONAL MEASUREMENTS AND COUNTS OF YELLOW PERCH,
SAUGER, AND WALLEYE (*Perca* and *Stizostedion*)

All proportions are expressed in percentage of standard length.

	<i>Perca</i>	<i>Stizostedion</i>	
	<i>flavescens</i>	<i>canadense</i>	<i>vitreum</i>
ST. LENGTH (mm)	60.0	343.6	103.2
TOTAL LENGTH	123.4	117.8	120.2
FORK LENGTH	117.9	111.8	113.2
PREDORSAL	34.4	32.7	36.0
PREANAL	67.8	68.2	68.6
PREPELVIC	38.1	32.2	37.2
DORSAL BASE	30.7	54.0	50.8
ANAL BASE	11.9	13.2	12.6
BODY DEPTH	26.9	24.4	20.0
BODY WIDTH	14.1	16.5	15.0
C. PED. DEPTH	9.8	8.0	7.6
PECTORAL ALT.	18.2	13.6	13.8
HEAD LENGTH	32.9	29.7	34.8
SNOUT	8.5	8.3	10.1
EYE	9.9	4.6	7.6
MOUTH LENGTH	11.2	13.0	15.0
INTERORB	7.7	5.8	5.8
N (sample size)	5	1	2
COUNTS:			
DORSAL SPINES	XV-XVI	XIII	XIV
DORSAL RAYS	12-13	17	20-21
ANAL RAYS	II,7-8	II,12	II,11-13
PECTORAL RAYS	13-14	13-15	15
PELVIC RAYS	I,5	I,5	I,5
GILL RAKERS	19-23	19-22	21
VERTEBRAE	39-41	45	46-47
SCALES:			
ABOVE L. L.	5-6	10	12
LATERAL LINE	53-60	90-94	84
BELOW L. L.	11-13	12	15

DRUMS

SCIAENIDAE

The freshwater drum is an exception to the general rule that drums are coastal marine species. Like its marine relatives, it has a short first and long second dorsal fin and the lateral line continues out to the end of the tail fin. It also has heavy molar-like pharyngeal teeth, enlarged head canals, and the general look of some of the marine drums.

The family Sciaenidae is worldwide in temperate and warm seas. It contains about 28 genera and 160 species. Although they all share a characteristic appearance, they are, in fact, quite diverse.

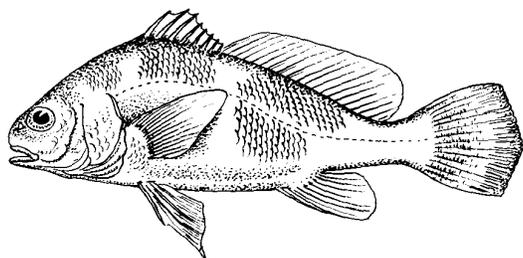
Freshwater drum are not highly regarded as food fish but they can provide some sport fishing in the larger waters of our state.

A recent general study of the family, including the freshwater drum, is that of Chao (1978).

A key to the species of drums reported from the inland waters of New York State will be found in the section on marine visitors.

Aplodinotus

This genus contains only one species. It is distinguished from other sciaenids by its simple, carrot-shaped swim bladder, its heavy, fused lower pharyngeal bones, and lack of barbels.



FRESHWATER DRUM

Aplodinotus grunniens
Rafinesque, 1819

Identification

The freshwater drum is a rather typical-looking member of this predominately marine family. It has a blunt head, with the snout overhanging the low horizontal mouth, and this distinctive physiognomy

has earned it its alternate name — sheepshead. The body is deepest anterior to the dorsal fin and tapers to the base of the asymmetrically pointed tail. The spiny dorsal is much shorter than the second dorsal.

One of its more distinctive sciaenid features is the enlarged sensory canals on the head. The bone covering the canals is reduced to narrow bridges and this sometimes gives the head a honeycomb appearance, although in life it is more or less masked by the dense scales covering the head. Another sciaenid feature is that the lateral line continues out to the tip of the middle caudal rays. The maxillary bone slides under the preorbital region when the mouth is closed.

Description

Body moderately elongate and somewhat compressed, deepest just behind the head. Dorsal profile rising steeply, then sloping evenly to the caudal peduncle. Ventral profile almost straight. Body compressed dorsally, less so ventrally, producing a somewhat triangular cross section. Snout blunt, overhanging the almost horizontal mouth. Top of head scaly to a line in front of the eyes. Cheeks, preopercles, and opercles scaly, bases of vertical fins and pectorals scaly. Dorsal fins continuous, the first spine short, the second and third subequal, the rest graduated, except the last which is longer than the preceding and closely connected to the first soft ray. Soft dorsal long, its margin evenly convex, rounded posteriorly. Anal high, rounded. Caudal asymmetrically rounded or bluntly pointed, its longest rays below the center. Pelvics inserted slightly behind the pectoral base, retrogressive, rounded posteriorly. First pelvic ray with a short filament. Gill membranes separate, free from the isthmus. Lateral line complete, parallel to the dorsal profile anteriorly, straight on the caudal peduncle, continuing to the end of the caudal rays. Head bones cavernous. Gill rakers short and blunt. Counts and proportional measurements are given in Table 30.

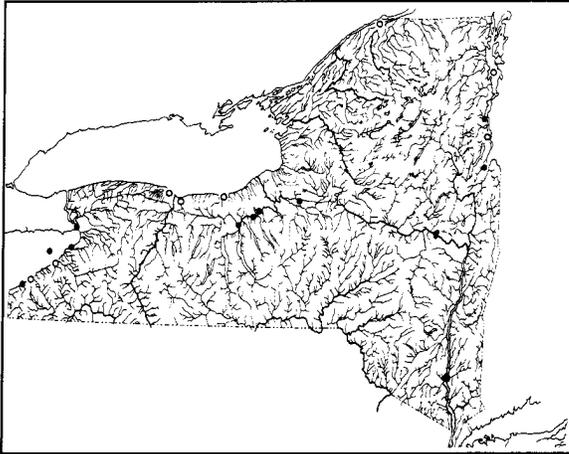
Color: Silvery gray to brownish above, shading to silvery on the lower sides and white on the belly. Pelvic fins white, sometimes with an orange tinge distally. Pectoral clear.

Juveniles and breeding adults: Juveniles have longer and more pointed tails but otherwise are miniatures of the adults. There are no special breeding colors or structures in this species.

Size: The drum can reach weights of 25 pounds or more although they are seldom over 10 pounds. Statements that bones from Indian middens indicate weights of 100 pounds, or more, are probably in error. The New York State angling record is a 15-pound 6-ounce drum from the Barge Canal caught May 1981 by Paul Donovan.

Habitat

Drums are limited to big rivers and lakes. The species is generally restricted to shallow water and is quite tolerant of turbidity.



Distribution

The freshwater drum ranges from the gulf coast drainages between Yucatan and Mobile Bay. It occurs throughout the Mississippi and Missouri basins to Montana and east to the Hudson Bay drainage and the estuarine part of the St. Lawrence River. In New York, it is common in Lakes Erie, Ontario and Champlain.

Life History

The drum is one of the few freshwater fishes that produces a planktonic egg. It has a protracted breeding season, spawning from July to September in Lake Erie. Its spawning behavior has not been described and, indeed, it is not known exactly where spawning takes place, but it is presumed that it spawns in midwater or near the surface.

The drum is a long-lived species, reaching at least age XII. Ovarian egg counts of more than 1/2 million have been reported.

Foods and Feeding

Young drum eat plankton and midge larvae, switching to midges, entomostracans, and larger insect larvae as they grow. Fish and crayfish are prominent in the diet of larger drums.

Notes

The otoliths of drums are large, nearly an inch in diameter in larger individuals. They make fine curios; an angled groove on one side forms an L (for luck). The drum also has very large molariform teeth that appear to be adapted for crushing molluscan prey, although Lake Erie drum were found to be feeding on insects and soft-bodied organisms even in areas where snails were abundant.

References

Barney, 1926 (ecology). Daiber, 1952 (food habits). Edsall, 1967 (ecology). Witt, 1960 (size of ancient fish). Swedberg and Walberg, 1970 (spawning and life history). Burkett and Jackson, 1971 (eye lens as indicator of age). Green, 1941 (osteology). Price, 1963 (food).

Names

The trivial name *grunniens* is the Latin word for grunting like a pig. This species is a notorious sound producer.

Aplodinotus grunniens Rafinesque, 1819: 418 Ohio River

Sciaena oscula Lesueur, 1822b: 252 Lake Ontario

Corvina oscula DeKay, 1842: 73-74 Lakes Erie and Ontario

SCULPINS

COTTIDAE

Sculpins and their relatives belong to a group called the mail-cheeked fishes because they have a bony bar connecting the circumorbital bones with the preopercle. In sculpins, this bar is covered with skin but it can be felt with a little probing. This is a rather large family with more than 300 species in about 67 genera. Most of the species are marine but a few live in fresh water. There are four freshwater species in New York, and two marine strays have been reported from the Lower Hudson.

All of our species are scaleless, although they may have a few prickly remnants of scales. Sculpins

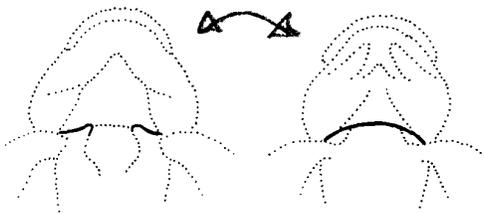
have broad, somewhat depressed, heads and large fan-like pectoral fins. The pelvic fins have a small spine and usually three or four soft rays. There are no spines in the anal fin but there is a separate spiny dorsal fin with slender, weak spines.

Sculpins are sometimes abundant in small, cold streams where they are often associated with trout. They are accused of preying on trout eggs but apparently they eat only those not covered during the spawning process. Their role as competitors of trout is less clear.

KEY TO THE SPECIES OF SCULPINS IN THE INLAND WATERS OF NEW YORK

A. Gill membranes free from the isthmus.

A'. Gill membranes broadly attached to the isthmus.



Gill membranes free from (left) and joined to the isthmus.

B. Lateral line complete. Upper preopercular spine strongly curved upward and forward, its length greater than two-thirds the diameter of the eye.

Cottus ricei Spoonhead sculpin, p. 358



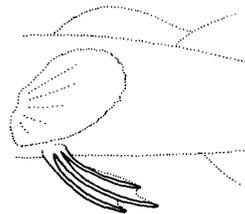
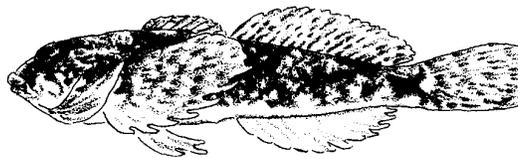
B'. Lateral line incomplete. Upper preopercular spine curved but not hooked upward and forward, shorter, its length less than two-thirds the diameter of the eye.

E.

C. Pelvic rays typically 1,3. Palatine teeth usually absent. Anal fin interradiated membranes deeply notched between the rays. Caudal peduncle always shorter than the postorbital head length.

Cottus cognatus

Slimy sculpin, p. 356



Pelvic rays of slimy sculpin.

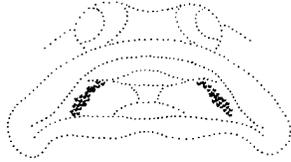
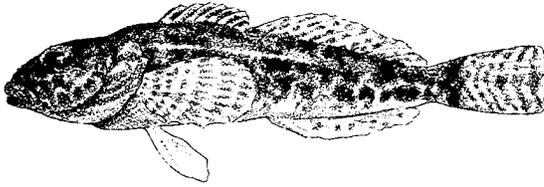


The caudal peduncle of the slimy sculpin is shorter than the postorbital head length. In the mottled sculpin it is longer.

C'. Pelvic rays typically I,4. Palatine teeth usually present. Anal interradiated membranes less deeply notched. Caudal peduncle always shorter than the postorbital head length.

Cottus bairdi

Mottled sculpin, D.



Palatine teeth of mottled sculpin.

D. Distance between tip of snout and anus when measured backward from the anus extending to a point nearer the base than the tip of the caudal fin. Body with definite dark bars.

Cottus b. bairdi

p. 355

D'. Distance from tip of snout to anus when stepped backward from anus reaching a point nearer the tip than the base of the caudal fin. Body rather slender with less definite dark bars.

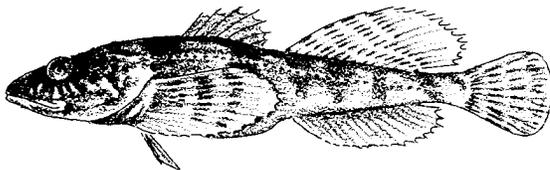
Cottus b. kumlieni

p. 355

E. (A. Gill membranes free from the isthmus.) Preopercle with four spines. Dorsal fins separated by a distinct gap. Great Lakes.

Myoxocephalus thompsoni

Deepwater sculpin, p. 359

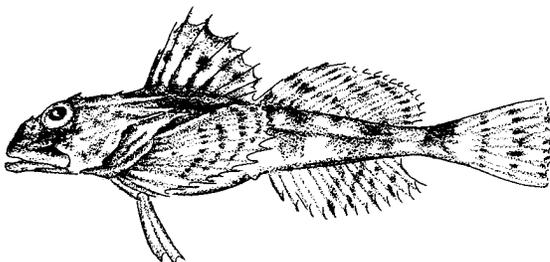


E'. Preopercle with three spines. Dorsal fins close together. Marine.

F. Uppermost preopercular spine long, about four times as long as the spine below it, its tip reaching the margin of the gill cover.

Myoxocephalus octodecemspinosus

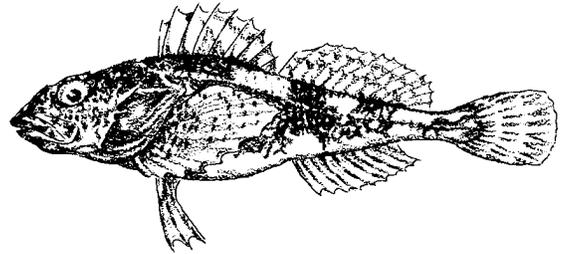
Longhorn sculpin, p. 450



F'. Uppermost preopercular spine at most twice as long as spine below it, its tip not reaching the margin of the gill cover. Origin of first dorsal ahead of a vertical line through the tip of the gill cover.

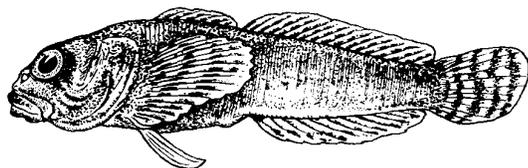
Myoxocephalus aeneus

Grubby, p. 449



Cottus

There are about 25 species of *Cottus* of which 3 occur in New York waters. They are scaleless freshwater fishes with three or four pelvic rays and contiguous dorsal fins. The gill membranes are joined to the isthmus.



MOTTLED SCULPIN

Cottus bairdi Girard, 1850

Identification

The three New York species of *Cottus* are quite similar and easily confused. All three have the same general shape and color and all have the gill membranes broadly joined to the isthmus whereas in the related genus, *Myoxocephalus*, the gill membranes are joined to each other but free from the isthmus. The mottled sculpin and the slimy sculpin both have two pores at the tip of the chin where the spoonhead has only one. The spoonhead also has a flatter head, and the upper spine on its preopercle is curved almost into a semicircle. In New York, the slimy and the mottled sculpins can be told apart by the number of pelvic fin rays, nearly always four in *C. bairdi* and nearly always three in *C. cognatus*. Farther west, the two species vary more and this feature becomes unreliable. McAllister noted that the caudal peduncle length, the distance from the posterior end of the anal fin base to the middle of the caudal fold, is greater than the distance from the rear margin of the eye to the tip of the opercular membrane in the slimy sculpin, but less in the mottled sculpin. The membranes between the anal fin rays are deeply incised in the slimy sculpin and less so in the mottled sculpin. Palatine teeth are usually present in *C. bairdi*, usually absent in *C. cognatus*. The last ray of the dorsal fin is usually double in *bairdi*, usually single in *cognatus*, and the bands on the pectoral fin are wider than the pupil in *cognatus*, narrower in *bairdi*.

Description

Body short and robust, head and anterior body depressed. Caudal peduncle slightly compressed. Dorsal profile much more curved than the ventral, which is nearly straight. Head flattened ventrally, rounded above. Eyes dorsolateral. Dorsal fins close together, spiny dorsal convex, soft dorsal with spines increasing in length to the fourth or fifth, then becoming shorter. Caudal rounded. Anal similar to the soft dorsal, inserted below the fourth dorsal soft ray, its fourth through sixth spines longest. Membranes of anal fin slightly indented between

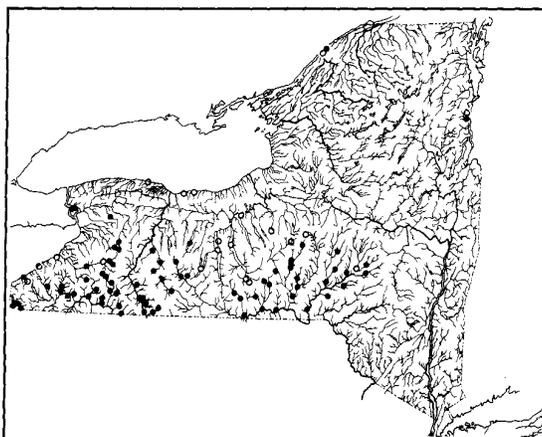
the rays. Pelvic fin inserted behind the anterior, lower end of the pectoral base. Pelvic pointed, with its second and third rays subequal. Pectoral large and asymmetrically rounded, its lower membranes incised and lower rays somewhat thickened. Gill membranes broadly joined to the isthmus. Preopercular spines four, the uppermost longest, stout and slightly curved. Maxillary reaching to below the anterior third of the eye. Lips prominent. Lateral line ending below the posterior third of the dorsal fin. Two chin pores. Last two anal elements close together. Counts and proportional measurements are given in Table 38.

Color: Upper surface generally brownish, belly clear white in front of the anal fin. Dorsal surface with traces of four saddles, rather small and indistinct, the first at the beginning of the dorsal fin, the second under the last dorsal spine, the third under the anterior third of the second dorsal, and the fourth near the end of the soft dorsal. There is an irregular bar at the caudal base. The caudal fin has spots on its proximal third, then three vertical bars. Margin of the caudal fin clear.

The lower sides of the body are punctate, with irregular marbling and blotches on the back extending to slightly below the lateral line. Dorsal and anal fins with relatively clear membranes. Intensification of the pigment along the rays forms irregular oblique bands across the dorsal fin. Anal fin with similar rows of spots. Pectoral with seven or eight narrow bands of spots. Interradial membranes of the fin punctate. Dorsal surface of the head dark, lower side and ventral surface merely punctate back to, and including, the pelvic fin.

Juveniles and breeding adults: Breeding males have the margin of the spiny dorsal fin orange with a submarginal dark band. In nonbreeding males and females, this submarginal band is represented by dark spots at each end of the fin.

Size: The largest specimen reported by Scott and Crossman (1973) measured 5.2 inches total length.



Habitat

The mottled sculpin lives in lakes and cooler streams. Specimens from the Great Lakes and other larger lakes are said to have shorter caudal regions and have been recognized as a separate

subspecies, *C. b. kumlieni*. The distance from the tip of the snout to the anus, projected backward, reaches to near the end of the caudal fin in *kumlieni*, and only to the base of the caudal in *C. b. bairdi*.

Distribution

The mottled sculpin ranges from eastern Canada south to the Tennessee, Alabama and Mobile drainages of the gulf coast. There are disjunct populations in the Ozark region and the Columbia River system in southern Canada, Utah, Montana, Idaho, and Washington. This is a variable species but some of those populations may be different species. It occurs across the southern part of New York State.

Life History

The mottled sculpin is a spring spawner and its breeding season begins when the water temperature reaches approximately 50 F. Males set up territories near a shelter site, a rock or overhanging ledge. Savage reported on the breeding behavior in aquaria where the shelter was a sloping piece of brick or slate. When a female was placed in the aquarium, the male turned black and responded to the female with one of four movements: Shaking the head, nodding the head, expanding the gill covers, or undulating the body. If the female responded, the male bit her cheeks or pectoral fin and enticed her into the shelter site where the courtship continued, sometimes for several hours. Spawning took place when the female turned upside down. The eggs were emitted in an initial burst, then additional eggs were added more slowly. During the spawning, the male's body gradually turned paler but his fins remained black.

Bailey studied reproduction in southwestern Montana. Spawning occurred 5 June through 30 June when the water temperature was 46 to 63 F. Hatching took 21 to 28 days. Each female produced 69 to 406 eggs (average 203) and nests contained 54 to 1,587 eggs, indicating that there was some polygamy.

The newly hatched larvae were 5.8 to 8.1 mm long and the yolk sac was absorbed in 2 weeks when the larvae were 9.0 to 9.9 mm long. Age I fish ranged from 29.6 to 56.7 mm, age II - 64.4 to 79.3 mm, age III - 80.5 to 98.0 mm, age IV - 84 to 118.8 mm, and age V - 93 to 110.3 mm.

Food and Feeding

Food habits of the mottled sculpin were studied in streams near Ithaca and in Cayuga Lake by Koster. Mayflies, caddisflies, and dipteran larvae were the most important items and together made up about 90 percent of the diet of the stream form (called *C. b. bairdi* by Koster). The smallest fish ate mostly dipterans and the larger fish ate mostly caddisflies. The lake form, *Cottus b. kumlieni*, ate more mayflies and crustaceans which probably reflected the abundance of these items in the environment. Daiber studied the winter food habits of this species and the fantail darter in a small headwater tributary of the Genesee River. The food of both was primarily

insects with some copepods. Occasionally, a small sculpin was eaten by a larger one. Larger fish ate larger items and the sculpins ate fewer items than the darters did, possibly a reflection of the sculpin's sedentary feeding by ambush.

Notes

The subspecies *kumlieni* is said to be a Great Lakes form that lives in Lakes Superior, Michigan, Huron, Ontario, and the eastern basin of Lake Erie. It also occurs in the Finger Lakes and the St. Lawrence River and a few inland lakes in Michigan. In view of the variability of this species, the distinctions are doubtful, and the subspecies are not recognized here.

References

McAllister, 1964 (identification). McAllister and Lindsey, 1961 (systematics). Smith, 1923 (nesting). Savage, 1963 (behavior). Dineen, 1951 (food habits). Bailey, 1952 (life history). Robins, 1955 (taxonomy). Gage, 1878 (Cayuga Lake). Koster, 1936, 1937 (life history and feeding), Ludwig and Norden, 1969 (life history). Ludwig and Lange, 1975 (fecundity). Gilson and Bensen, 1979 (prey selection). Daiber, 1956 (winter feeding). Godkin, Christie, and McAllister, 1982 (identification).

Names

The mottled sculpin is named for Spencer Fullerton Baird, the first United States Commissioner of Fisheries.

Cottus bairdii Girard, 1850: 410 Mahoning River, Ohio

Cottus bairdii Greeley, 1927: 65 Genesee drainage

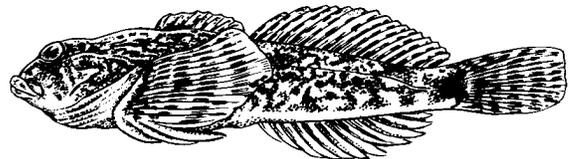
Pegedictis ictalops Rafinesque, 1820a: 85 Lexington, Kentucky

Cottus ictalops, Bean, 1903: 635-637 New York
Cottus ictalops bairdii, Meek, 1889: 315 Cayuga Lake

Cottus bairdii bairdii, Greeley, 1929: 178 Erie-Niagara drainage

Uranidea kumlieni Hoy in Nelson, 1876: 41 Lake Michigan

Cottus bairdii kumlieni, Greeley, 1928: 102 Oswego drainage.



SLIMY SCULPIN

Cottus cognatus
Richardson, 1836

Identification

The slimy sculpin closely resembles the mottled sculpin, but the two can usually be told apart in our area by the number of pelvic fin rays: three in the

slimy sculpin and four in the mottled sculpin. (Both species have a tiny spine that cannot be seen without dissection.) Other useful characters are as follows: No palatine teeth in the slimy sculpin; the last rays of the dorsal and anal fins are single in the slimy sculpin but double in the mottled sculpin, that is, they are closer to each other than the rest of the rays in those fins. McAllister (1964) also noted that while most of these features are variable and occasionally overlap, the caudal peduncle of the slimy sculpin is always longer than the postorbital distance, and the interradiation membranes of the anal fin are more deeply incised in the slimy sculpin. Color differences include narrower and more distinct bands on fins of the mottled sculpin.

The slimy sculpin differs from the spoonhead in having a less flattened head and a gently curved, rather than strongly hooked, upper preopercular spine. Also, the spoonhead has a single pore at the tip of the lower jaw where the slimy and mottled sculpins have two. Members of the genus *Myoxocephalus* have the gill membranes free from the isthmus.

Description

Body stout and short, round or slightly depressed anteriorly. Dorsal profile arched, ventral profile nearly straight. First dorsal strongly arched, second dorsal convex, the fifth ray longest. Caudal fin rounded. Anal similar to the second dorsal, its last two rays not closer than the other rays. Anal and lower pectoral interradiation membranes deeply incised. Pectoral fin large and fan-shaped, its base sloping downward and forward. Pelvic inserted behind the lower end of the pectoral base. Head triangular in dorsal view, eyes rather close together. Maxillary reaching to below anterior third of the eye, head and mouth generally shorter than in the mottled sculpin. Pelvic fins progressive, third rays the longest. Preopercle with four spines, the upper long and gently curved upward. The other spines are embedded in the skin. Dorsal surface with prickles, lateral line ending below middle of the second dorsal fin. Counts and proportional measurements are given in Table 38.

Color: Mottled brown to pinkish above with indistinct dorsal saddle-shaped darker blotches. Sides marbled to punctate above a line between the middle of the pectoral base and the anal fin origin. Belly and lower surface of the caudal peduncle white. Few melanophores on the pelvic and anal fins. Pectoral fin with five wide, irregular, and indistinct bands. Spiny dorsal with three or four oblique bands. Second dorsal with about nine similar bands. Caudal with a few spots forming weak bands.

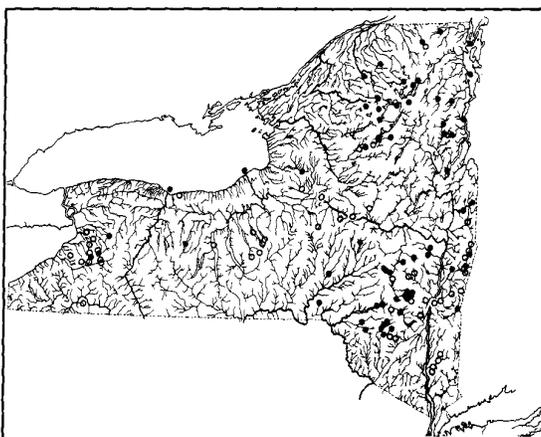
Juveniles and breeding adults: Breeding males tend to be darker and have a bright orange margin on the first dorsal fin.

Size: The largest specimens are about 5 inches total length.

Habitat

This is a northern species. In our area, it is limited to

cold creeks where there is some shelter and to lakes. It occurs at depths of 18 to 270 feet in Lake Michigan, 300 to 350 feet in Lake Superior.



Distribution

Slimy sculpins range from northeastern Siberia throughout much of Canada and south on the Atlantic coast to Virginia. On the west coast, they reach British Columbia, Washington, and Montana. In New York State, it is widely distributed but absent from the Genesee and Chemung drainages and sporadic in the Ontario and St. Lawrence corridors.

Life History

Koster studied the reproduction of the slimy sculpin in a tributary of Fall Creek near Ithaca. Spawning took place in the spring when water temperatures reached 40 to 60 F and at somewhat lower temperatures in Cayuga Lake. Males established territories that included a nesting site, usually a crevice under a log, rock, or tree root. Females were enticed into the nest and deposited the eggs on the roof of the cavity. After spawning, the female left and the male often courted other females so that a single nest usually contained the eggs of more than one female. Males kept guard over the nest and the young until they began to feed.

In Saskatchewan (Van Vleit as quoted by Scott and Crossman, 1973), the eggs were 2.3 to 2.6 mm in diameter and females age III produced 1,400 eggs. The eggs hatched in about 4 weeks.

Food and Feeding

Sculpins frequently occur with trout and, because of the potential for interacting with the game species, their food habits have been studied rather intensively. Koster investigated the food of slimy and mottled sculpins near Ithaca and in Cayuga Lake. Insects made up most of the diet. Mayflies contributed 35 percent of the volume, caddisflies 18.4 percent and dipterans 32 percent. Smaller sculpins ate more dipterans and the larger fish ate more caddisflies. The largest individuals ate a few fish and fish eggs but this was not considered significant. The smallest individuals frequently fed on entomostacans. Plant materials, worms, mollusks, and spiders were rare in the stomachs.

Notes

In New York, the slimy and mottled sculpins have quite consistent characteristics and can usually be identified with little difficulty. In the northwestern parts of their range, the species are more variable and most of the distinguishing features overlap.

References

McAllister, 1964 (identification). McAllister and Lindsey, 1961 (systematics). Koster, 1936 (life history); 1937 (feeding). Symons, Metcalf, and Harding, 1976 (temperature requirements). Otto and O'Hara Rice, 1977 (temperature). Godkin, Christie, and McAllister, 1982 (identification).

Names

The name *cognatus* is the Latin word meaning related. It is a reference to the similarity of the slimy sculpin to a European species.

Cottus cognatus Richardson, 1836: 40 Great Bear Lake

Cottus cognatus, Greeley, 1928: 102 Oswego drainage

Cottus gracilis Heckel, 1840: 148 New York

Cottus gracilis cayuga Meek, 1889: 315 Cayuga Lake

Uranidea gracilis, Evermann and Kendall, 1902c: 240 St. Lawrence

Cottus viscosus Haldemann, 1840: 3 Susquehanna River

Uranidea gracilis viscosa (Haldeman), Greeley, 1927: 65 (not taken in Genesee)

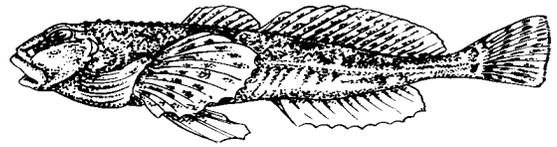
Uranidea quiescens DeKay, 1842: 61 Adirondacks

Cottus formosus Girard, 1852: 587 Lake Ontario

Uranidea formosa, Bean, 1903: 638 New York (after Girard)

Cottus meridionalis Girard, 1850: 410 James River, Virginia

Cottus meridionalis, Hankinson, 1924: 87 western New York

**SPOONHEAD SCULPIN*****Cottus ricei* (Nelson, 1876)****Identification**

The spoonhead is the most distinctive of the three species of the genus *Cottus* that occur, or did occur, in New York State. These three species are quite similar in appearance and a close look is often necessary to determine their identification. The spoonhead is the most distinctive. It has a flattened depressed head, a single pore at the tip of the chin (two in the others), and the upper spine on its preopercle is curved, almost forming a semicircle. It also has a complete lateral line, four pelvic rays, and prominent prickles over most of its body.

Description

Body rather slender, profiles about equally curved. Head flattened, the preorbital area expanded forward so as to appear as lobes on either side of the snout and giving the posterior margin of the premaxillary groove a trilobed appearance. Preopercular spines two, three, or four. Dorsal fins contiguous, the spiny dorsal rounded, the soft dorsal gently convex. Caudal fin truncate. Anal fin similar to the second dorsal, its rays increasing slightly in length posteriorly. Pectoral fins long and rounded, their bases sloping so the lower rays are farther forward. No scales, but the body has small prickles. Lateral line complete. Gill membranes broadly joined to the isthmus. Maxillary reaching to below the eye. Counts and proportional measurements are given in Table 38.

Color: Light brown or tan with indistinct saddle-shaped blotches and various speckling on head, body, and fins. Ventral surface generally unmarked, pelvic fins white. Anal fin pale with faint groups of melanophores. Small specimens sometimes have a vertical bar at the caudal base.

Juveniles and breeding adults: No sexual or juvenile characters have been reported.

Size: The largest known specimen was 5.3 inches total length. Most specimens are 1.6 to 2.4 inches but specimens more than 3 inches long are not uncommon.

Habitat

In the Great Lakes, the spoonhead is known from moderately deep water from the shore to 450 feet. Scott and Crossman suggested that its optimum depth is about 200 feet. Farther north it occurs in larger rivers and sometimes even in swift streams.

Distribution

The range of the spoonhead is a broad area from the Great Lakes and the St. Lawrence River to the

Lower Mackenzie River and to the Peace and Upper Missouri Rivers in Alberta. It is now apparently extinct in Lake Ontario and possibly also in Lake Erie. Fish reported it from off Dunkirk, New York. Trautman notes that there have been no Lake Erie records since 1950.

Life History

According to Scott and Crossman, females taken in August have larger eggs than those taken in June or July, which suggests a summer or fall spawning season. Otherwise, its life history is unknown.

Food and Feeding

Its diet has not been reported.

Notes

Most of the lake specimens of this species are from the stomachs of larger fish such as burbot and lake trout.

References

McAllister and Lindsey, 1961 (systematics). Delisle and Van Vliet, 1968 (life history). Scott and Crossman, 1973 (Canada). Trautman, 1981 (Ohio). Fish, 1932 (larvae).

Names

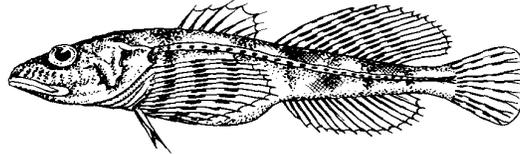
This species is named in honor of M. L. Rice who discovered the first specimen.

Cottopsis ricei Nelson, 1876: 40 Lake Michigan off Evanston, Illinois

Cottus ricei, Greeley, 1929: 179 Lake Erie

Myoxocephalus

This genus includes the larger cottid fishes of marine and deep-lake waters. Members of this genus have well-separated dorsal fins and gill membranes that are not joined to the isthmus.



DEEPWATER SCULPIN

Myoxocephalus thompsoni (Girard, 1852)

Identification

Members of the genus *Myoxocephalus* are rather large sculpins with well-separated dorsal fins and gill membranes that are joined to each other but free from the isthmus. Three species occur in New York waters: Two are marine strays occasionally reported from the Hudson Estuary, but the deepwater sculpin is a true freshwater species occurring in the Great Lakes and in some smaller lakes in Canada and Michigan. It is often cited as a glacial relict on the assumption that its present disjunct distribution pattern must have resulted from its moving along the glacial margin as the Wisconsin ice sheet receded.

The preopercular margin of the deepwater sculpin has four strong spines, of which the upper two are close together and similar in size, so that they appear to be a single bifurcate spine. The two marine species have three preopercular spines with the second much larger than the other two.

All members of the genus *Cottus* have the gill membranes joined to the isthmus.

Description

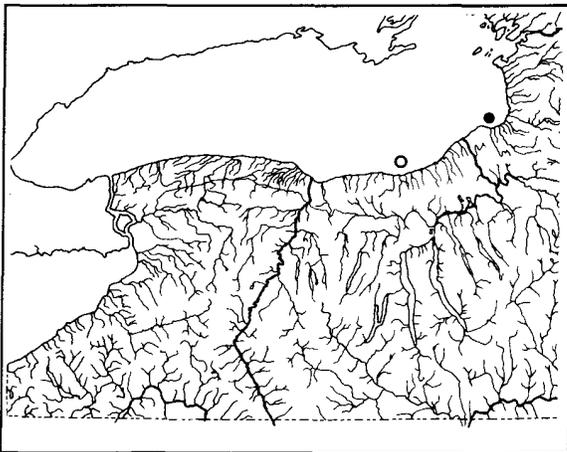
Body rather elongate, tapering, and terete. Head depressed. Snout blunt, rising sharply and flat on top, slightly concave between and behind the orbits. Epaxial muscles prominent behind the occiput. All fin rays unbranched. Spiny dorsal short, separated from the second dorsal by a wide space. Dorsal spines slender. Spiny dorsal outline rounded. Second dorsal with the rays increasing in length to the sixth, and the posterior part of the fin rounded. Caudal square. Anal fin with short rays at the front, most of the rays about equal in length. Pelvic fins paddle shaped with the third ray longest. Pectoral fins large, asymmetrically rounded, with exerted rays, their bases sloping backward. Preopercle with four spines, the first directed upward, the second backward, the third downward, and the fourth separated from the others and directed anteriorly. Skin of dorsal surface with weak prickles. Mouth large, maxillary reaching to below rear edge of pupil.

Lower jaw with a distinct symphyseal knob. Lateral line prominent, nearly complete, dipping low on the caudal peduncle and ending behind the end of the dorsal base. Counts and proportional measurements are given in Table 38.

Color: (from Lake Michigan specimens) Generally pale grayish to tan above, sharply delimited along sides and white ventrally. Body somewhat blotched but no regular markings. First dorsal peppered with melanophores, a little heavier along the rays. Second dorsal with an intensification of pigment along the base and at the middle third of the fin. Caudal with traces of three irregular, equally spaced bands, and an indistinct marginal band. Anal fin white. Pelvics white. Pectoral fins with three irregular bands alternating with rows of spots, becoming paler ventrally where the melanophores are confined to the rays. Iris with golden bronze ring at edge of pupil.

Juveniles and breeding adults: The sexes are about the same color, but the adult males have the dorsal, anal, and upper pectoral rays extending beyond the membrane as short filaments. These extensions have approximately four points on each segment so that they are quite rough. The points are less well developed on the anal fins.

Size: Deepwater sculpins from the northern parts of their range are said to be smaller than those from the Great Lakes. It is reported to have reached lengths of 9.2 inches total length in Lake Ontario.



Habitat

True to its name, the deepwater sculpin lives in deeper parts of freshwater lakes where the summer maximum temperatures are always below 8 C. Preferred temperatures are between 0 and 5 C. Most of the lakes from which the species is known are clear and slightly acidic (pH 6.5 to 6.7). Deepwater sculpins are most abundant at depths of 73 to 91 meters but they have been taken from 25 meters to 366 meters, the deepest record being from Lake Superior.

Distribution

The deepwater sculpin occurs in North America from Great Bear Lake in the Canadian Northwest Territories, south and east in a curving band to the

Great Lakes. It has received considerable attention as an example of a glacially distributed fish (Dadswell, 1974). It is apparently extinct in Lake Ontario where no specimens have been reported in nearly 20 years, but it remains abundant in Lakes Huron, Michigan, and Superior. Its present status in Lake Erie is not known.

Life History

The life history of the deepwater sculpin is unknown. Reports suggest that spawning occurs in summer or perhaps early fall but the exact dates undoubtedly vary with latitude. Fish illustrated specimens 12.5 and 16.2 mm long taken in Lake Erie in July and mid-August so spawning must have occurred there in June or July. One Lake Ontario specimen has eggs in its mouth but it is not known if this was accidental or if the species is an oral brooder.

Foods and Feeding

Midges, *Pontoporeia*, mysids, and copepods have been reported from the stomachs of deepwater sculpins.

Notes

This species was formerly considered a subspecies of the marine fourhorn sculpin, *Myoxocephalus quadricornis*, but there is evidence that it is a distinct species and the two are sometimes found together in the brackish waters of the Hudson Bay region. Larval pigment and other structural differences support its being accorded full species rank. Champagne, Harrington, and McAllister reported a fossil from the Champlain sea clays east of Ottawa, Canada. The specimen was thought to be late Wisconsin of postglacial age.

References

Dadswell, 1974 (origin and distribution). Cowan, 1971 (morphology). McAllister, 1961 (systematics). McAllister and Aniskowicz, 1976 (vertebral numbers). McPhail and Lindsey, 1970 (general account). Fish, 1932 (juvenile stages). Champagne, Harrington, and McAllister, 1979 (fossil record). Delisle and Van Vliet, 1968 (Canadian records).

Names

The species is named in honor of Zadock Thompson who published on the fishes of Lake Champlain.

Triglopsis thompsonii Girard, 1852: 65, 66, 67, 71 Lake Ontario

Triglopsis thompsonii, Girard, 1854a: 19 Lake Ontario off Oswego, New York

Triglopsis thompsonii, Greeley, 1929: 178 Lake Erie

Myoxocephalus quadricornis thompsonii, Hubbs and Lagler, 1964: 118 (distribution)

TABLE 38
AVERAGE PROPORTIONAL MEASUREMENTS AND COUNTS OF FRESHWATER
SCULPINS (*Cottus* and *Myoxocephalus*)

All proportions are expressed in percentage of standard length.

	<i>bairdi</i>	<i>Cottus</i> <i>cognatus</i>	<i>ricei</i>	<i>Myoxocephalus</i> <i>thompsoni</i>
ST. LENGTH (mm)	44.3	64.9	43.6	96.8
TOTAL LENGTH	124.3	123.4	122.5	118.7
FORK LENGTH	124.3	123.4	121.6	118.7
PREDORSAL	36.0	34.2	35.3	38.3
PREANAL	57.0	55.7	54.5	61.5
PREPELVIC	30.5	30.8	30.3	31.6
DORSAL BASE	55.9	58.9	54.8	48.9
ANAL BASE	28.4	29.1	29.9	24.5
BODY DEPTH	18.8	20.1	15.8	19.1
BODY WIDTH	18.3	17.8	16.5	21.0
C.PED. DEPTH	8.9	9.2	5.3	4.9
PECTORAL ALT.	12.2	11.8	9.4	11.5
HEAD LENGTH	32.7	33.6	31.8	30.5
SNOUT	8.8	9.4	9.0	10.2
EYE	9.6	6.9	6.9	7.7
MOUTH LENGTH	12.0	13.0	11.5	15.5
INTERORB	2.5	2.9	3.7	5.2
N (sample size)	5	5	5	10
COUNTS:				
DORSAL SPINES	VII-VIII	VI-IX	VIII-IX	VII-X
DORSAL RAYS	16-18	14-19	13-14	13-16
ANAL RAYS	11-13	10-14	13-14	13-16
PECTORAL RAYS	13-17	12-16	14-16	15-18
PELVIC RAYS	I,4	I,3	(4)	I,3 or 4
GILL RAKERS	Rudimentary	Rudimentary	?	8-13
VERTEBRAE	31-33	31-35	34-35	37-39

Vertebral counts for *C. ricei* from Scott and Crossman, (1973); other counts and measurements from USNM specimens from Glacier Park, Montana.

FRESHWATER AND DIADROMOUS FISHES OF NEW YORK

✓ PETROMYZONTIDAE

1. *Ichthyomyzon bdellium* (Jordan, 1885), Ohio lamprey
2. *Ichthyomyzon fossor* Reighard and Cummins, 1916, northern brook lamprey
3. *Ichthyomyzon greeleyi* Hubbs and Trautman, 1937, mountain brook lamprey
4. *Ichthyomyzon unicuspis* Hubbs and Trautman, 1937, silver lamprey
5. *Lampetra appendix* (DeKay, 1842), American brook lamprey
6. *Petromyzon marinus* Linnaeus, 1758, sea lamprey

✓ ACIPENSERIDAE

7. *Acipenser brevirostrum* Lesueur, 1818, shortnose sturgeon
8. *Acipenser fulvescens* Rafinesque, 1817, lake sturgeon
9. *Acipenser oxyrhynchus* Mitchell, 1815, Atlantic sturgeon

✓ POLYDONTIDAE

10. *Polyodon spathula* (Walbaum, 1792), paddlefish

✓ LEPISOSTEIDAE

11. *Lepisosteus osseus* (Linnaeus, 1758), longnose gar
12. *Lepisosteus platostomus* (Rafinesque, 1820), shortnose gar
Lepisosteus oculatus (Winchell, 1864), spotted gar (hypothetical)

✓ AMIIDAE

13. *Amia calva* Linnaeus, 1766, bowfin

✓ ANGUILLIDAE

14. *Anguilla rostrata* (Lesueur, 1817), American eel

✓ CLUPEIDAE

15. *Alosa aestivalis* (Mitchill, 1814), blueback herring
16. *Alosa mediocris* (Mitchill, 1815), hickory shad
17. *Alosa pseudoharengus* (Wilson, 1811?), alewife
18. *Alosa sapidissima* (Wilson, 1811?), American shad
19. *Dorosoma cepedianum* (Lesueur, 1818), gizzard shad

✓ HIODONTIDAE

20. *Hiodon tergisus* Lesueur, 1818, mooneye

✓ ICTALURIDAE

21. *Ictalurus catus* (Linnaeus, 1758), white catfish
22. *Ictalurus melas* (Rafinesque, 1820), black bullhead
23. *Ictalurus natalis* (Lesueur, 1819), yellow bullhead
24. *Ictalurus nebulosus* (Lesueur, 1819), brown bullhead
25. *Ictalurus punctatus* (Rafinesque, 1818), channel catfish
26. *Noturus flavus* Rafinesque, 1818, stonecat
27. *Noturus gyrinus* (Mitchill, 1817), tadpole madtom
28. *Noturus insignis* (Richardson, 1836), margined madtom
29. *Noturus miurus* Jordan, 1877, brindled madtom

✓ CATOSTOMIDAE

30. *Carpiodes cyprinus* (Lesueur, 1817), quillback
31. *Catostomus catostomus* (Forster, 1773), longnose sucker
32. *Catostomus commersoni* (Lacépède, 1803), white sucker
33. *Erimyzon oblongus* (Mitchill, 1815), creek chubsucker
34. *Erimyzon sucetta* (Lacépède, 1803), lake chubsucker
35. *Hypentelium nigricans* (Lesueur, 1817), northern hog-sucker
36. *Moxostoma anisurum* (Rafinesque, 1820), silver redhorse

37. *Moxostoma carinatum* (Cope, 1870), river redhorse
38. *Moxostoma duquesnei* (Lesueur, 1817), black redhorse
39. *Moxostoma erythrurum* (Rafinesque, 1818), golden redhorse
40. *Moxostoma macrolepidotum* (Lesueur, 1817), shorthead redhorse
M. m. macrolepidotum (Lesueur, 1817)
M. m. breviceps (Cope, 1870)
41. *Moxostoma valenciennesi* Jordan, 1885, greater redhorse

✓ CYPRINIDAE

42. *Carassius auratus* (Linnaeus, 1758), goldfish
43. *Ctenopharyngodon idella* (Valenciennes, 1844), grass carp
44. *Cyprinus carpio* Linnaeus, 1758, common carp
45. *Rhodeus sericeus* (Pallas, 1776), bitterling
46. *Scardinius erythrophthalmus* (Linnaeus, 1785), rudd
47. *Camptostoma anomalum* (Rafinesque, 1820), central stoneroller
48. *Ericymba buccata* Cope, 1865, silverjaw minnow
49. *Exoglossum laurae* (Hubbs, 1931), tonguetied minnow
50. *Exoglossum maxillingua* (Lesueur, 1818), cutlips minnow
51. *Notemigonus crysoleucas* (Mitchill, 1814), golden shiner
52. *Couesius plumbeus* (Agassiz, 1850), lake chub
53. *Hybopsis amblops* (Rafinesque, 1820), bigeye chub
54. *Hybopsis dissimilis* (Kirtland, 1840), streamline chub
55. *Hybopsis storeriana* (Kirtland, 1844), silver chub
56. *Hybopsis x-punctata* Hubbs and Crowe, 1956, gravel chub
57. *Nocomis biguttatus* (Kirtland, 1840), hornyhead chub
58. *Nocomis micropogon* (Cope, 1865), river chub
59. *Rhinichthys atratulus* (Hermann, 1804), eastern blacknose dace
60. *Rhinichthys cataractae* (Valenciennes, 1842), longnose dace
61. *Rhinichthys meleagris* Agassiz, 1854, western blacknose dace
62. *Semotilus atromaculatus* (Mitchill, 1818), creek chub
63. *Semotilus corporalis* (Mitchill, 1817), fallfish
64. *Semotilus margarita* (Cope, 1868), pearl dace
S. m. margarita (Cope, 1868)
S. m. nachtriebi (Cox, 1896)
65. *Clinostomus elongatus* (Kirtland, 1838), redbelt dace
66. *Hybognathus hankinsoni* Hubbs, 1929, brassy minnow
67. *Hybognathus regius* Girard, 1857, eastern silvery minnow
68. *Notropis amoenus* (Abbott, 1874), comely shiner
69. *Notropis atherinoides* Rafinesque, 1818, emerald shiner
70. *Notropis photogenis* (Cope, 1865), silver shiner
71. *Notropis rubellus* (Agassiz, 1850), rosyface shiner
72. *Notropis analostanus* (Girard, 1860), satinfin shiner
73. *Notropis chrysocephalus* (Rafinesque, 1820), striped shiner
74. *Notropis cornutus* (Mitchill, 1817), common shiner
75. *Notropis spilopterus* (Cope, 1868), spotfin shiner
76. *Notropis umbratilis* (Girard, 1857), redfin shiner
77. *Notropis anogenus* Forbes, 1885, pugnose shiner
78. *Notropis bifrenatus* (Cope, 1869), bride shiner
79. *Notropis chalybaeus* (Cope, 1869), ironcolor shiner
80. *Notropis heterodon* (Cope, 1865), blackchin shiner
81. *Notropis heterolepis* Eigenmann and Eigenmann, 1893, blacknose shiner
82. *Notropis procne* (Cope, 1865), swallowtail shiner
83. *Notropis dorsalis* (Agassiz, 1854), bigmouth shiner
84. *Notropis hudsonius* (Clinton, 1824), spottail shiner
85. *Notropis stramineus* (Cope, 1865), sand shiner

86. *Notropis volucellus* (Cope, 1865), mimic shiner
 87. *Phoxinus eos* (Cope, 1862), northern redbelly dace
 88. *Phoxinus neogaeus* Cope, 1868, finescale dace
 89. *Pimephales notatus* (Rafinesque, 1820), bluntnose minnow
 90. *Pimephales promelas* Rafinesque, 1820, fathead minnow

SALMONIDAE

91. *Coregonus alpenae* (Koelz, 1924), longjaw cisco ✓
 92. *Coregonus artedii* Lesueur, 1818, cisco or lake herring ✓
 93. *Coregonus clupeaformis* (Mitchill, 1818), lake whitefish ✓
 94. *Coregonus hoyi* (Gill, 1872), bloater ✓
 95. *Coregonus kiyi* (Koelz, 1921), kiyi ✓
 96. *Coregonus reighardi* (Koelz, 1924), shortnose cisco ✓
 97. *Coregonus zenithicus* (Jordan and Evermann, 1909), shortjaw cisco ✓
 98. *Prosopium cylindraceum* (Pallas, 1784), round whitefish ✓
 99. *Oncorhynchus kisutch* (Walbaum, 1792), coho salmon ✓
 100. *Oncorhynchus nerka* (Walbaum, 1792), kokanee ✓
 101. *Oncorhynchus tshawytscha* (Walbaum, 1792), chinook salmon ✓
 102. *Oncorhynchus gorbuscha* (Walbaum, 1792), pink salmon ✓
 103. *Salmo gairdneri* Richardson, 1836, rainbow trout ✓
 104. *Salmo salar* Linnaeus, 1758, Atlantic salmon ✓
 105. *Salmo trutta* Linnaeus, 1758, brown trout ✓
 106. *Salvelinus fontinalis* (Mitchill, 1815), brook trout ✓
 107. *Salvelinus namaycush* (Walbaum, 1792), lake trout ✓

OSMERIDAE

108. *Osmerus mordax* (Mitchill, 1815), rainbow smelt ✓

UMBRIDAE

109. *Umbra limi* (Kirtland, 1841), central mudminnow ✓
 110. *Umbra pygmaea* (DeKay, 1842), eastern mudminnow ✓

ESOCIDAE

111. *Esox americanus* Gmelin, 1788
E. a. americanus Gmelin, 1788, redbfin pickerel ✓
E. a. vermiculatus Lesueur, 1846, grass pickerel ✓
 112. *Esox lucius* Linnaeus, 1758, northern pike ✓
 113. *Esox masquinongy* Mitchill, 1824, muskellunge ✓
 114. *Esox niger* Lesueur, 1818, chain pickerel ✓

APHREDODERIDAE

115. *Aphredoderus sayanus* (Gilliams, 1824), pirate perch ✓
A. s. sayanus (Gilliams, 1824) ✓
A. s. gibbosus Lesueur, 1833 ✓

PERCOPSIDAE

116. *Percopsis omiscomaycus* (Walbaum, 1792), trout-perch ✓

GADIDAE

117. *Lota lota* (Linnaeus, 1758), burbot ✓

CYPRINODONTIDAE

118. *Fundulus diaphanus* (Lesueur, 1817), banded killifish ✓

POECILIIDAE

119. *Gambusia affinis* (Baird and Girard, 1853), mosquitofish ✓

ATHERINIDAE

120. *Labidesthes sicculus* (Cope, 1865), brook silverside ✓

GASTEROSTEIDAE

121. *Apeltes quadracus* (Mitchill, 1815), fourspine stickleback ✓
 122. *Culaea inconstans* (Kirtland, 1840), brook stickleback ✓

123. *Gasterosteus aculeatus* Linnaeus, 1758, threespine stickleback ✓
 124. *Pungitius pungitius* (Linnaeus, 1758), ninespine stickleback ✓

MORONIDAE

125. *Morone americana* (Gmelin, 1789), white perch ✓
 126. *Morone chrysops* (Rafinesque, 1820), white bass ✓
 127. *Morone saxatilis* (Walbaum, 1792), striped bass ✓

CENTRARCHIDAE

128. *Acantharchus pomotis* (Baird, 1855), mud sunfish ✓
 129. *Ambloplites rupestris* (Rafinesque, 1817), rock bass ✓
 130. *Enneacanthus gloriosus* (Holbrook, 1855), bluespotted sunfish ✓
 131. *Enneacanthus obesus* (Girard, 1854), banded sunfish ✓
 132. *Lepomis auritus* (Linnaeus, 1758), redbreast sunfish ✓
 133. *Lepomis cyanellus* Rafinesque, 1819, green sunfish ✓
 134. *Lepomis gibbosus* (Linnaeus, 1758), pumpkinseed ✓
 135. *Lepomis gulosus* (Cuvier, 1829), warmouth ✓
 136. *Lepomis macrochirus* Rafinesque, 1818, bluegill ✓
 137. *Lepomis megalotis* (Rafinesque, 1820), longear sunfish ✓
 138. *Micropterus dolomieu* Lacepède, 1802, smallmouth bass ✓
 139. *Micropterus salmoides* (Lacepède, 1802), largemouth bass ✓
 140. *Pomoxis annularis* Rafinesque, 1818, white crappie ✓
 141. *Pomoxis nigromaculatus* (Lesueur, 1829), black crappie ✓

PERCIDAE

142. *Ammocrypta pellucida* (Putnam, 1863), eastern sand darter ✓
 143. *Etheostoma blennioides* Rafinesque, 1819, greenside darter ✓
 144. *Etheostoma caeruleum* Storer, 1845, rainbow darter ✓
 145. *Etheostoma camurum* (Cope, 1870), bluebreast darter ✓
 146. *Etheostoma exile* (Girard, 1860), Iowa darter ✓
 147. *Etheostoma flabellare* Rafinesque, 1819, fantail darter ✓
 148. *Etheostoma fusiforme* (Girard, 1854), swamp darter ✓
 149. *Etheostoma maculatum* Kirtland, 1841, spotted darter ✓
 150. *Etheostoma nigrum* Rafinesque, 1820, johnny darter ✓
 151. *Etheostoma olmstedii* Storer, 1842, tessellated darter ✓
 152. *Etheostoma variatum* Kirtland, 1838, variegated darter ✓
 153. *Etheostoma zonale* (Cope, 1868), banded darter ✓
 154. *Perca flavescens* (Mitchill, 1814), yellow perch ✓
 155. *Percina caprodes* (Rafinesque, 1818), logperch ✓
 156. *Percina copelandi* (Jordan, 1877), channel darter ✓
 157. *Percina evides* (Jordan and Copeland, 1877), gilt darter ✓
 158. *Percina macrocephala* (Cope, 1869), longhead darter ✓
 159. *Percina maculata* (Girard, 1860), blackside darter ✓
 160. *Percina peltata* (Stauffer, 1864), shield darter ✓
 161. *Stizostedion canadense* (Smith, 1834), sauger ✓
 162. *Stizostedion vitreum* (Mitchill, 1818)
S. v. vitreum (Mitchill, 1818), walleye ✓
S. v. glaucum Hubbs, 1926, blue pike ✓

SCIAENIDAE

163. *Aplodinotus grunniens* Rafinesque, 1819, freshwater drum ✓

COTTIDAE

164. *Cottus bairdi* Girard, 1850, mottled sculpin ✓
 165. *Cottus cognatus* Richardson, 1836, slimy sculpin ✓
 166. *Cottus ricei* (Nelson, 1876), spoonhead sculpin ✓
 167. *Myoxocephalus thompsoni* (Girard, 1852), deepwater sculpin ✓



BROOK TROUT *Salvelinus fontinalis*



COMMON SHINER *Notropis cornutus*



SPOTFIN SHINER *Notropis spilopterus*



REDFIN SHINER *Notropis umbratilis*



ROSYFACE SHINER *Notropis rubellus*



EASTERN BLACKNOSE DACE *Rhinichthys atratulus* male



EASTERN BLACKNOSE DACE *Rhinichthys atratulus* female



WESTERN BLACKNOSE DACE *Rhinichthys mealegris* male



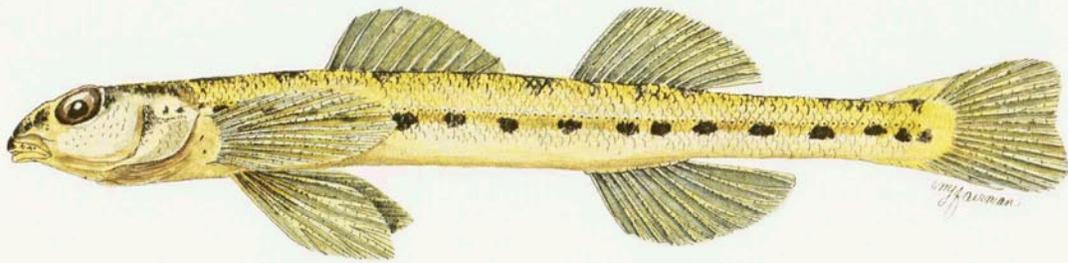
REDSIDE DACE *Clinostomus elongatus*



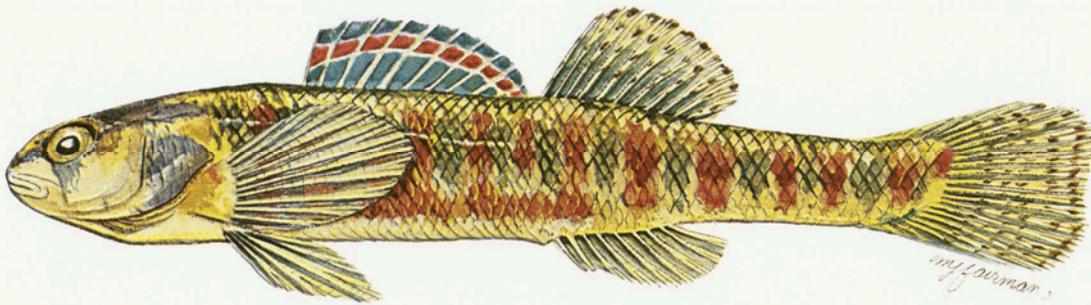
NORTHERN REDBELLY DACE *Phoxinus eos* female



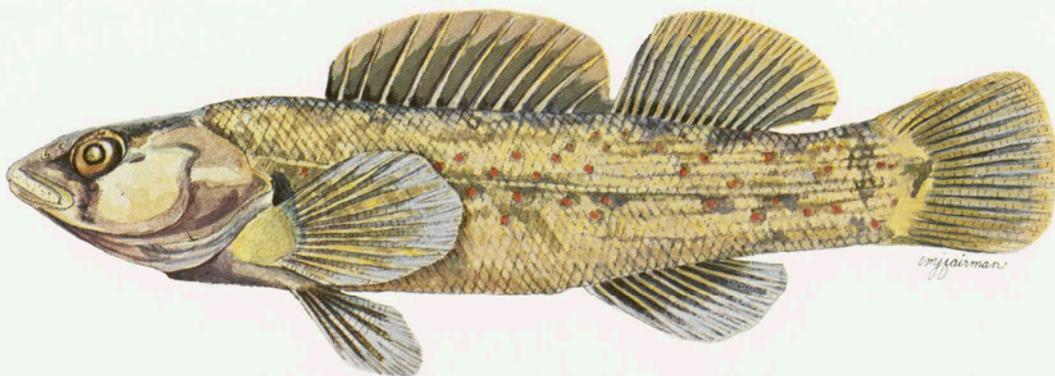
PEARL DACE *Semotilus margarita*



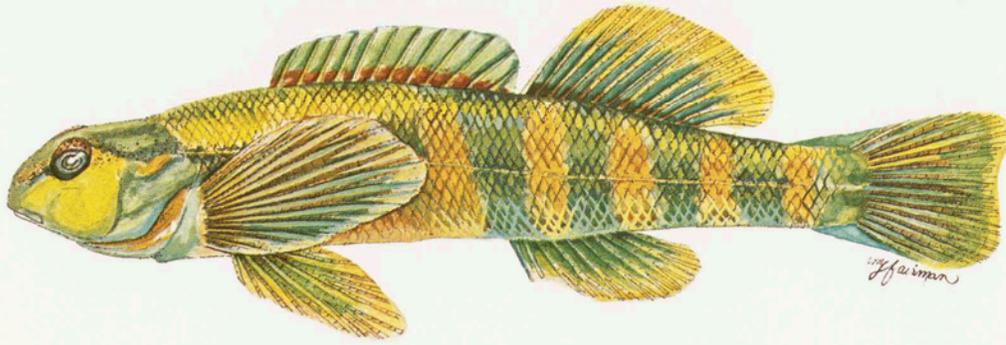
EASTERN SAND DARTER *Ammocrypta pellucida*



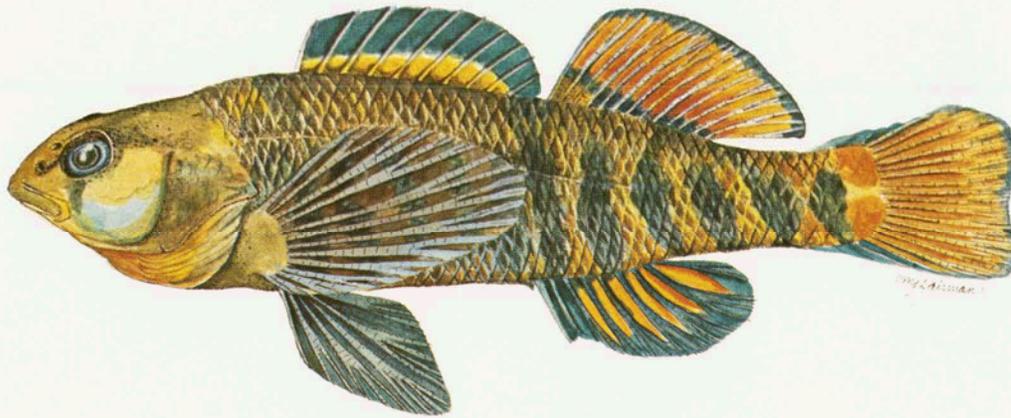
IOWA DARTER *Etheostoma exile*



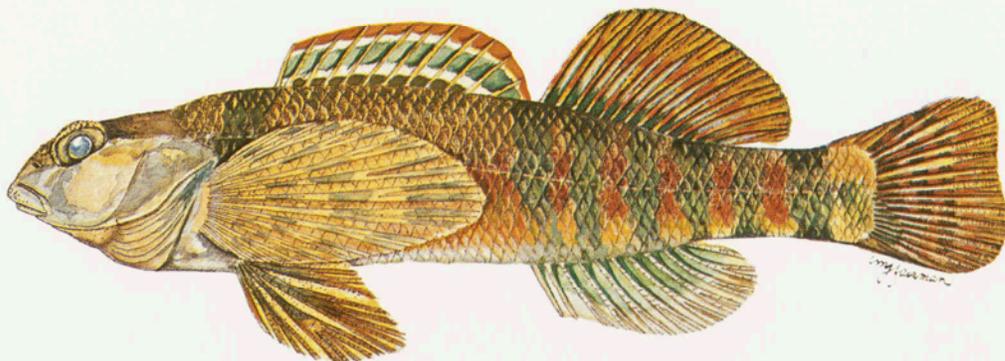
SPOTTED DARTER *Etheostoma maculatum*



GREENSIDE DARTER *Etheostoma blennioides*



RAINBOW DARTER *Etheostoma caeruleum*



VARIEGATE DARTER *Etheostoma variatum*



TESSELLATED DARTER *Etheostoma olmstedi*



BANDED DARTER *Etheostoma zonale*



CHANNEL DARTER *Percina copelandi*

6

MARINE FISHES IN THE INLAND WATERS OF NEW YORK

Because the Hudson River is open to the sea with no physical barriers below the Troy dam and lock at River Mile 153 (153 miles above Battery Park), almost any species that occurs in the nearby Atlantic Ocean could enter the estuary. In order to simplify the identification of inland fishes, the marine species found inland only in the Hudson River estuary are treated separately. The species listed here are those known to have been collected in, or reliably reported from, the river through 1982. Species from the North River (the area off Manhattan) are included but species that have only been reported from the Arthur Kill (between Staten Island and New Jersey) are not (Figure 10).

The Hudson River is a complex estuarine ecosystem with a correspondingly complex fish fauna. Normally, the salt water intrudes as far upstream as the region between Poughkeepsie and Newburgh but this varies with the amount of rainfall in the upper parts of the river basin. Furthermore, the salt front has rather vague limits under most conditions because there is considerable mixing due to wind and flow currents, and to the effects of the propellers of tugs and large ships as they travel up the Hudson. Thus, the distance that marine fishes travel upstream varies with the season and with the climatic conditions of each particular year. A number of the marine fishes reported from the Hudson are tropical species that normally live in the West Indies. These apparently were carried northward by the Gulf Stream when they were larvae and were able to survive, at least for the summer, in our waters.

The decisions as to which species to include in this section have not always been easy because there is a gradation from strictly freshwater fishes to

strictly marine forms with several families containing species that are not clearly one or the other. Species that have only been reported from the Hudson Estuary a few times are generally considered to be marine strays. Most of the tropical species fall into this category. There are some other species regularly found in the river but only during certain parts of the year. I consider these to be seasonal resident marine species. The bay anchovy, tomcod, and hogchoker are examples of estuarine species that spend protracted periods in fresh water. They are included here with the marine species. The fourspine stickleback, on the other hand, has been included with the freshwater fishes because the other three members of its family have both marine and freshwater populations. Truly anadromous species, those that move into the river to spawn, and the catadromous American eel are treated with the freshwater species but I have chosen to separate the marine herrings (family Clupeidae) from the freshwater gizzard shad and the anadromous river shads. I have done the same with the mummichog, although with less conviction.

Most of the families in this section have such distinctive shapes that they can easily be identified by direct comparison with the key drawings. The keys will supplement the drawings and present precise anatomical distinctions between similar families. For identification of species, however, the reader should refer to the family keys and species accounts where characteristics will be found that will separate similar species that either have been found or might be expected in the inland waters of the Hudson Estuary. As with the freshwater species, it is important to compare all specimens with the descriptions as well as with the illustrations.

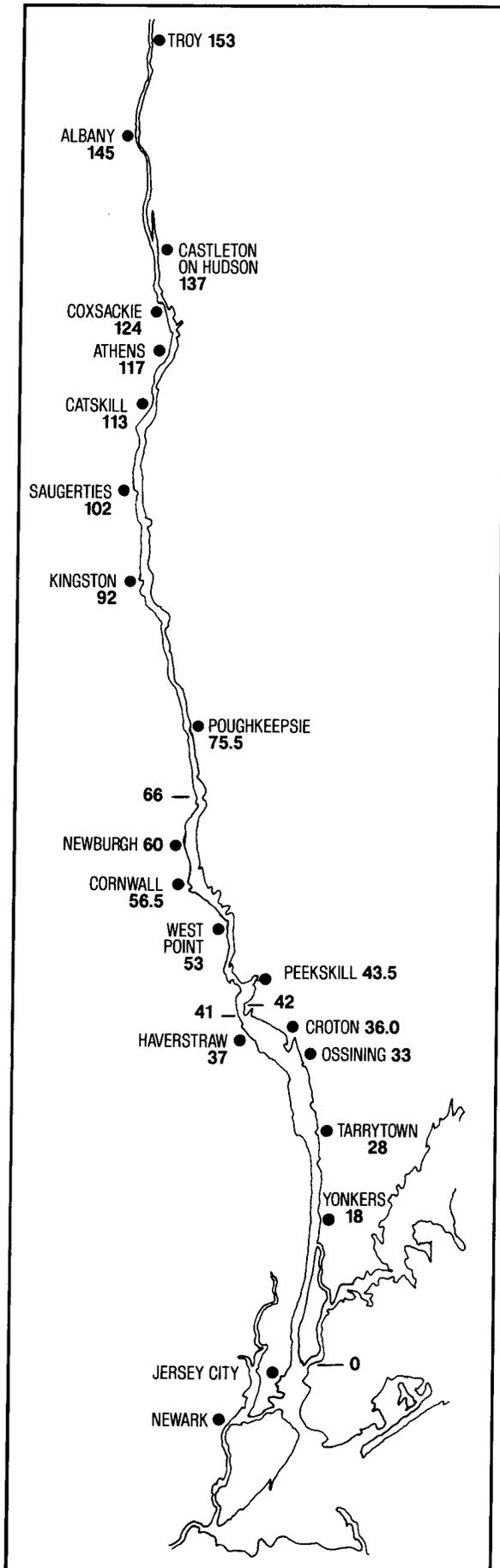


Figure 10. Hudson River Locations in River Miles above Battery Park

KEY TO FAMILIES

Anadromous species such as the sea lamprey, the sturgeons, the river herrings including the American shad, and the temperate basses are in the freshwater and anadromous keys beginning on page 25. When you are in doubt as to which key to use, try them both.

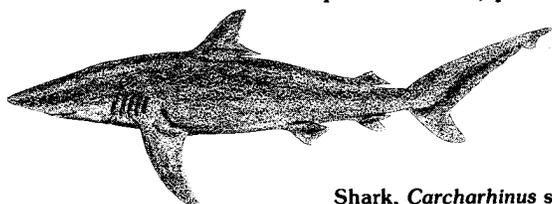
A. Gills covered with a bony plate so that there is only a single pair of gill openings, which may be completely separate or joined across the ventral side of the head.

C.

A'. Head with five pairs of gill openings.

B. Body nearly round in cross section. Gill openings in front of, and mostly above the level of, the pectoral fins.

Requiem sharks, p. 390

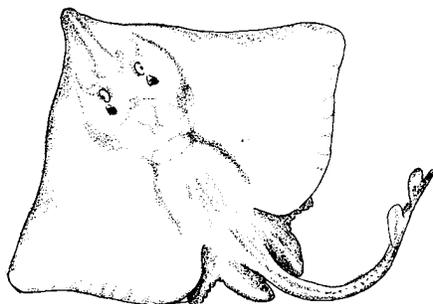


Shark, *Carcharhinus* sp.

B'. Body flat and diamond shaped. Gill openings on the underside of the head.

Rajidae

Skates, p. 391

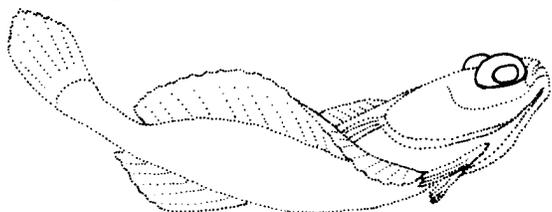


Barndoor skate, *Raja laevis*

C. (A. A single pair of gill openings.) Both eyes on the same side of the head.

SS.

C'. One eye on each side of the head.

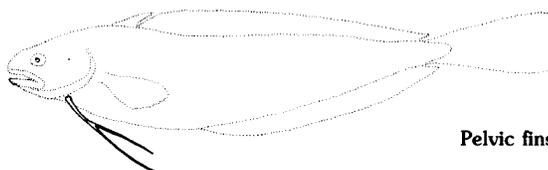
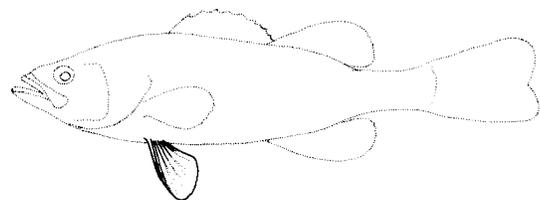
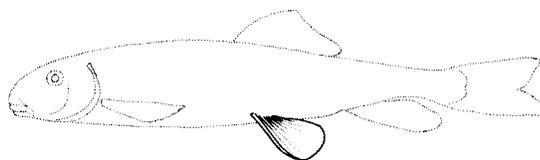


Flatfish showing both eyes on the same side of the body.

D. Pelvic fins present although sometimes small, fused into a sucker-like disk or reduced to a pair of double filaments inserted on the underside of the head.

L.

D'. Pelvic fins absent.



Pelvic fins.

E. Body not extremely flexible, not eel-like, tail separate from dorsal and anal fins.

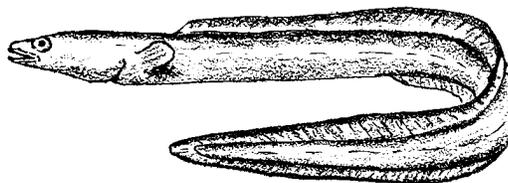
G.

E'. Body extremely flexible, eel-like. Tail pointed and joined to the dorsal and anal fins.

F. Dorsal origin well forward, over the ends of the pectoral fins.

Congridae

Conger eels, p. 393



Conger eel, *Conger oceanicus*

F'. Dorsal fin origin farther back, well behind the tips of the pectoral fins.

Anguillidae

Freshwater eels, p. 60



American eel, *Anguilla rostrata*

G. (E. Body not eel-like.) Mouth not at the end of a tube.

I.

G'. Mouth at the end of a tube-like face.

H. Body encased in bony rings.

Syngnathidae

Pipefishes, p. 418



Tube-like snout of pipefish, note bony rings encircling body.



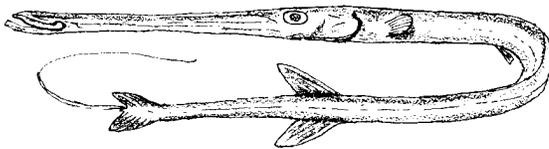
Northern pipefish, *Syngnathus fuscus*



Lined seahorse, *Hippocampus erectus*

H'. Body not encased in bony rings, tail with a long filament formed by extensions of its central rays.

Fistulariidae **Cornetfishes, p. 417**



Bluespotted cornetfish, *Fistularia tabacaria*

I. (G. Face not tube-like.) Body elongate and slender, lower jaw projecting. Skin with diagonal folds.

Ammodytidae **Sand lances, p. 441**



American sand lance, *Ammodytes americanus*

I'. Body not elongate

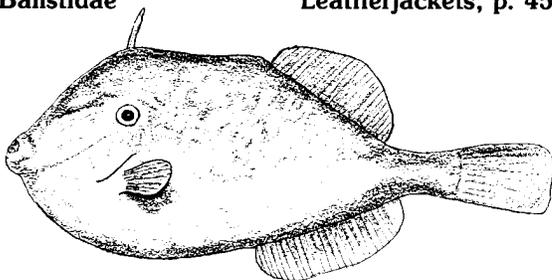
J. Body not strongly compressed but nearly terete and inflatable. Teeth fused into beak-like structures.

UU.

J'. Body strongly compressed.

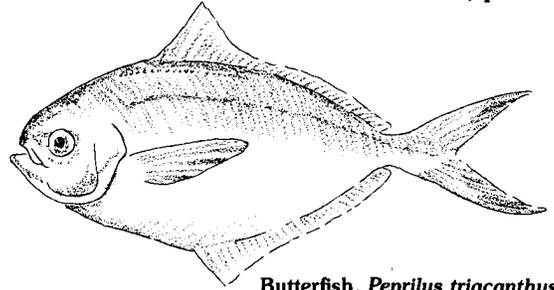
K. Dorsal fin with a stout spine, color gray to brownish yellow.

Balistidae **Leatherjackets, p. 459**



Orange filefish, *Aluterus schoepfi*

K'. Dorsal fin without large spines. Color silvery.
Stromateidae **Butterfishes, p. 446**



Butterfish, *Peprilus triacanthus*

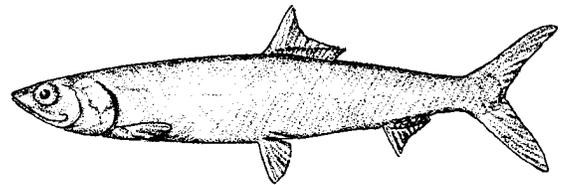
L. (D. Pelvic fins present.) Pelvic fins thoracic or jugular.

U.

L'. Pelvic fins abdominal.

M. Gular plate present.

Elopidae **Tarpons, p. 392**



Ladyfish, *Elops saurus*

M'. Gular plate absent.

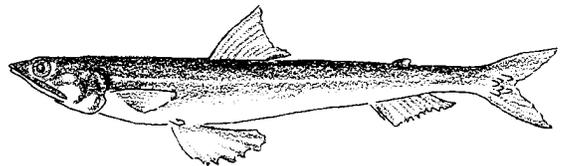
N. No adipose dorsal fin.

P.

N'. Adipose dorsal fin present.

O. Body terete, head pointed.

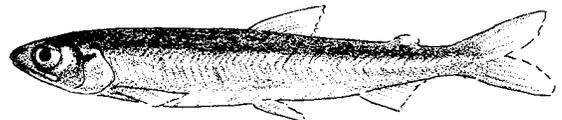
Synodontidae **Lizardfishes, p. 399**



Inshore lizardfish, *Synodus foetens*

O'. Body slightly compressed, head not especially pointed.

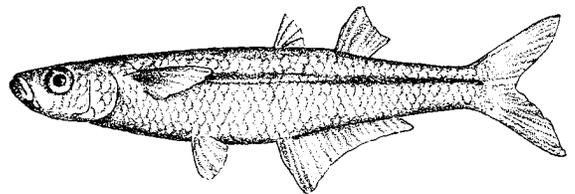
Osmeridae **Smelts, p. 239**



Rainbow smelt, *Osmerus mordax*

P. (N. No adipose dorsal fin.) Two dorsal fins, well separated, the first with four slender spines.

Atherinidae **Silversides, p. 414**



Atlantic silverside, *Menidia menidia*

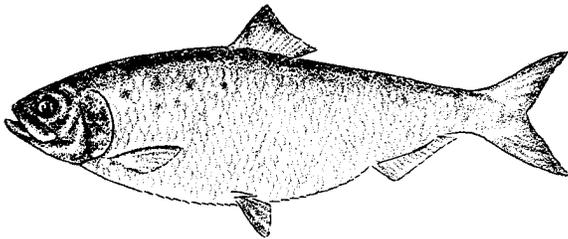
P'. A single dorsal fin.

Q. Body robust or elongated but not strongly compressed, not especially silvery, head canals simple.
S.

Q'. Body compressed, silvery or with a silvery stripe, head canals dendritic.

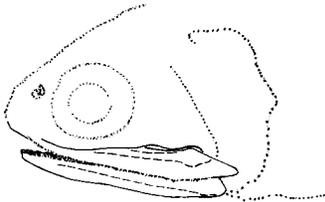
R. Mouth smaller, not reaching to preopercle. At least one and usually several ventral scutes are present but if there is only one it may be deeply embedded in the skin.

Clupeidae **Herrings, p. 394**

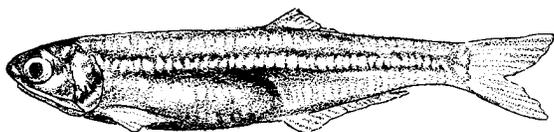


American shad, *Alosa sapidissima*

R'. Mouth large, maxillary bone reaching past the edge of the preoperculum. No ventral scutes.
Engraulidae **Anchovies, p. 397**



Anchovy, showing long maxillary bone.



Bay anchovy, *Anchoa mitchilli*

S. (Q. Head canals simple.) Body long and slender. Jaws elongate with needlelike teeth.
Belonidae **Needlefishes, p. 408**



Atlantic needlefish, *Strongylura marina*

S'. Body not especially elongate. Jaws short, mouth superior or termino-superior.

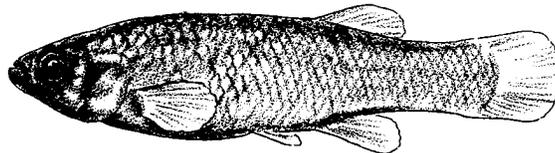
Cyprinodontidae **Killifishes, T.**

T. Body stubby.
subfamily **Cyprinodontinae** **Pupfishes, p. 409**



Sheepshead minnow, *Cyprinodon variegatus*

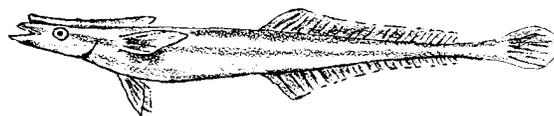
T'. Body somewhat elongate.
subfamily **Fundulinae** **Killifishes, p. 409**



Mummichog, *Fundulus heteroclitus*

U. (L. Pelvic fins thoracic or jugular.) Top of head with a complex sucker which is a modified first dorsal fin.

Echeneidae **Remoras, p. 423**



Sharksucker, *Echeneis naucrates*

U'. No sucker on top of head..

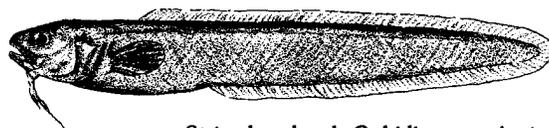
V. Dorsal fin with true spines although they may be slender and flexible.

X.

V'. Dorsal fin without true spines.

W. Body elongate, eel shaped. Dorsal and anal fins joined to the tail. Pelvic fins reduced to a double filament on each side of the isthmus.

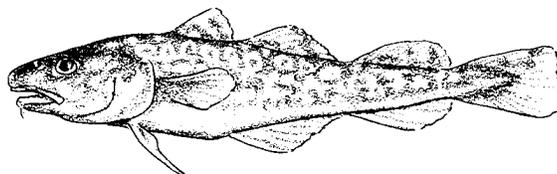
Ophidiidae **Cusk-eels, p. 407**



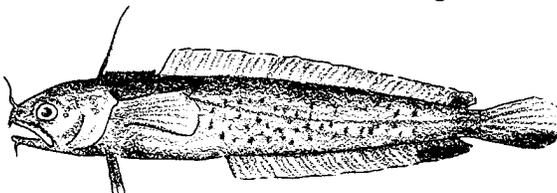
Striped cusk-eel, *Ophidion marginatum*

W'. Body not eel shaped. Tail fin separate. Pelvic fins thoracic.

Gadidae **Codfishes, p. 401**



Atlantic tomcod, *Microgadus tomcod*



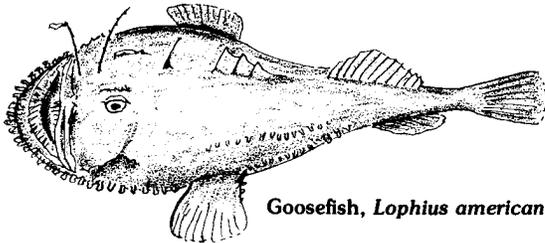
Fourbeard rockling, *Enchelyopus cimbrius*

X. (V. Dorsal fin with true spines.) All dorsal spines connected by membrane.

AA.

X'. Some dorsal spines not fully connected by membrane, although usually there is a triangular membrane behind each separate spine.

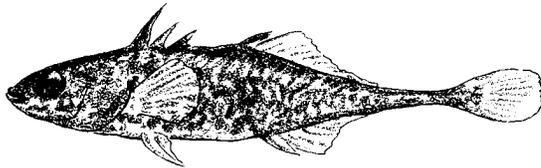
Y. Only the first three dorsal spines unconnected, the first with a specialized fishing lure. Head and body depressed, Head very large with a huge mouth. No scales but body and lips with fleshy tabs.
Lophiidae **Goosefishes, p. 400**



Goosefish, *Lophius americanus*

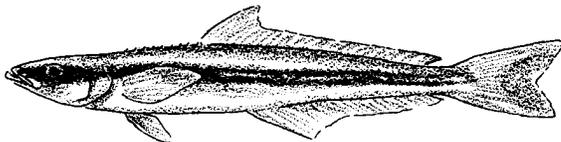
Y'. All dorsal spines unconnected.

Z. Small fishes with a slender caudal peduncle and one or two pelvic soft rays.
Gasterosteidae **Sticklebacks, p. 272**



Fourspine stickleback, *Apeltes quadracus*

Z'. Large fish with five pelvic rays.
Rachycentridae **Cobia, p. 422**



Cobia, *Rachycentron canadum*

AA. (X. Dorsal spines connected.) Dorsal fins separated into a spiny first dorsal and a second dorsal which may or may not have one spine at its front. Bases of the first and second dorsal fins separated by a space at least as wide as the length of the base of the first dorsal fin.

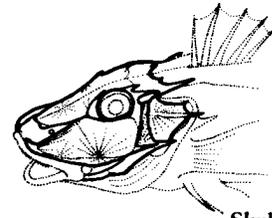
RR.

AA'. Spiny and soft dorsal fins contiguous or nearly so, sometimes separated by a deep notch.

BB. Head covered with skin or scales but not with sculptured plates.

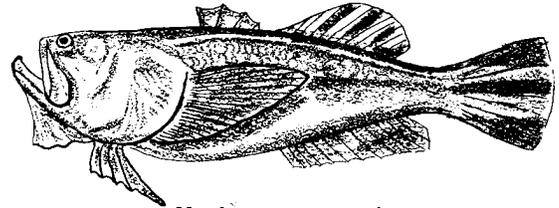
EE.

BB'. Head covered with sculptured bony plates. Pectoral fins very large.



Skull plates of searobin.

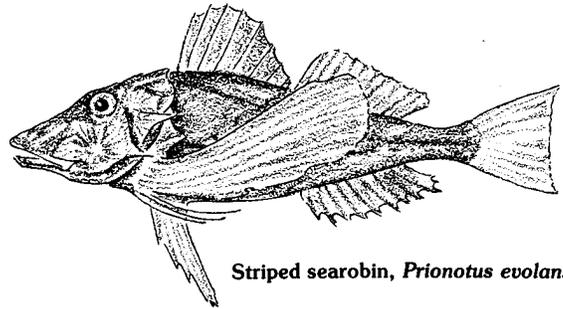
CC. Head cuboidal, mouth nearly vertical. Top of head with smooth areas behind the eyes.
Uranoscopidae **Stargazers, p. 439**



Northern stargazer, *Astroscopus guttatus*

CC'. Head tapering, mouth inferior, top of head without smooth areas.

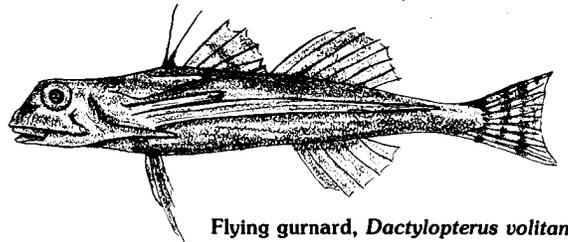
DD. Lower pectoral rays free, finger-like.
Triglidae **Searobins, p. 447**



Striped searobin, *Prionotus evolans*

DD'. Lower pectoral rays not separate. Upper five or six pectoral rays form a separate fin. Preopercle with a large backward spine.

Dactylopteridae **Flying gurnards, p. 452**



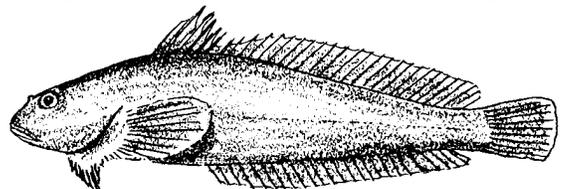
Flying gurnard, *Dactylopterus volitans*

EE. (BB. Head not covered with bony plates.) Skin with large or small scales.

GG.

EE'. Skin naked.

FF. Ventral fins modified into a sucker.
Cyclopteridae **Snailfishes, p. 451**

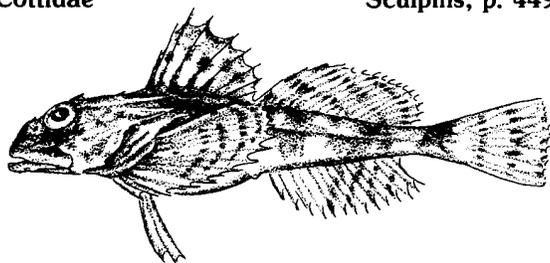


Seasnail, *Liparis atlanticus*

FF'. Ventral fins not modified. Preopercle with prominent spines.

Cottidae

Sculpins, p. 449



Longhorn sculpin, *Myoxocephalus octodecemspinosus*

GG. (EE. Skin with scales.) Anal fin with fewer than 13 rays.

JJ.

GG'. Anal fin with more than 15 rays.

HH. Dorsal fin consisting of all spines and no rays. Body elongate, eel shaped, caudal fin rounded.

Pholidae

Gunnels, p. 440



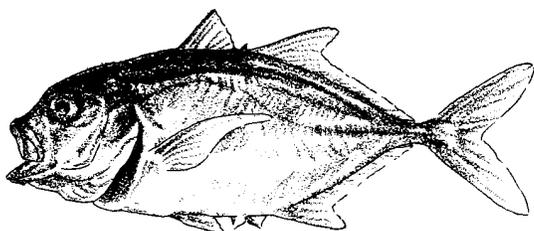
Rock gunnel, *Pholis gunnellus*

HH'. Dorsal fin with some soft rays. Body not eel shaped, caudal fin deeply forked. First two anal spines well separated from the rest of the fin.

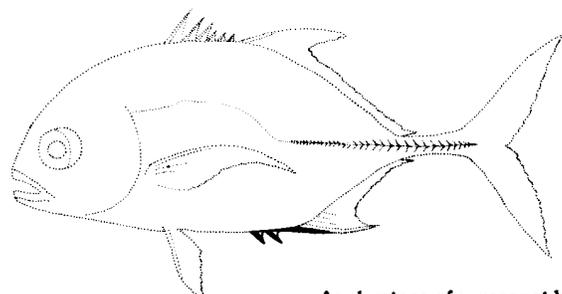
II. First two anal spines large and conspicuous. Jaw teeth small, in bands. No teeth on basibranchial bones.

Carangidae

Jacks, p. 424



Crevalle jack, *Caranx hippos*

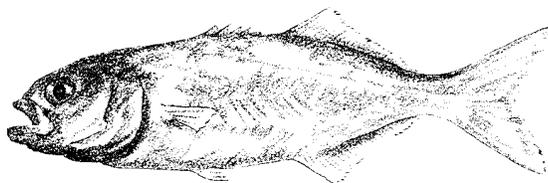


Anal spines of a carangid.

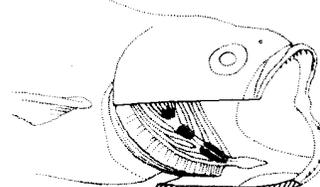
II'. First two anal spines small, almost totally embedded in skin. Jaws with large, flattened conical teeth. Teeth present on basibranchial bones.

Pomatomidae

Bluefishes, p. 421



Bluefish, *Pomatomus saltatrix*

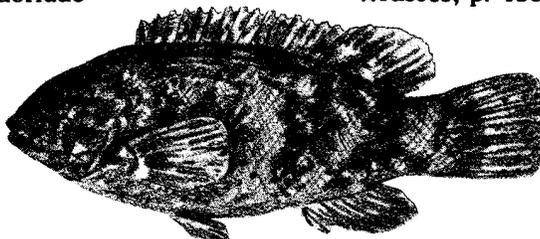


Basibranchial teeth of bluefish.

JJ. (GG. Anal fin with fewer than 13 rays.) Dorsal fin with 16 to 18 spines. Caudal fin squarish or rounded.

Labridae

Wrasses, p. 435



Tautog, *Tautoga onitis*

JJ'. Dorsal fin with 12 or fewer spines.

KK. Anal spines three.

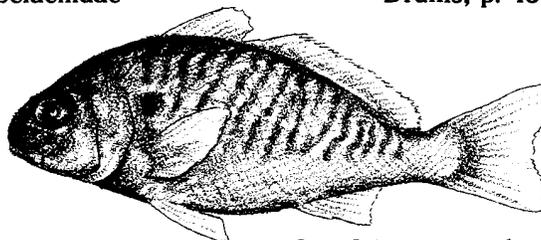
NN.

KK'. Anal spines zero to two.

LL. Anal spines one or two in adult.

Sciaenidae

Drums, p. 431



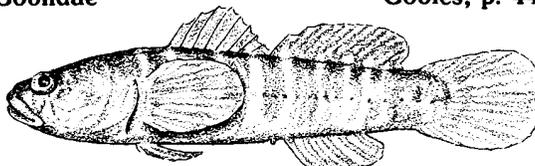
Spot, *Leiostomus xanthurus*

LL'. No anal spines.

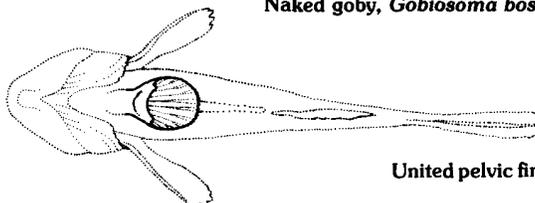
MM. Pelvic fins united by membrane forming a cup-shaped, sucker-like disk.

Gobiidae

Gobies, p. 443



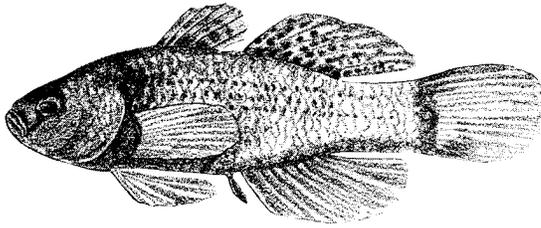
Naked goby, *Gobiosoma boscii*



United pelvic fins.

MM'. Pelvic fins separate.
Eleotridae

Sleepers, p. 442

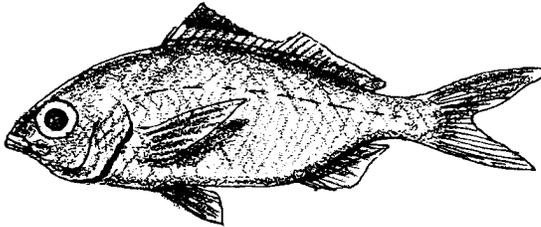


Fat sleeper, *Dormitator maculatus*

NN. (KK. Anal spines three.) Mouth extremely protrusible, capable of being extended forward into a tube. Body diamond shaped, chin profile concave.

Gerreidae

Mojarras, p. 428



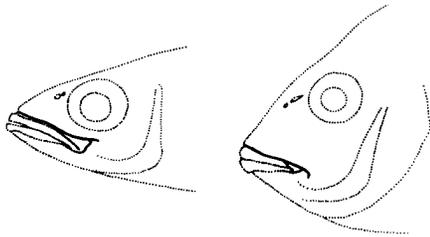
Spotfin mojarra, *Eucinostomus argenteus*

NN'. Mouth only slightly or not at all protrusible.

OO. Maxillary bone exposed for its entire length.

QQ.

OO'. Maxillary bone slipping under the preorbital region, exposed only at its posterior end when the mouth is closed.

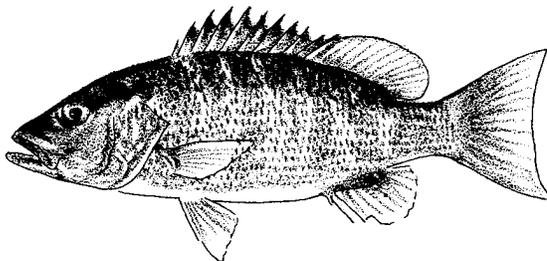


Exposed (left) and concealed maxillary bones.

PP. Teeth conical. Some anterior teeth enlarged, caniniform.

Lutjanidae

Snappers, p. 427

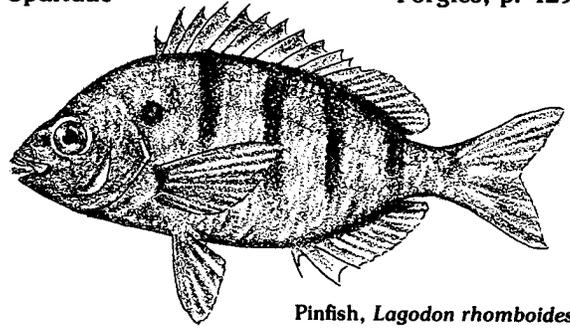


Gray snapper, *Lutjanus griseus*

PP'. Anterior jaw teeth incisiform, lateral jaw teeth molariform.

Sparidae

Porgies, p. 429

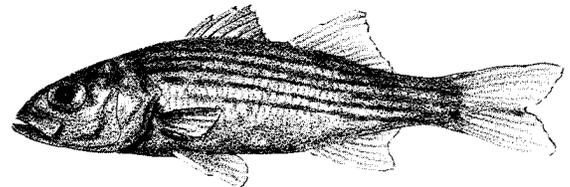


Pinfish, *Lagodon rhomboides*

QQ. (OO. Maxillary exposed.) Body color silvery, dorsal fins nearly separate. Opercle with two spines.

Moronidae

Temperate basses, p. 280

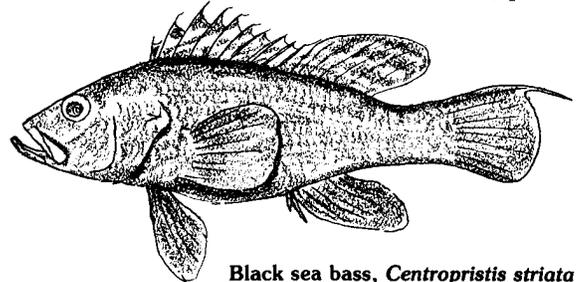


Striped bass, *Morone saxatilis*

QQ'. Body color not silvery. Dorsal fins with only a shallow notch. Opercle with three spines.

Serranidae

Sea basses, p. 420

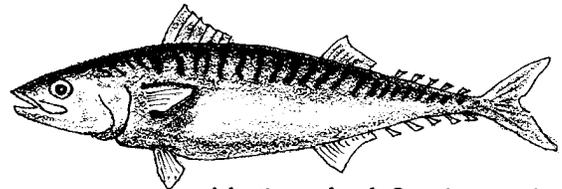


Black sea bass, *Centropristis striata*

RR. (AA. Dorsal fins separated by a wide space.) Scales small, finlets present behind the dorsal and anal fins.

Scombridae

Mackerels, p. 445

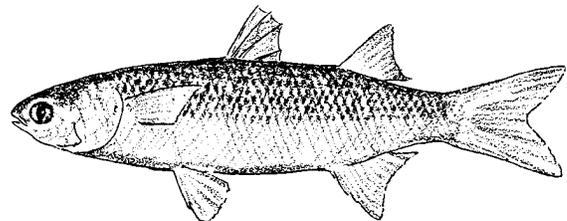


Atlantic mackerel, *Scomber scombrus*

RR'. Scales larger, no finlets.

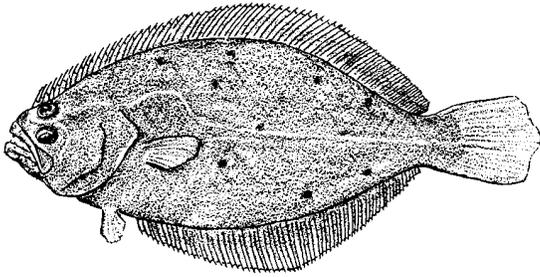
Mugilidae

Mulletts, p. 437



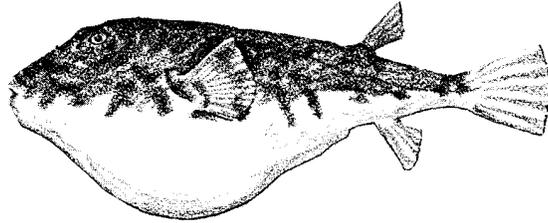
Striped mullet, *Mugil cephalus*

SS. (C. Both eyes on the same side of the head.)
Both eyes on the left side of the head.
Bothidae **Lefteye flounders, p. 453**



Summer flounder (Fluke), *Paralichthys dentatus*

UU'. Upper and lower jaws each with two tooth plates.
Tetraodontidae **Puffers, p. 460**

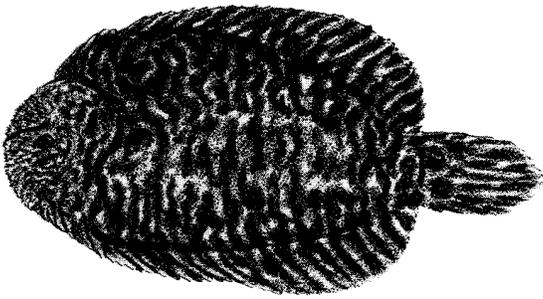


Northern puffer, *Sphoeroides maculatus*

SS'. Both eyes on the right side of the head.

TT. Body oval, no pectoral fins.
Soleidae

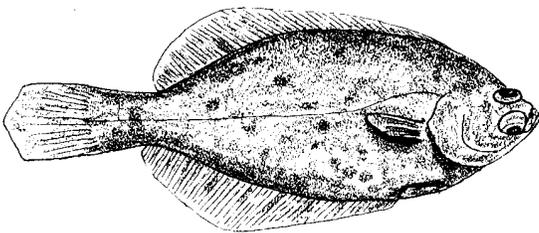
Soles, p. 458



Hogchoker, *Trinectes maculatus*

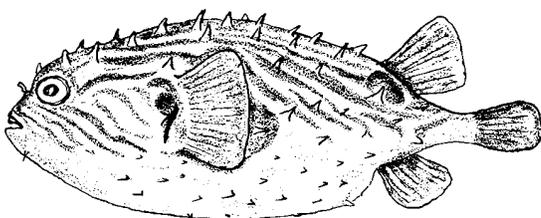
TT'. Body diamond shaped, pectoral fin present
at least on the eyed side.

Pleuronectidae **Righteye flounders, p. 456**



Winter flounder, *Pseudopleuronectes americanus*

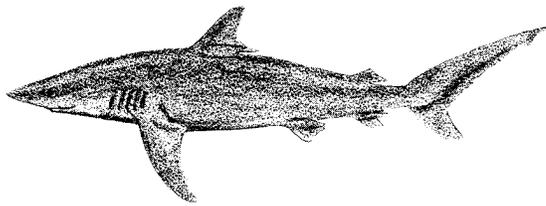
UU. (J. Teeth fused into beak-like structures.) Up-
per and lower jaws each with a single tooth plate.
Diodontidae **Porcupinefishes, p. 461**



Striped burrfish, *Chilomycterus schoepfi*

REQUIEM SHARKS

CARCHARHINIDAE



SHARKS

Carcharhinidae; Sphyrnidae

Identification

Recognizing a shark, with its distinctive heterocercal tail, five gill openings and undershot mouth, is no particular problem, but identifying sharks to species is quite difficult and in many cases requires close examination of specimens in hand. Only an expert should attempt to identify sharks at a distance. Because of the problem of accurate identification, it is not at all certain which species of sharks have been reported from the inland waters of New York.

Occurrence

Mearns (1898) listed the dusky shark, *Carcharhinus obscurus*, from the area of the Hudson Highlands: "Several were taken in the lower part of the Hudson in the summer of 1881, and one up the river as far as Peekskill." Since Mearns did not give any distinguishing characteristics, this record must be regarded as questionable. The dusky shark is an open-ocean species of the tropical parts of the Atlantic and the Mediterranean Sea. It is much more likely that the Hudson River sharks were bull sharks, *Carcharhinus leucas*, which frequently enter fresh water in many parts of the world. Bull sharks and dusky sharks are quite similar in shape but the dusky shark has a definite keel between the dorsal fins which is lacking in the bull shark.

Mearns also mentioned a hammerhead caught between West Point and Cornwall "about 1876" but this could also have been one of several species.

Notes

Sharks are exciting animals and somehow seem to be irresistible to pranksters who catch them in the ocean and bring them home to plant in places where they are likely to be found by friends. A blue shark, *Prionace glauca*, reported from Yonkers

in June 1979 was such a hoax as, no doubt, was the one found in Chittenango Creek in October 1982.

Any specimens of sharks captured in the Hudson River estuary should be examined by a specialist. If it is not possible to freeze the entire shark, a series of photographs showing a good side view of the entire body and details of the fins and the underside of the head may serve. Many species have distinctive teeth and the jaws can be carefully dissected out and frozen or preserved in formalin or isopropyl (rubbing) alcohol.

References

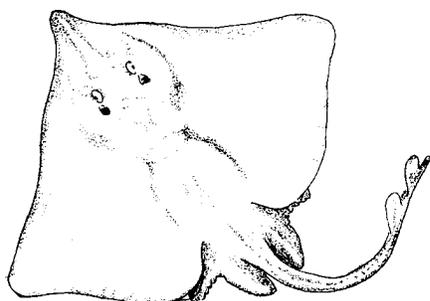
Bigelow and Schroeder, 1948 (general account, a standard reference on sharks). Gilbert, 1967 (hammerheads). Lineaweaver and Backus, 1970 (excellent popular account of the natural history of sharks). Ellis, 1975 (popular text on sharks).

SKATES

RAJIDAE

Skates are cartilaginous fishes somewhat related to sharks. Both groups have five pairs of gill slits, a cartilaginous skeleton, and primitive jaw and fin structure. Sharks have the gill openings on the sides of the head, in front of and above the pectoral fins, but in the skates and their relatives, the rays, the gill openings are on the underside of the head below the pectoral fins. Most rays and skates are very flat and diamond shaped but some are elongate and quite shark-like.

Skates and rays have a conspicuous opening called the spiracle behind the eye. Water is taken in through the spiracle, passed over the gills, and expelled through the gill slits. Nearly all other fishes take in water for breathing through the mouth. Many skates have specialized scales on the surfaces of the body and tail. The distribution of these prickles is important for recognizing species. Rays bear their young alive but skates lay eggs in horny, squarish cases with tendrils at the corners. These are the familiar "mermaids' purses" so often seen on Long Island beaches. Skate teeth are flat and fit together like floor tiles to form a surface for crushing their prey. One species is doubtfully recorded from the Hudson River.



BARNDOOR SKATE

***Raja laevis* Mitchill, 1818**

Identification

The barndoor skate differs from similar species in having no large thorny scales in the midline of the back from the spiracles to the level of the ends of the bases of the pectoral fins. It has three rows of

prickles on the tail and in all but the smallest individuals there is black pigment around the sensory pores of the head and body. This is a large species, reaching a length of 5 feet.

Occurrence

The only inland record for the Hudson River is a specimen in the New York State Museum. This specimen was contributed on 4 August 1932 although the date of capture is not stated. The fisherman claimed to have caught it at North Albany on hook and line but in view of the absence of other records, and since this is a species that seldom comes into fresh water, we must regard this record as dubious. The specimen was not located in 1979. The barndoor skate ranges along the Atlantic coast from the Grand Banks to North Carolina.

Notes

The egg capsules of the barndoor skate are larger than those of other species in the area, measuring 68 to 72 mm by 124 to 132 mm. They have short tapering tendrils about 13 to 19 mm long. The barndoor skate is a bottom feeder whose diet consists mostly of large crustaceans including crabs, spider crabs, lobsters, and shrimp. It also takes squids and worms and a variety of fishes including sand lances, cunners, tautogs, butterfish, herring, and flatfishes.

References

Bigelow, H.B. and W.C. Schroeder, 1953a (general account). Greeley, 1936 (Albany record).

Names

Laevis is a Latin word meaning smooth.

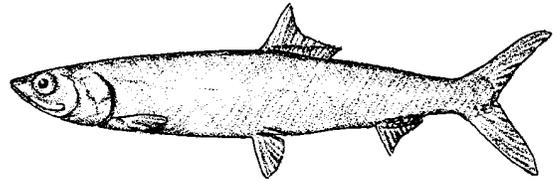
Raja laevis Mitchill, 1818a: 327 New York

TARPONS

ELOPIDAE

The ladyfish is a close relative of the tarpon and the two are now placed in a single family, the Elopidae. They are also related to the bonefish, *Albula*, and more distantly to the eels. The chief characteristic that unites these rather different fishes is the specialized larval stage, the leptocephalus. This is a transparent, ribbon-like, pelagic (free-swimming) stage that is found in no other fishes. There are also some unique anatomical features that unite the group.

The genus *Elops* has five or six species.



LADYFISH

Elops saurus Linnaeus, 1766

Identification

The ladyfish is a slender, streamlined fish with a deeply forked tail, small scales and a short dorsal fin situated well back on the body. The eye is large, the mouth large, oblique and terminal. Its pectoral fins are low and horizontal and the pelvics originate just slightly ahead of the dorsal fin. Both the pelvic and pectoral fins have large scaly axillary processes and the dorsal and anal fins have scaly sheaths at their bases. The single most important characteristic of the ladyfish is its gular plate, a superficial bone in the midline of the lower jaw between the gill membranes. A similar gular plate occurs in the bowfin but in that species it is broad whereas in the ladyfish it is slender.

Occurrence

A single specimen about 12 inches long was collected at Bowline Pond by LMS in 1979, and Tom Lake caught another at River Mile 66.5 in October 1982. Mr. Lake's specimen was 13 inches total length.

Notes

Although the ladyfish looks something like a hering, it is a close relative of the bonefish and the tarpon and a distant relative of the eels, sharing with that group the very specialized larval form called a leptocephalus. Because no other fishes have such larvae, its presence is considered evidence of close relationship.

Recent studies have revealed the existence of several closely similar species instead of one worldwide form.

References

Hildebrand, 1963a: 124-131 (general account).

Names

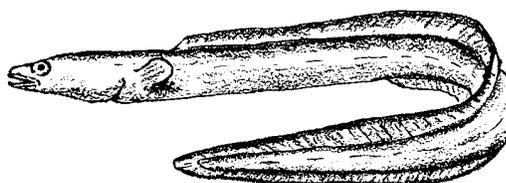
Saurus is a Greek word meaning lizard.

Elops saurus Linnaeus, 1766: 518 Carolinas

CONGER EELS

CONGRIDAE

The relationships of eels are not well understood and the present arrangement of nineteen families and nearly 600 species must be considered tentative. The family Congridae is one of the larger families with about 38 genera and 100 species. This is strictly a marine family and the one species that strays into the Lower Hudson is definitely a visitor.



CONGER EEL

Conger oceanicus (Mitchill, 1818)

Identification

Eels, unless they are brightly colored, tend to look alike and the conger is likely to be mistaken for an American eel which it resembles in color and shape. The two are easily told apart, however, by the position of the origin of the dorsal fin. In the conger, the dorsal origin is at the level of the tip of the pectoral fins whereas in the American eel the dorsal fin begins much farther back, closer to the origin of the anal fin than to the tip of the pectoral. Congers also have larger eyes than American eels. Congers have no scales but those of American eels are deeply embedded in the skin and arranged in a herringbone pattern. Congers are generally grayish, somewhat lighter ventrally, with dark margins on the dorsal and anal fins. They are said to reach a weight of 22 pounds and a length of 7 feet in American waters, and in England they may weigh more than 100 pounds. In June 1982, a world record for 30-pound-test line was set by an 87-pound conger eel that was 7.5 feet long.

Occurrence

Congers are occasionally taken in the Hudson Estuary. AMNH 48297 is a specimen 544 mm total length that was collected at River Mile 42 on 1 December 1978 by Texas Instruments personnel.

References

Bigelow and Schroeder, 1953b: 154-157 (general account).

Names

The species name refers to its habitat in salt water.
Anguilla oceanica Mitchill, 1818b: 407 New York

HERRINGS

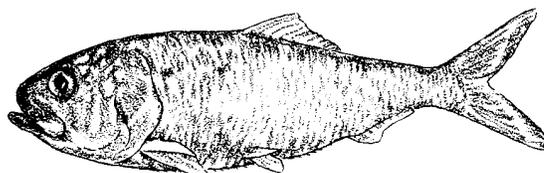
CLUPEIDAE

Herrings are silvery soft-rayed fishes with abdominal pelvics, forked tails and deciduous, sometimes fimbriate, cycloid scales. They have a single pair of nostrils and their lateral line is reduced to a short branched tube in the shoulder region or altogether absent. The head canals are greatly elaborated, with many branches. The head is scaleless, the mouth is variable and the teeth are small or absent. Most herrings have strongly compressed bodies, often with a row of modified scales forming a saw-toothed keel along the ventral edge of the breast and belly. The eyes are partially covered with adipose tissue and the swim bladder is connected to the ear by a hollow tube.

Most herrings are marine or anadromous but some are confined to fresh water. Herrings are worldwide in distribution but reach their greatest diversity in the tropics. At present, about 50 genera and 180 species are recognized.

The round herrings are recognized by some ichthyologists as a separate family because they do not have the row of scutes (modified scales) along the edge of the belly. They do, however, have one or two scutes embedded in the skin around the base of the pelvic fins and are otherwise similar to the herrings. Whitehead (1963) recognized 7 genera and 10 species of round herrings, mostly from the Indo-Pacific region with a few species along our Atlantic and Pacific coasts.

The New York fauna includes freshwater, marine, and estuarine species. A key to all of the local species will be found in the freshwater section. The three species that are treated here, the menhaden, the Atlantic herring, and the round herring are marine strays in the Hudson Estuary.



ATLANTIC MENHADEN

Brevoortia tyrannus (Latrobe, 1802)

Identification

The menhaden is a deep-bodied, compressed fish, with a very large head and a double row of modified scales in the middorsal line in front of the dorsal fin. Menhaden scales have nearly straight vertical edges that are toothed (pectinate) so that the surface of the fish has a distinctive appearance. Like other herrings, the menhaden is generally silvery with a row of sharp scutes along the ventral midline. The peritoneum is black and the intestine has extra loops. The back is dusky olive to bluish, and the sides of the head and body sometimes have a brassy or iridescent cast. There is a large spot followed by a band of smaller spots, not necessarily in rows, behind the gill opening. In life, the fins have a yellowish cast.

The maximum size is around 18 to 20 inches but the usual size of adults is 12 to 14 inches.

Occurrence

Menhaden are coastal marine fishes and usually stay within 10 or 15 miles of shore. From May to September, they move into estuaries. Fishermen say that arrival of menhaden signals the end of shad fishing season. Young menhaden are common in the river in late summer. In the Hudson, the menhaden is found as far upstream as Newburgh.

Atlantic menhaden range from Nova Scotia to Florida and they are taken commercially from Maine to Florida. A similar and closely related species, *Brevoortia patronus*, replaces the Atlantic menhaden in the Gulf of Mexico.

Notes

Unlike the river herrings that come into fresh water to spawn, the menhaden is a species that moves into the river after spawning offshore. The peak in spawning in our area seems to be in June. Females

lay 38,000 to 631,000 eggs, each about 1.3 to 2.0 mm in diameter. Hatching requires 42 to 54 hours at water temperatures of 15 to 20 C.

Menhaden are filter feeders. They strain small particles from the water with their gill rakers. They have a muscular stomach that is used for grinding food and the intestine is about 4.5 times as long as the body.

Menhaden are extremely valuable commercial fishes. Large commercial vessels use purse seines to surround the schools after they are spotted from light planes. Most of the catch is used for oil and meal and they are not considered a desirable food fish.

References

Hildebrand, 1963c (general review). Reintjes, 1964 (bibliography). Dietrich, 1979 (fecundity). Jones, Martin, and Hardy, 1978 (larval stages). Ferraro, 1980 (embryology). Edgar and Hoff, 1976 (feeding). Hildebrand, 1948 (systematics). Higham and Nicholson, 1964 (reproduction). Goode, 1878a, 1878b, (systematics). Jeffries, 1975 (food habits). Westman and Nigrelli, 1955 (mortality).

Names

Tyrannus is Latin for tyrant. In the New York area, menhaden are usually called mossbunkers or simply bunkers. They are also known as pogies.

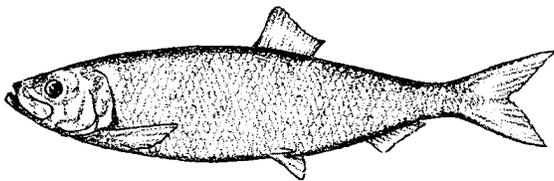
Clupea tyrannus Latrobe, 1802: 77 Chesapeake Bay

Alosa tyrannus, DeKay, 1842: 258 New York

Clupea menhaden Mitchill, 1815: 453 New York

Clupea neglecta Rafinesque, 1818b: 206 Long Island

Alosa sadina DeKay, 1842: 263 (not of Mitchill)



ATLANTIC HERRING

Clupea harengus Linnaeus, 1758

Identification

The Atlantic herring is easily recognized as a herring by its silvery color, compressed shape, ventral scutes, and its lack of a lateral line, adipose fin, and gular plate. It differs from the menhaden in that it has a shorter head, a more slender body, and no modified scales in front of the dorsal fin. It has neither the dorsal filament nor the bulbous snout of the gizzard shad. The Atlantic herring differs from the river herrings of the genus *Alosa* in that its dorsal fin originates about midway between the tip of the snout and the base of the tail. In the river shads, the dorsal origin is much farther forward. The presence of teeth on the vomer is a distinctive feature of the herring.

The usual size of the herring is about 12 inches total length, maximum about 18 inches.

In life, the herring is blue or greenish on the back with the change from the dark back to the pale sides often marked by a greenish band. The gill covers often have brassy or golden tones.

Occurrence

The Atlantic herring is a fish of open seas that seldom ventures into fresh water. There are a few records of juveniles from the Hudson River as far upstream as River Mile 42. The subspecies *Clupea harengus harengus* is found on both sides of the Atlantic. In Europe, it ranges from the Straits of Gibraltar to Spitzbergen, and on the American coast it is found from Greenland to North Carolina. A Pacific subspecies, *C. h. pallasi*, ranges from southern California to the Aleutian Islands, Siberia, and Japan.

Notes

The herring has been studied intensively because of its great commercial importance. There are several discrete stocks with slightly different morphological characteristics. Herrings are plankton feeders. They spawn along the coasts, usually in waters 2 to 20 feet deep but sometimes in water so shallow that the eggs wash ashore, and sometimes 15 to 20 miles offshore. Spawning takes place in the spring, summer, and fall, and in some stocks there are both spring and fall runs. Females lay 20,000 to 40,000 sticky eggs.

References

Hildebrand, 1963c: 275-293 (general account). Jones, Martin, and Hardy, 1978 (life history).

Names

Harengus is Middle Latin for herring.

Clupea harengus Linnaeus, 1758: 317 seas of Europe

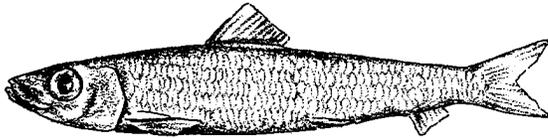
Clupea halec Mitchill, 1815: 451 New York

Clupea vittata Mitchill, 1815: 456 New York

Clupea elongata (Lesueur), DeKay, 1842: 250-251 New York

Clupea caerulea Mitchill, 1815: 457 New York

Clupea minima, DeKay, 1842: 253-254 New York



ROUND HERRING

Etrumeus teres (DeKay, 1842)

Identification

The round herring differs from other herrings in that its body is nearly round in cross section rather than compressed and its belly does not have a saw-toothed edge. Unlike other herrings in our area, the round herring has only one ventral scute and that is deeply embedded in the skin around the pelvic fins. It is more slender and less compressed than the river shads, it lacks the deep body and the modified predorsal scales of the menhaden, and it has neither the dorsal filament nor the overhanging snout of the gizzard shad. Otherwise, it shares with the herrings the following characteristics: all fin rays soft, no gular plate, no adipose dorsal fin, no lateral line on the body, a single pair of nostrils. Body silvery, scales deciduous.

The color in life is greenish olive above, shading to silvery on the sides. The maximum size is 380 mm (15 inches) total length but most specimens are 8 to 10 inches total length.

Occurrence

Round herring occur from the Bay of Fundy to Florida and the Gulf of Mexico. There are a few records from the Hudson Estuary.

References

Hildebrand, 1963c (general account). Jones, Martin and Hardy, 1978 (life history). Bath et al., 1977 (Hudson River). Whitehead, 1963: 321 (nomenclature)

Names

Teres means terete, round in cross section.

Clupea sadina Mitchill, 1815: 457 New York

Alosa teres DeKay, 1842: 262 New York

ANCHOVIES

ENGRAULIDAE

Anchovies are usually small, transparent fishes with a conical, transparent snout that extends in front of a very large mouth. The maxillary bone extends well behind the eye, even beyond the gill opening in some species. The preopercle and the bones supporting the lower jaw slope backward to accommodate the large mouth and this gives anchovies an unmistakable physiognomy. Most species have fine gill rakers, usually more than 50 on the lower limb of the first arch. There are no fin spines and the

dorsal fin is short and usually placed about mid-body. They have very little pigment and are nearly transparent with a broad silvery stripe along their midside. About 20 genera and more than 100 species are known, some of which are important commercial species. Anchovies are near relatives of the herrings and are classified with them in the order Clupeiformes.

The bay anchovy is a resident in the Hudson Estuary and the striped anchovy is a stray.

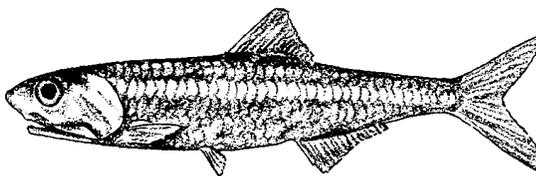
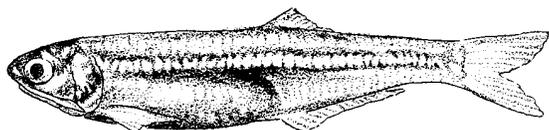
KEY TO THE SPECIES OF ANCHOVIES IN NEW YORK

A. Anal fin originates below the anterior third of the dorsal fin. Anal rays 24 to 27. Lateral silvery stripe somewhat diffuse.

Anchoa mitchilli Bay anchovy, p. 397

A'. Anal fin originates below the posterior part of the dorsal fin. Anal rays usually 20 or 21. Lateral silvery stripe sharply defined.

Anchoa hepsetus Striped anchovy, p. 398



BAY ANCHOVY

Anchoa mitchilli (Valenciennes, 1848)

Identification

Anchovies are distinctive in having a snout that overhangs the mouth and a very long maxillary bone reaching at least to near the margin of the preopercle and usually beyond. This places the corner of the mouth well behind the back of the eye and gives the head a distinctive appearance. The bay anchovy is similar in appearance to the striped anchovy, but the anal fin originates farther forward (under or just behind the dorsal origin) in the bay anchovy. In the striped anchovy, it originates under the middle of the dorsal fin. The bay anchovy has a more prominent snout and a longer anal fin with 24 to 30, rather than 18 to 23 rays. This is a pale spe-

cies, nearly transparent in life. It is slightly greenish with a prominent silvery band along the midside. The peritoneum is silvery and shows through the body muscles. There are a few melanophores scattered on the upper surface and around and behind the anal fin base. The usual size is 3 to 4 inches total length.

The bay anchovy is usually found along ocean beaches and in the saltwater part of the Hudson Estuary, sometimes moving into fresh water. In the ocean, it has been taken at depths of up to 30 or 40 meters.

Occurrence

Bay anchovies occur from Yucatan, Mexico, north to Cape Cod with occasional individuals reaching the Gulf of Maine. In New York, it occurs along the coast of Long Island and in the lower reaches of the Hudson Estuary. In the spring of 1983, Walter Kel-

ler of the New York Department of Environmental Conservation, collected several adults at the Troy dam at River Mile 151.5 but the usual range seems to be below Croton Point, sometimes as far upstream as Kingston. Young-of-the-year are common in Piermont Marsh.

Notes

The spawning season is listed as June to September in Long Island Sound. Spawning seems to take place in the early evening hours. Incubation requires 24 hours at 27.2 to 27.8 C. Newly hatched larvae are about 1.8 to 2.7 mm. The larvae are transparent and pelagic until they reach about 225 mm when they are completely transformed and resemble miniature adults. According to Hildebrand, the bay anchovy feeds extensively on mysid shrimps and copepods. Small fish, gastropods, and isopods are also taken.

Anchovies are considered an important link in the food chains of the Hudson Estuary.

References

Hildebrand, 1963b (general account). Jones, Martin, and Hardy, 1978 (life history summary). Kuntz, 1914a (development).

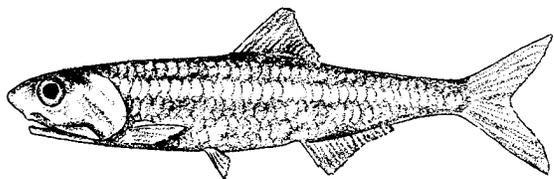
Names

The trivial name *mitchilli* is in honor of Samuel L. Mitchill, the first naturalist to write extensively on the fishes of New York.

Engraulis Mitchilli Valenciennes in Cuvier and Valenciennes, 1848: 50 New York, Carolina, Lake Pontchartrain

Anchoviella mitchilli, Greeley, 1937: 91 Hudson River

Stolephorus mitchilli, Bean, 1903: 218-219 New York



STRIPED ANCHOVY

Anchoa hepsetus (Linnaeus, 1758)

Identification

The slender, compressed shape and the conical snout with long maxillary bone reaching to the gill opening brand the striped anchovy as a member of the Engraulidae. In our area, the only other anchovy is the bay anchovy, *Anchoa mitchilli*, and while the two species are quite similar, they differ in number of anal fin rays (18 to 23 in the striped anchovy, 24 to 30 in the bay anchovy) and in the fact that the anal fin originates just behind the dorsal origin in the bay anchovy and under the posterior part of the dorsal base in the striped anchovy.

The striped anchovy is nearly transparent in life with a striking silver stripe along the side. The stripe is somewhat variable — in some individuals it is

only slightly wider than the diameter of the pupil and in others it is four-fifths of the eye diameter.

Most striped anchovy adults are 100 to 125 mm total length. One specimen 153 mm long has been reported.

Occurrence

The striped anchovy ranges from Nova Scotia to Uruguay. There are a few records from the Lower Hudson, but in general the striped anchovy rarely strays into brackish water. Its occurrence north of the Chesapeake is variable; some years it is abundant, other years it is quite rare.

Notes

Striped anchovies are plankton feeders and eat mostly copepods.

References

Hildebrand, 1963b: 194-200 (general account); 1943 (systematics). Bath et al., 1977: 1 (listed for the Lower Hudson). Jones, Martin, and Hardy, 1978: 154-157 (life history).

Names

The species name *hepsetus* is from the New Latin *epsetus*, which is an old name for anchovies.

Esox hepsetus Linnaeus, 1758: 314 America

Clupea vittata Mitchill, 1815: 456-459 New York

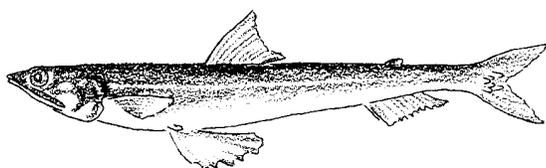
Engraulis brownii Valenciennes in Cuvier and Valenciennes, 1848: 41-49

Stolephorus brownii, Bean, 1903: 214-215 New York

LIZARDFISHES

SYNODONTIDAE

This is a rather small family with about 4 genera and 34 species. They are related to a number of deep-sea families although most lizardfishes occur on the continental slopes of tropical and temperate seas.



INSHORE LIZARDFISH

Synodus foetens (Linnaeus, 1766)

Identification

The inshore lizardfish is a slender, terete fish with a tiny adipose dorsal fin. It gets its name from its distinctive physiognomy — its cheeks and opercles are scaly and its head is pointed with bands of pointed teeth that give it a definite reptilian appearance. The fins of the lizardfish are also distinctive. The pelvics are larger than the pectorals and their inner rays are longer than the outer ones. The pelvics are subthoracic, having their origin between the ends of the pectorals and the beginning of the dorsal. There is a large pelvic axillary process. The pectorals are high on the side of the body. The scales are thin and cycloid. The lateral line is incomplete. The top of the head is scaleless, the branchiostegal rays are numerous, and the upper jaw is bounded by the premaxillary alone.

The larvae of lizardfishes are planktonic with a distinctive series of black spots formed by pigment in the lining of the body cavity. The extreme transparency of the body wall makes these spots visible externally.

Occurrence

Larval lizardfishes are occasionally carried into the Hudson Estuary. Specimens were collected by Texas Instruments personnel on 27 September 1976 at River Mile 27 and on 8 September 1980 at River Mile 30. Tabery et al. (1978) recorded it from River Miles 17 to 26.

Notes

Lizardfishes have a mixture of primitive and advanced features that confused the early ichthyologists. This resulted in their being placed with the trouts by Linnaeus (1766) (owing, no doubt, to the presence of an adipose dorsal fin) and with the pikes by Mitchill (1815) (presumably because of their numerous strong teeth). Rosen (1973) places them in the order Aulopiformes.

References

Gibbs, 1959 (larval stage identification). Anderson, Gehringer, and Berry, 1966 (general account).

Names

The species name is a Latin word meaning *odorous*, having a bad smell.

Salmo foetens Linnaeus, 1766: 513-514 South Carolina

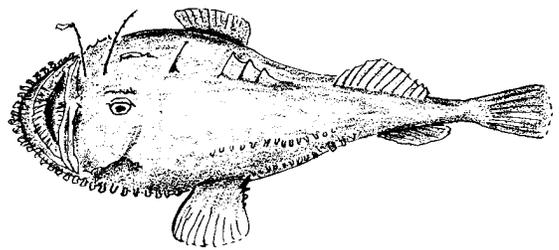
Esox salmoneus Mitchill, 1815: 442-443 New York

GOOSEFISHES

LOPHIIDAE

The goosefishes are bizarre creatures that have been described as animated fish traps. The goosefish is a large, shallow-water species that sometimes wanders into the mouths of estuaries. The first impression is that the fish is mostly head, and the head is mostly mouth, with long sharp caniniform teeth. A closer look reveals that the first spine of the dorsal fin is separate and has a wormlike appendage at its tip, and that the chin bears a fringe of feathery, fleshy tabs.

The entire fish is flattened and the pectoral fins are almost arm-like. The gill opening is restricted to a small hole at the "elbow" of the pectoral fin base. Fishes of this family occur on both sides of the Atlantic and in the Indian and Western Pacific Oceans. It is a small group with about five genera and a dozen species.



GOOSEFISH

Lophius americanus Valenciennes, 1837

Identification

If a fish ever deserved to be called a monster, this one does. It is a large species reaching nearly 3 feet in length. It is a depressed fish that is mostly head, and its head is mostly mouth. The lower jaw projects so that the long sharp teeth are exposed even when the mouth is closed. Its skin is smooth with a row of fleshy flaps on the lower jaws and smaller flaps along the sides. The pectoral fins are arm-like, and the gill openings reduced to small pores at the elbows of the pectoral fins. The first dorsal spine has a fleshy lure at its tip. The second and third spines have small triangular membranes and there are two small dorsal fins that are well separated, the first with only three spines.

They are also known as anglerfish because they attract their prey with a lure-like modification of the first dorsal spine.

Occurrence

Goosefish are marine but they are occasionally taken in the Lower Hudson about as far north as the George Washington Bridge.

References

Bigelow and Schroeder, 1953b (general account).

Names

Americanus is in reference to its range — America. A similar species occurs in European Atlantic waters.

Lophius piscatorius Linnaeus, 1766: 402 Europe
Lophius americanus Valenciennes in Cuvier and Valenciennes, 1837: 380 Philadelphia

CODFISHES

GADIDAE

The codfishes and their allies constitute a rather diverse group of about 55 species of temperate and coldwater fishes. They are presently classified in a group called the Paracanthopterygii which is characterized by the presence of a specialized subdivision of the jaw muscles and certain peculiarities of the caudal fin skeleton.

The limits of the family are in some question. Some authorities regard the silver hake as a member of the Gadidae; others assign it and its near relatives to a separate family, the Merlucciidae. Silver hakes are slender fishes with rather large mouths and strong teeth. Their pelvic fins are not reduced to filaments. Their unifying character is a V-shaped ridge on the top of a rather flattened head. Otherwise, they are quite similar to the rest of the cods.

Without the silver hake, the family includes two

subfamilies, the Gadinae which includes such forms as the cod, tomcod, pollock, haddock and others that have three dorsal and two anal fins. The other subfamily, the Lotinae, have two dorsals and one anal fin and this group includes the red and spotted hakes and the only freshwater cod, the burbot, *Lota lota*.

Cods have no spines in their fins. The pelvic fins are usually inserted anterior to the pectoral fins and sometimes reduced to filaments. The scales are small and of a special type with the circuli broken into short segments. Many cods have barbels on the chin or snout.

Codfishes are extremely important in the commercial fishery of the north temperate regions because of their size, abundance, and high quality as food fishes.

KEY TO THE SPECIES OF CODFISHES IN THE INLAND WATERS OF NEW YORK

A. One or two dorsal fins and one anal fin.

D.

A'. Three dorsal fins and two anal fins.

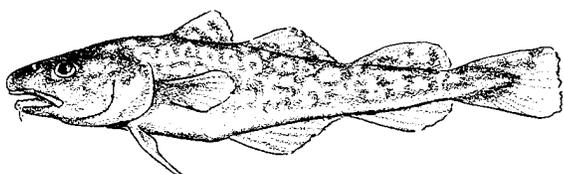
B. Pelvic fins wide, with the second ray extended as a short filament less than one-third as long as the rest of the ray. Maximum length more than 3 feet.

C.

B'. Pelvic fins narrow, the second ray protruding as a long filament about as long as the rest of the ray. Maximum size less than 15 inches.

Microgadus tomcod

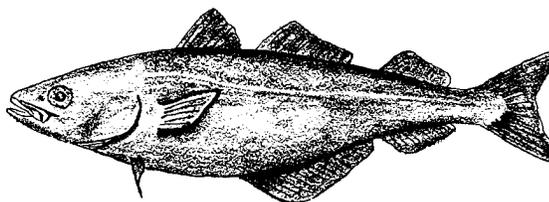
Atlantic tomcod, p. 404



C. (B. Pelvic fins wide, with short filament.) Lower jaw longer than the upper jaw. Chin barbel small or sometimes absent.

Pollachius virens

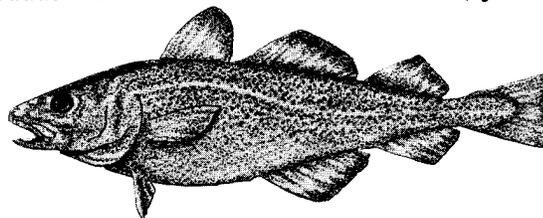
Pollock, p. 404



C'. Lower jaw shorter than the upper. Chin barbel well developed.

Gadus morhua

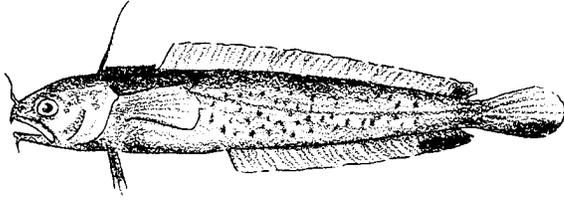
Atlantic cod, p. 403



D. (A. Dorsal fins one or two.) Dorsal fin single, preceded by a fringe of short rays and one long ray. Three barbels at the tip of the snout and one on the chin.

Enchelyopus cimbrius

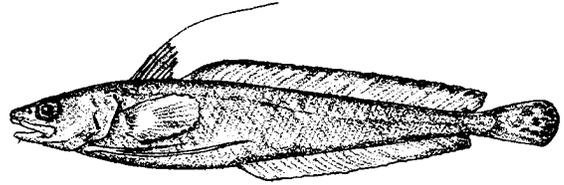
Fourbeard rockling, p. 403



G'. Third ray of first dorsal fin prolonged into a filament that is three to five times as long as the rest of the fin. Pectoral fins not reaching to anal origin. Lateral line not dark with white spots.

Urophycis chuss

Red hake, p. 405



D'. Two dorsal fins, no separate dorsal fin rays.

E. Pelvic fins long and feeler-like, consisting of two filaments and inserted well forward, almost on the edge of the gill openings.

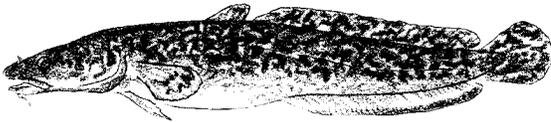
G.

E'. Pelvic fins of the normal type, not long and feeler-like but consisting of several soft rays, inserted below or slightly ahead of the pectoral fins.

F. A chin barbel is present. First dorsal fin originating behind the tips of the pectorals. No notch in second dorsal or anal fins. Fresh water. See freshwater section.

Lota lota

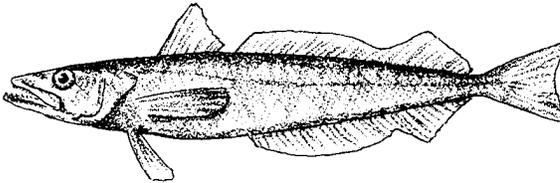
Burbot, p. 261



F'. No chin barbel. First dorsal originating just behind base of pectoral fins. Second dorsal and anal fins with a notch, followed by longer rays giving the appearance of two fins joined together.

Merluccius bilinearis

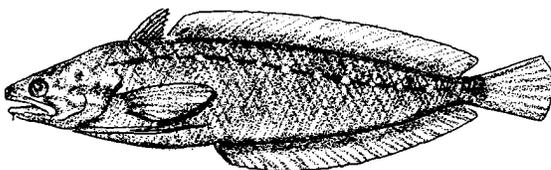
Silver hake, p. 406

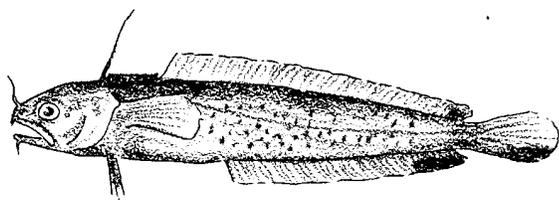


G. (E. Pelvic fins feeler-like.) First dorsal fin without prolonged filamentous rays. Outer half of first dorsal fin black with a whitish margin. Pectoral fins reaching to origin of anal fin. Lateral line dark but interrupted by a series of whitish spots.

Urophycis regia

Spotted hake, p. 405





FOURBEARD ROCKLING

Enchelyopus cimbrius
(Linnaeus, 1766)

Identification

The fourbeard rockling gets its name from its conspicuous barbels — one in front of the nostril on each side, one at the tip of the snout, and one at the tip of the chin. The fourbeard is a peculiar fish in other ways, too. The first dorsal fin consists of a single long ray followed by about 50 short hairlike rays that are not interconnected by membrane. The second dorsal fin is elongate with 45 to 53 rays. The anal fin has 39 to 43 rays. It has a rounded tail and the pectorals are high on the sides with their bases almost vertical. The pelvic fins begin in front of the pectorals. In general shape, the fourbeard resembles the hakes — tapering, round in front of the anal, and compressed behind. The fourbeard is a rather somber fish with conspicuous spots at the ends of the dorsal and anal fins and on the base of the tail. There are some scattered spots on the sides of the body. The maximum size is about 12 inches total length.

Occurrence

Fourbeard rocklings have been taken in the Lower Hudson as far upstream as Indian Point where Wayne Ahlmer collected a specimen in the winter of 1973.

Notes

Cohen and Russo studied variation in this species and found that southern populations have more dark pigment and frequently have four dark blotches in the dorsal fin rather than one. Southern fish also have more dark pigment at the base of the short rays of the dorsal fin. There is clinal variation in dorsal, anal, and pectoral fin ray counts, gill raker number and vertebral number. These authors consider the fourbeard to be a single species not divisible into subspecies.

References

Bath, Beebe, Dew, Reider, and Hecht, 1977 (Hudson River). Cohen and Russo, 1979 (relationships and variation).

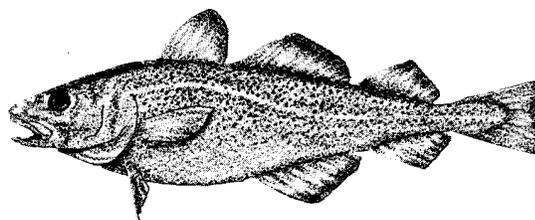
Names

According to Jordan and Evermann *cimbrius* is Latin for Welsh

Gadus cimbrius Linnaeus, 1766: 440 Atlantic Ocean

Rhinonemus cimbrius, Goode and Bean, 1895: 384-385 New York

Enchelyopus cimbrius, Bean, 1903: 710-711



ATLANTIC COD

Gadus morhua Linnaeus, 1758

Identification

The Atlantic cod is an ordinary codfish which is to say that it has three dorsal fins, two anal fins, and rather normal pelvic fins. In the inland waters of New York, it could only be confused with the tomcod which is a much smaller species and differs in the following ways: 1) The Atlantic cod has a square tail whereas that of the tomcod is rounded. 2) The anterior rays of the pelvic fin of the tomcod are prolonged into a filament which is about as long as the rest of the fin, but in the Atlantic cod the filament is only about a fourth as long as the rest of the fin. 3) The dorsal fin originates over the base of the pectoral in the Atlantic cod and the pectoral extends beyond the rear of the base of the first dorsal fin. In the tomcod, the dorsal originates farther back and the end of the pectoral is below the rear third of the first dorsal. 4) The eye of the cod is large, about four times in the head length, but in the tomcod it is small, about six times in the head length.

The color pattern of the Atlantic cod is one of darker spots on a lighter background which can be either green or red. In contrast to some other similar codfishes, the lateral line is pale.

Codfish are large, reaching weights of more than 200 pounds. The all-tackle record is 98 pounds 12 ounces from the Isle of Shoals, New Hampshire. Fish weighing 50 to 60 pounds are still caught on occasion.

Occurrence

Boyle reported that Atlantic cods are sometimes taken by commercial fishermen in Haverstraw Bay. Mr. Tom Lake picked up the skull of a cod estimated to have been about 2 feet long on the beach at Haverstraw Bay in the winter of 1983.

Notes

The Atlantic cod occurs on both sides of the Atlantic from the Bay of Biscay and Novaya Zemlya to Greenland and south to Cape Hatteras.

References

Bigelow and Schroeder, 1953b: 182-196. Boyle, 1969 (Hudson River).

Names

Morhua is a Middle Latin name for the cod.

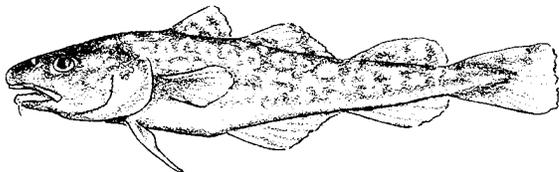
Gadus morhua Linnaeus, 1758: 252 off Europe

Gadus arenosus Mitchill, 1815: 368 New York

Gadus rupestris Mitchill, 1815: 368 New York

Morrhua minuta (Linnaeus), DeKay, 1842: 277 New York

Morrhua americana, DeKay, 1842: 274-276 New York (not *M. americana* of Storer which is *Microgadus*)



ATLANTIC TOMCOD

Microgadus tomcod (Walbaum, 1792)

Identification

At first glance, the tomcod with its three dorsal fins, two anal fins, and prominent chin barbel, looks like a small version of the Atlantic cod. The two are easy to distinguish, however, because the tomcod has a smaller eye, a rounded rather than square tail, and filaments on the pelvic fins that are as long as the rest of the fin. The tomcod is a much smaller species than the cod and its dorsal fin originates farther back, over the middle of the pectoral rather than over its base. The color varies from olive to green without definite color phases and the pattern is mottled rather than spotted. Its size is usually 10 to 12 inches, rarely 15 inches, total length.

Occurrence

Tomcod are fish of the inshore coastal areas. They are almost anadromous, moving upstream to brackish water to spawn. In Canada, there are landlocked populations in a few lakes. Tomcod range from insular Newfoundland to Chesapeake Bay. It apparently does not spawn south of the Hudson River.

In the Hudson, most of the spawning takes place between West Point and Poughkeepsie.

Notes

The tomcod spawns from November to February in tidal waters. The demersal and somewhat adhesive eggs are deposited on sand or gravel shoals at temperatures of 0 to 2.5 C. Growth is rapid and individuals seldom live more than 2 years. Ninety percent mature 1 year after they are hatched. Each female lays 14,000 to 20,000 eggs. After spawning, they move downstream to the Lower Hudson and ocean bays. The eggs hatch in 5 or 6 weeks and the yolk-sac larvae drift for another week or two. The larvae spend March to May feeding on zooplankton and drifting downstream, reaching Croton by May or June and feeding more and more on benthic organisms. They spend July through September in the lower estuary, sometimes moving into the deep waters near West Point and downstream again to the ocean bays. Their growth is rapid and by December they begin to move upstream toward the spawning grounds.

Bigelow and Schroeder report that tomcod feed on small crustaceans, mollusks, and fish fry. They feed near the bottom and depend largely on chemical senses for finding their food.

This species is tremendously abundant in the lower estuary and it is potentially an important sport fish during the colder months. Because of its short life span, its abundance is an excellent index of environmental conditions in the estuary.

References

Bigelow and Schroeder, 1953b: 196-199 (general account). Grabe, 1978 (food of juveniles); 1980 (food of age I and age II fish). Smith et al., 1979 (hepatoma in Hudson River fish). Hecht and Dew, n.d. (ecology and population dynamics). Peterson et al., 1980 (early life history stages). Schaner and Sherman, 1960 (fecundity).

Names

The trivial name is taken directly from the English common name.

Gadus tomcod Walbaum, 1792: 133

Gadus tomcodus pruinus Mitchill, 1815: 369

Morrhua pruinosa, DeKay, 1842: 278 Albany

Gadus tomcodus fuscus Mitchill, 1815: 369

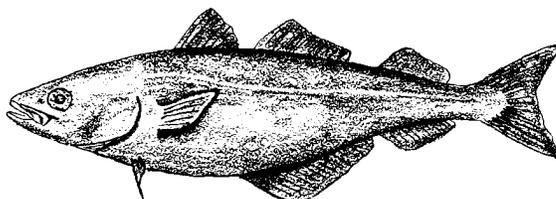
Gadus tomcodus luteus Mitchill, 1815: 369

Gadus tomcodus luteo-pallidus Mitchill, 1815: 369

Gadus tomcodus mixtus Mitchill, 1815: 369

Gadus polymorphus Mitchill, 1815: 369

Microgadus tomcod, Greeley, 1935: 101



POLLOCK

Pollachius virens (Linnaeus, 1758)

Identification

The pollock resembles the Atlantic cod in having three dorsal fins, two anal fins, and a pale lateral line. It differs from the cod in that its lower jaw projects beyond the upper and in the fact that its chin barbel is small or absent whereas in the cod it is quite prominent. The cod is spotted but the pollock is a uniform olive green. The tail of the pollock is more deeply forked with sharper angles than that of the cod.

Occurrence

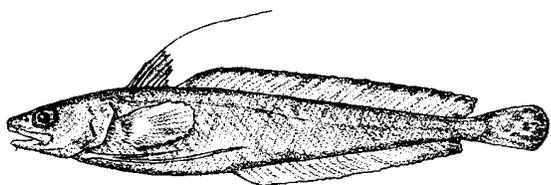
The pollock is included here on the basis of a 53-mm specimen collected 28 October 1980 at River Mile 42 by J. Reichle of Texas Instruments. This specimen is now AMNH 48283.

Names

Virens is the past participle of the Latin word meaning to be green.

Gadus virens Linnaeus, 1758: 253 oceans of Europe

Gadus purpureus Mitchill, 1815: 370 New York
Merlangus leptocephalus DeKay, 1842: 288 Long Island



RED HAKE

Urophycis chuss (Walbaum, 1792)

Identification

In the red hake and the spotted hake, *Urophycis regia*, the pelvic fins are reduced to long filaments inserted on the side of the isthmus between the gill covers. The body is long and tapering, the caudal fin rounded, and there are two dorsal fins in both species. The red hake differs from the spotted hake in lacking spots along the lateral line and in having the third ray of the dorsal fin prolonged into a filament three to five times as long as the rest of the dorsal rays. There is no such prolongation in the spotted hake. The red hake is also difficult to distinguish from the white hake, *Urophycis tenuis*, which has been reported from the Arthur Kill but not from the Hudson Estuary. The white hake has smaller scales (119 to 148 in the lateral line, 12 rows between the lateral line and the base of the dorsal fin; the red hake has 95 to 117 lateral line scales and 9 rows between the lateral line and the dorsal fin). It has been stated that the upper jaw reaches to below the rear margin of the pupil in the red hake, to the rear margin of the eye in the white hake and well beyond the rear of the eye in the spotted hake but Musick found that this feature did not work for separating the red hake and the white hake. A much better characteristic, according to Musick, is that the red hake has three gill rakers on the upper part of the gill arch and the white hake has two (not counting rudiments).

The red hake reaches a maximum weight of about 6 pounds.

Occurrence

Juvenile red hake are inquilines, that is, they live in the mantle cavities of scallops. As they get too large for the scallop shells they become free-living.

The red hake sometimes moves up the Hudson River as far as Indian Point (River Mile 42) where it was reported by Texas Instruments personnel in 1975.

References

Hildebrand and Cable, 1938: 612-618 (development). Musick, 1973 (identification); 1974 (distribution). Miller and Marak, 1959 (larval stages). Markle et al., 1982 (habitat). Texas Instruments Report to

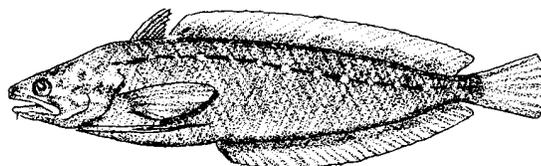
Consolidated Edison, 1975. Bigelow and Schroeder, 1953b (general summary). Svetovidov, 1982 (recognition). Pearson and Miller, 1980 (feeding).

Names

Chuss is an old vernacular name, probably derived from cusk.

Blennius chuss Walbaum, 1792: 186 Long Island

Gadus longipes Mitchill, 1815: 372 New York
Urophycis chuss, Bean, 1903: 704-708 New York



SPOTTED HAKE

Urophycis regia (Walbaum, 1792)

Identification

The spotted hake, with its tapering body, two dorsal fins and filamentous pelvic fins resembles the red hake and the white hake. It differs, however, in not having the third ray of the dorsal fin prolonged into a filament, in having larger scales (90 to 95 in the lateral line of the spotted hake; 100 to 110 in the lateral line of the red hake), and a larger mouth with the end of the maxillary behind the level of the back of the eye. The coloration of the spotted hake is distinctive. The distal half of the dorsal fin is black with a narrow white margin. The lateral line is black but interrupted by a series of white spots. The pelvic fins are white.

Occurrence

Bath et al. (1977) listed the spotted hake from the Hudson Estuary. On 2 June 1980 a 111-mm specimen was collected at River Mile 20 by H.M. Woodward. This specimen is AMNH 48283.

References

Bigelow and Schroeder, 1953b (summary account). Barans and Barans, 1972 (larval stages).

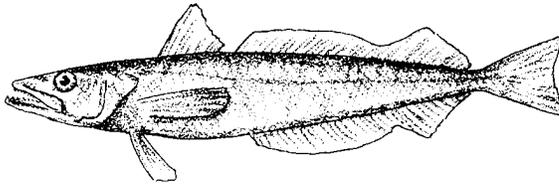
Names

Regia is Latin for royal.

Blennius regius Walbaum, 1792: 186 Long Island (after Schoepf)

Enchelyopus regalis Bloch and Schneider, 1801: 53 Long Island

Gadus punctatus Mitchill, 1815: 372 New York



SILVER HAKE

Merluccius bilinearis
(Mitchill, 1814)

Identification

The silver hake is quite different from other cods. It is a long, slender fish with a projecting lower jaw, strong teeth and two dorsal fins, although the second has a notch that suggests the division into two, the second and third fins. The anal is similar to the second dorsal fin and has a similar notch. The pelvic fins are of the usual form, that is not reduced to filaments, and are inserted slightly ahead of the pectorals. There are no chin barbels. The tail is emarginate.

The silver hake is indeed iridescent silvery, somewhat darker above, with a slight reddish or purplish cast. There are about 13 indistinct dusky rose blotches along the side. The usual size is about 14 inches; the maximum is about 30 inches.

Occurrence

The silver hake is a marine species that occasionally strays into the Hudson Estuary. Boyle reported that commercial fishermen sometimes get it in Haverstraw Bay in November and December. One fisherman reported catching one in a muskrat trap set in a tidal marsh.

Notes

Schaefer noted that in the inshore areas of the New York Bight the silver hake feeds on invertebrates, especially amphipods, and sand shrimps and about as frequently on small fishes. Blueback herring and Atlantic silversides are the most frequent fish species eaten in inshore areas whereas offshore the most frequent item in the stomachs was other members of their own species. Schaefer also found that female whiting (silver hake) grew more rapidly and to a larger size than the males.

References

Cohen, 1980 (names). Schaefer, 1960 (growth and feeding). Boyle, 1969 (Hudson River).

Names

The silver hake is also called whiting in the New York area. *Bilinearis* is Latin for two lines.

Stomodon bilinearis Mitchill, 1814: 7 New York
Gadus albidus Mitchill, 1818b: 409 New York
Merluccius albidus, DeKay, 1842: 280-282 New York

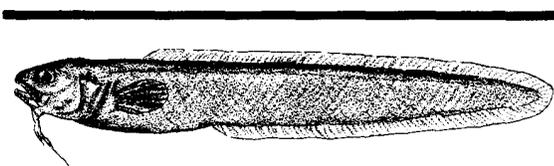
Merluccius bilinearis, Boyle, 1969: 260 Verplanck

CUSK-EELS

OPHIDIIDAE

The cusk-eels are slender, eel-like fishes closely allied to the codfishes. They resemble eels in shape and in having the dorsal and anal fins long and continuous with the tail fin but they differ superficially in that they have pelvic fins. These fins, however, are reduced to two slender rays each and they are inserted far forward in the throat region, in fact, directly below the eye.

Cusk-eels are bottom dwellers in coastal waters. The family is rather a small one; worldwide, there are about 10 genera and some 35 species. One species has been recorded from the Hudson River as a marine stray.



STRIPED CUSK-EEL

Ophidion marginatum
(DeKay, 1842)

Identification

The cusk-eel resembles an eel but the filament-like pelvic fins on the sides of the isthmus are distinctive. The longer of the two filaments on each side is slightly shorter than the head. The lateral line stops a little before the base of the tail and is darker than the pale grayish-green ground color. The dorsal fin has a distinct dark marginal line that continues around the tail and forward to about the middle of the anal fin.

Occurrence

The striped cusk-eel is a marine species reported from the Arthur Kill and from the Lower Hudson. Specimens 224 and 287 mm long were collected at River Mile 42 in 1980. These are AMNH 48292 and 48293, respectively.

Notes

Studies in progress show that there are at least 10 species of *Ophidion* in the Western North Atlantic.

References

Bath et al., 1977 (in list of Hudson River fishes).
Cohen and Nielson, 1978 (systematics).

Names

The name *marginatum* apparently refers to the dark margins on the vertical fins.

Ophidium marginatum DeKay, 1842: 315 New York Harbor

Rissola marginata, Bath et al., 1977 Hudson River

NEEDLEFISHES

BELONIDAE

The needlefishes are related to the flyingfishes and halfbeaks. Most needlefishes are marine but a few live in fresh water. One species is a summer resident in the Hudson Estuary. There are about 10 genera and nearly 30 species.

Sometimes, the needlefishes are called sea gars because of their elongated jaws and slender bodies. They are not at all related to the true gars which are primitive freshwater fishes with thick diamond-shaped bony scales.



ATLANTIC NEEDLEFISH

Strongylura marina (Walbaum, 1792)

Identification

The Atlantic needlefish is distinguished by its very elongate, slender and terete body. There are only soft rays in the fins and the dorsal and anal fins are placed far back on the body, the dorsal origin somewhat behind the origin of the anal. The tail is only slightly forked, with the lower lobe a little larger; the pelvic fins are abdominal.

In needlefishes, as in their relatives, the flyingfishes, the lateral line runs low on the side of the body. Living fish are conspicuously green above and silvery below with a narrow dark line along the side and another in the middorsal line. The jaws are extremely elongate and narrow and armed with sharply pointed teeth. In this species, only the right gonad develops whereas in its southern relative, the very similar *Strongylura timucu*, both gonads are functional. *Strongylura marina* has 213 to 214 scales (average 256) and *S. timucu* has 120 to 185 (average 156).

Occurrence

The Atlantic needlefish is a consistent summer resident in the Hudson Estuary where it occurs as far north as Ulster Park. In the summer of 1984, it was taken at Kingston Point Beach (River Mile 91) by

Steve Stanne and John Mylod of the Hudson River Sloop Clearwater.

Notes

Tom Lake and Christopher Letts report that although they are hard to hook, needlefish readily strike artificial lures and provide some interesting late summer fishing.

References

Collette, 1968 (systematics). Lake, 1982 (fishing for needlefish in the Hudson River).

Names

The species name *marina* refers to its habitat. It is a Latin word meaning of the sea.

Esox marinus Walbaum, 1792: 88 off New York (after Schoepf)

Tylosurus marinus, Bean, 1903: 317-319

Strongylura marina, Greeley, 1937: 98 Lower Hudson

Esox longirostris Mitchill, 1818a: 322 Hudson River

Belone truncata Lesueur, 1821: 126 New York Bay

KILLIFISHES

CYPRINODONTIDAE

The killifishes are generally small fishes and some species are called topminnows or toothcarps although they have no Weberian apparatus and are not related to the true minnows. Killifishes live in fresh and marine waters and some can even tolerate the hypersaline conditions of drying tide pools. This is a rather large family with about 50 genera and more than 300 species. Recently, Parenti has divided the family, placing *Fundulus* and *Lucania* in the Fundulidae and *Cyprinodon* in the family Cy-

prinodontidae. Other ichthyologists believe that the relationships between the two groups are best expressed by calling them subfamilies of the family Cyprinodontidae.

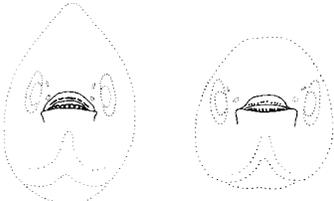
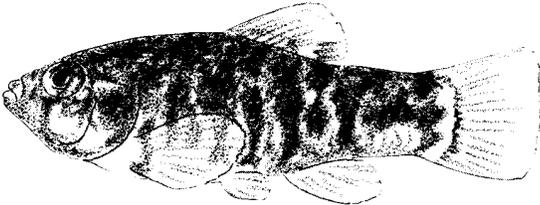
In the New York fauna, the banded killifish occurs in truly fresh water as well as in brackish water, the mummichog lives in marine and brackish water, and the rest of the species treated here are primarily marine species that sometimes wander into brackish or fresh water.

KEY TO THE SPECIES OF KILLIFISHES IN THE INLAND WATERS OF NEW YORK

A. Jaw teeth each with two or more points. Body short and deep, its depth contained about 2 times in the standard length.

Cyprinodon variegatus

Sheepshead minnow, p. 411



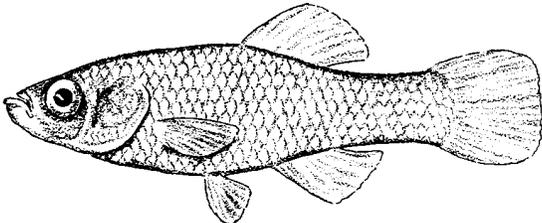
Teeth of *Fundulus* (left) and *Cyprinodon*.

A'. Jaw teeth with single points. Body more elongate, depth at least 3 times in the standard length.

B. Jaw teeth in a single series.

Lucania parva

Rainwater killifish, p. 413

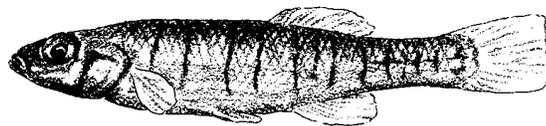


B'. Jaw teeth in a band of more than one row.

C. Scales 35 to 55. Caudal peduncle slender, its least depth contained more than 7 times in the standard length.

Fundulus diaphanus

Banded killifish, F.

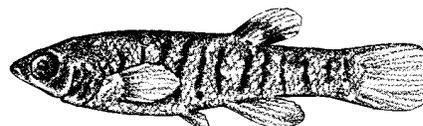
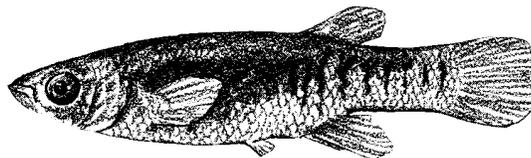


C'. Scales 31 to 35. Caudal peduncle deep, its least depth less than 7 times in standard length.

D. Dorsal fin of males originating slightly behind the origin of the anal fin. Scales 31 or 32. Male with a distinct ocellus on the last few rays of the dorsal fin. Sides of males with 10 to 12 heavy darker bars. Females unbarred or with numerous delicate bars. A small species not exceeding 40 mm in length.

Fundulus luciae

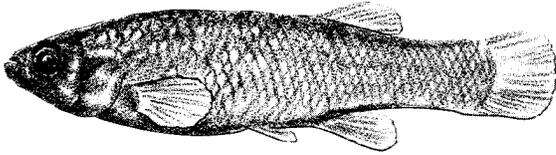
Spotfin killifish, p. 412



D'. Dorsal fin of males originating over or slightly ahead of the origin of the anal fin.

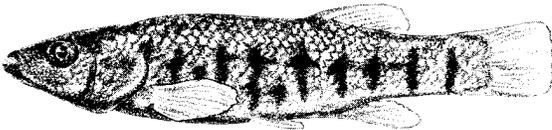
E. Snout blunt, its length slightly longer than eye. Eye contained 1.5 to 2 times in the postorbital head length. Color pattern dark, without longitudinal lines. Males with vertical bars on the body and an ocellus on the back of the dorsal fin.

Fundulus heteroclitus Mummichog, p. 411



E'. Snout long, its length nearly twice the eye diameter. Eye 2 to 3 times in the postorbital head length. Color pattern of both sexes pale, males with vertical bars and females with two or three longitudinal lines.

Fundulus majalis Striped killifish, p. 413



F. (C. Scales 35 to 55.) Scales usually 45 to 49. Dorsal rays usually 13 or 14. Anal rays usually 11 or 12. Pectoral rays usually 16 or 17. Scales with sharp dark outlines. Bars on the sides of the body continue across the back. Bars on caudal peduncle short but distinct. Commonly reaching more than 70 mm standard length.

Fundulus diaphanus diaphanus p. 264

F'. Scales usually 40 to 44. Dorsal rays usually 11 to 13. Anal rays usually 10 or 11. Pectoral rays usually 14 or 15. Scales with diffuse dark outlines. Bars on the side of the body broken into spots across the back. Bars on caudal peduncle more or less fused into a median lengthwise stripe. Seldom more than 70 mm standard length.

Fundulus d. menona p. 264



SHEEPSHEAD MINNOW

Cyprinodon variegatus
Lacepède, 1803

Identification

Although not a true minnow, this species is minnow-sized, the largest individuals being about 2 inches in total length. The sheepshead minnow (really a killifish) differs from true minnows in having teeth on the jaws and in lacking a Weberian apparatus. Its rather flat head with scales on the top, large scales on the body, and saltwater habitat also differentiate it from the true minnows. This is the most distinctive of our killifishes for it is the only one that has a short deep shape. Its greatest depth is approximately half the standard length. It is also moderately compressed. The jaw teeth are tricuspid and wedge shaped rather than conical. The pelvic fins are small and abdominal in position and dwarfed by the much larger pectorals. The tail is square. The sheepshead minnow has a rather bold pattern of irregular bars. Breeding males have salmon-colored bellies and the pelvic and anal fin edges and the leading edge of the dorsal fin are bright orange contrasting with the steel-blue wash of the anterior dorsal part of the body and the greenish sheen behind the dorsal fin.

Occurrence

The sheepshead minnow is a coastal fish that ranges from Cape Cod to Mexico in brackish, marine, or hypersaline environments. It is common in bays and estuaries of Long Island and there is one record from the Hudson River at Newburgh.

Notes

The record from Newburgh is puzzling. Since sheepshead minnows are easily caught in shallow estuarine habitats and keep well in aquaria it is possible that this specimen was a discarded aquarium pet.

References

Hildebrand, 1917 (life history). Raney, Backus, Crawford, and Robins, 1953 (breeding behavior). Parenti, 1981 (systematics).

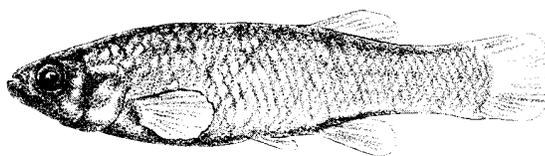
Names

The name *variegatus* is from the Latin *vario*, change, referring to the color pattern which varies on different parts of the body.

Cyprinodon variegatus Lacepède, 1803: 486 South Carolina

Esox ovinus Mitchell, 1815: 441 New York

Lebias ovinus, DeKay, 1842: 215-216 New York



MUMMICHOG

Fundulus heteroclitus
(Linnaeus, 1766)

Identification

The mummichog is easily recognized as a killifish by its general shape. The dorsal and anal fins are far back, the top of the head is scaly, and the upper jaw is protractile. It differs from the banded killifish and the striped killifish in that its snout is short and its body is shorter and deeper. It is also darker in color, the males with white or yellow spots on the scales and indistinct blue or silver bars. Males have an ocellus on the back of the dorsal fin. Females are lighter and more uniform in color. In general appearance, it is most like the spotfin killifish, *Fundulus luciae*, but that species has only 8 dorsal rays where the mummichog has 11 or 12. Young striped killifish, a more brackish water species, resemble small mummichogs but they have scales on the area in front of the eye. The mummichog has a scaleless preorbital.

The dorsal fin of the males is marbled and has a large posterior spot that is absent in the females. Adult males also have a yellow spot at the origin of the dorsal fin. Breeding males are intense yellow on the lower sides, the belly, head, and the lower fins. The blotch in the dorsal fin is surrounded by a yellow ring. Breeding males are also blue dorsally and the vertical bars become quite bright. The dorsal and anal fins of the males are larger than those of the females with small pearl organs along the fin rays.

The maximum size is about 130 mm. We have a 99-mm (standard length) specimen from Haverstraw Bay.

Occurrence

The mummichog is an estuarine species that can tolerate a wide range of salinities. It frequently occurs together with the banded killifish in fresh water and areas of low salinity. It can tolerate rather high temperatures, up to 93 F at 14 ppt salinity. Freshwater populations have growth rates similar to those of brackish water populations (Samaritan and Schmidt, 1982).

The general range of the mummichog is from northeastern Florida to the Gulf of St. Lawrence. Current studies by Able and others suggest that there is a northern form, *F. h. macrolepidotus*, which appears to intergrade with the typical mummichog, *F. h. heteroclitus*, in New Jersey. Both forms have been taken on Long Island. They are distinguished by egg structure (number of filaments and oil droplets) and in their spawning behavior.

In the Hudson River, there seem to be no records between Newburgh and Claverack, but the status of the populations above and below this stretch has yet to be determined.

Notes

In Delaware, where it has been studied rather thoroughly, the mummichog spawns between April and the end of August. Spawning is cyclical and correlated with high tides associated with the times of the new and full moon. The eggs are laid at levels reached only by high spring tides. Eggs are deposited in clutches of 10 to 300 and are hidden in leaves or empty mussel shells. In these situations, the eggs are protected from drying, and hatching can be delayed for at least 2 weeks until the eggs are again reached by the tides. Apparently, most of the spawning occurs on the night tide because females collected at night had ovulated eggs in the ovary and those collected during the day did not. Morin and Able have described variation in spawning habits.

The mummichog consumes a variety of plant and animal matter including diatoms, amphipods, mollusks, crustaceans, small fishes, fish eggs, and sea grass fragments. It is widely used as an experimental animal, especially for studies of endocrinology.

References

Newman, 1907 (spawning). Mast, 1915 (behavior in tide pools). Bigelow and Schroeder, 1953b (general summary). Perlmutter, 1958 (popular account). Butner and Brattstrom, 1960 (movements). Richards and McBean, 1966 (larvae). Garside and Morrison, 1977 (thermal preference). Meredith and Lotrich, 1979 (population dynamics). Taylor et al., 1979 (lunar spawning cycle). Lotrich, 1975 (movements and home range). Fritz et al., 1975 (movements). Able and Castagna, 1975 (reproductive behavior). Baker-Dittus, 1978 (foraging patterns). Samaritan and Schmidt, 1982 (life history in fresh water). Morin and Able, 1983 (spawning). Taylor and DiMichele, 1983 (spawning sites). Relyea, 1983 (systematics).

Names

Heteroclitus is from the Greek *hetero*, different, and *klitos*, a slope or hillside, the lower part of a place. In combination this is taken to mean irregular or unusual.

Cobitis heteroclitus Linnaeus, 1766: 500 Charleston, South Carolina

Fundulus heteroclitus, Greeley, 1935: 97 Hudson River

Cobitis macrolepidota Walbaum, 1792: 11 (after Schoepf)

Fundulus heteroclitus macrolepidota, Greeley, 1937: 98 Lower Hudson

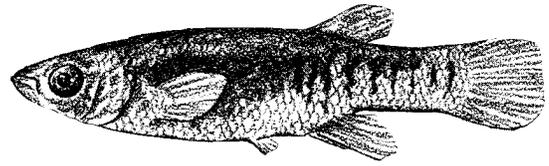
Esox pisculus Mitchill, 1815: 440 New York

Esox pisculentis Mitchill, 1815: 441 New York

Hydrargyra nigrofasciata Lesueur, 1817e: 133-134 Rhode Island

Fundulus viridescens DeKay, 1842: 217 New York

Fundulus zebra DeKay, 1842: 218 New York



SPOTFIN KILLIFISH

Fundulus luciae (Baird, 1855)

Identification

The spotfin closely resembles the mummichog in shape and coloration but the two species can be distinguished by dorsal ray count: 8 in the spotfin, 11 or 12 in the mummichog. The dorsal fin of the spotfin originates farther back, over or slightly behind the anal and about equidistant between the tip of the tail and the anterior half of the eye. In the mummichog, it is about equidistant between the tip of the tail and the tip of the snout in males, somewhat nearer to the tip of the tail than to the tip of the snout in adult females. The base of the dorsal fin is shorter than the base of the anal fin.

There is a pronounced ocellus (a black spot surrounded by a pale ring) on the back of the dorsal fin of males.

This is a small species, seldom attaining 50 mm in total length.

Occurrence

The Survey obtained this species on Long Island (Suffolk County). Its overall range is Long Island to Georgia.

Notes

Dr. Kenneth Able of Rutgers University has found this species to be common in pools in tidal marshes along the New Jersey coast.

References

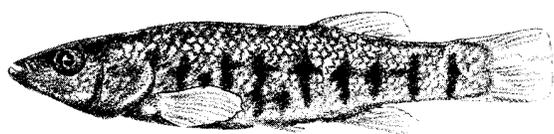
Richards and Bailey, 1967. Kneib, 1978 (ecology). Byrne, 1978 (life history).

Names

This species was named for Lucy Baird, the daughter of Spencer Fullerton Baird.

Hydrargyra luciae Baird, 1855: 344 Beesleys Point, New Jersey

Fundulus luciae, Greeley, 1939: 41 Long Island



STRIPED KILLIFISH

Fundulus majalis (Walbaum, 1792)

Identification

The striped killifish is more slender than the mummichog and has a much longer snout than any other killifish in our area. It differs from the mummichog in having scales on the preorbital region.

The striped killifish is a pale fish with a bold pattern of darker stripes: vertical lines in the males, and at least a trace of longitudinal lines in females. In fully mature females, a long narrow stripe runs from the gill opening to the tail with one or two interrupted stripes below this, and one or two vertical bars at the base of the tail. Juveniles of both sexes are barred.

Occurrence

The striped killifish is more of a saltwater fish than is the mummichog. The Survey did not get it in the Hudson River estuary, and I have been unable to find records of its occurrence there. It is abundant in the bays and estuaries of Long Island and the Survey collected it in the mouths of streams tributary to Long Island Sound.

References

Rosen, 1973a (identification). Able, 1976 (cleaning symbiosis). Clemmer and Schwartz, 1964 (age and growth). Richards and McBean, 1966 (larvae). Relyea, 1983 (systematics).

Names

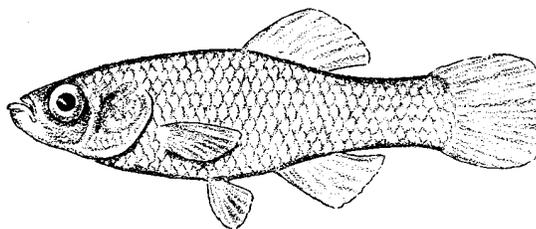
Majalis is from the New Latin, pertaining to the month of May, i.e. Mayfish.

Cobitis majalis Walbaum, 1792: 12 Long Island

Esox flavulus Mitchill, 1815: 439 New York

Esox zonatus Mitchill, 1815: 443 New York

Fundulus majalis, Greeley, 1937: 98 Long Island Sound (not Lower Hudson)



RAINWATER KILLIFISH

Lucania parva (Baird, 1855)

Identification

This is a small, rather undistinguished killifish that is more apt to be confused with the mosquitofish than with members of its own family. It is a stubby little fish with large scales conspicuously outlined with dark pigment. There is a dark middorsal streak in front of the dorsal fin. During the breeding season, the males develop a dark leading edge on the dorsal and anal fins, and the anal and pelvic fins become slightly red. The maximum size is about 2 inches total length.

The teeth of the rainwater killifish are pointed and in a single irregular row rather than in a band as in species of *Fundulus*, or tricuspid and incisor-like as in *Cyprinodon*.

Occurrence

Greeley (1939) reported this species from the lower parts of streams in Suffolk County, Long Island. He noted that while it is not a typical freshwater fish, it can tolerate fresh water at least temporarily. Its range is Cape Cod to Tampico, Mexico.

Notes

This species has been introduced into California.

References

Hubbs and Miller, 1965 (taxonomy). McCoid and St. Amant, 1980 (established in California).

Names

Parva is Latin for small.

Cyprinodon parvus Baird, 1855: 345. Long Island

Lucania parva, Greeley, 1939: 41-42. Long Island

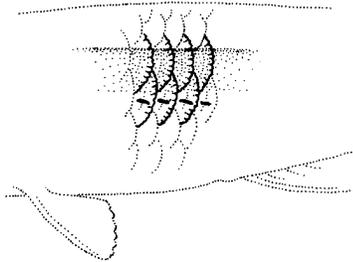
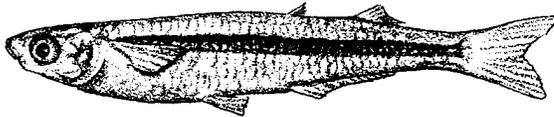
SILVERSIDES

ATHERINIDAE

The silversides are usually small slender fishes with two dorsal fins and a pronounced silver stripe along the sides. There are about 30 genera and more than 150 species living in fresh and salt water. In New York, there is one freshwater species and three others that live in brackish and salt water. Silversides are distantly related to the killifishes.

KEY TO THE SPECIES OF SILVERSIDES IN NEW YORK

A. Edges of the scales scalloped or undulating.
Membras martinica Rough silverside, p. 415



Lacinate scale of rough silverside.

A'. Edges of scales smooth.

B. Jaws prolonged into a short beak-like structure. Scales small, 76 to 80 in lateral series. Freshwater species.

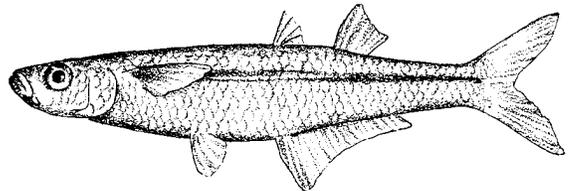
Labidesthes sicculus Brook silverside, p. 269



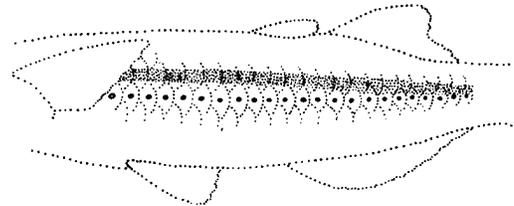
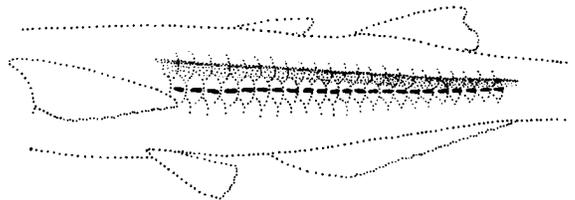
B'. Jaws short, not forming a beak. Scales larger, fewer than 50 in lateral series. Marine and estuarine species.

C. Lateral line consisting of tubes passing through the scale. Anal rays about 24.

Menidia menidia Atlantic silverside, p. 415



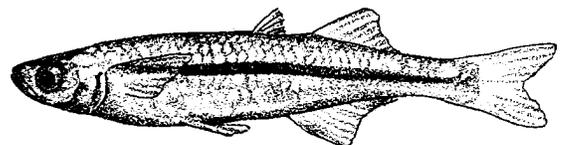
Atlantic silverside, *Menidia menidia*

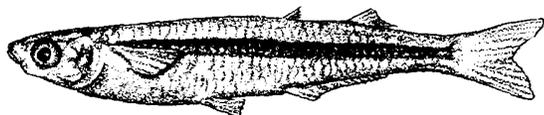


Lateral lines of Atlantic (above) and inland silversides.

C'. Lateral line consisting of pits in the face of each scale. Anal rays (15) 16 to 18.

Menidia beryllina Inland silverside, p. 415





ROUGH SILVERSIDE

Membras martinica (Valenciennes, 1835)

Identification

The rough silverside differs from the brook silverside in having short jaws and large scales. It closely resembles the two species of *Menidia* in our area but differs from them in that its scales are lacinate, that is, with scalloped edges that make the fish slightly rough to the touch. It also differs from *Menidia* in that it has sheaths of scales at the bases of the dorsal and anal fins. These sheaths consist of single rows of large scales that are rather easily dislodged.

Occurrence

Rough silversides are apparently resident in the Lower Hudson and they may be more common than is usually realized because they closely resemble the Atlantic and tidewater silversides. Boyle reported it first from Haverstraw Bay.

Notes

This is a coastal species generally restricted to areas of high salinity.

References

Boyle, 1969.

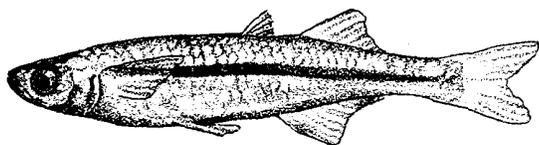
Names

This species is named for the island of Martinique in the West Indies where it was first collected.

Atherina martinica Valenciennes in Cuvier and Valenciennes, 1835: 40 Martinique

Membras martinica, Boyle, 1969: 227-228 Senasqua Beach

Kirtlandia vagrans, Bean, 1903: 359-361 Mecox Bay, Long Island



INLAND SILVERSIDE

Menidia beryllina (Cope, 1869)

Identification

The inland silverside differs from the brook silverside in having large scales and short jaws. It differs from the rough silverside in that its scales are, at most, only slightly scalloped and there are no scaly sheaths at the bases of the dorsal and anal fins. The difficulty in identifying the inland silverside is distinguishing between it and the Atlantic silverside.

While superficially very similar, these two species differ in lateral scale count (37 to 41 in *M. beryllina*, 44 to 50 in *M. menidia*), in the number of oblique scale rows between the upper end of the gill opening and the origin of the spiny dorsal fin (12 to 14 in tidewater, and 15 to 18 in Atlantic), and anal ray count (I, 14 to 20 in *beryllina*, I, 20 to 26 in *menidia*). In *M. beryllina*, the end of the dorsal fin is directly above the end of the anal fin, but in *M. menidia*, the end of the dorsal fin is conspicuously in front of the end of the anal fin. In the inland silverside, the lateral line consists of a series of pits in the scales but in the Atlantic silverside each lateral line scale has a definite tube. Finally, in the Atlantic silverside, the peritoneum is dark but in the inland silverside the peritoneum is silvery with well-spaced, small, black spots.

Occurrence

Greeley reported this species from Peekskill and from a Long Island Sound tributary near Mamaroneck. The Survey also found it to be common on Long Island in streams where it occurred in waters of lower salinity than did the Atlantic silverside. The Survey found it in one pond on Staten Island. It ranges from Massachusetts to Veracruz.

Notes

The inland form formerly known as *Menidia audens* has recently been shown to be indistinguishable from *Menidia beryllina*.

References

Johnson, 1975 (systematics). Chernoff et al., 1981 (systematics). Greeley, 1939 (Long Island).

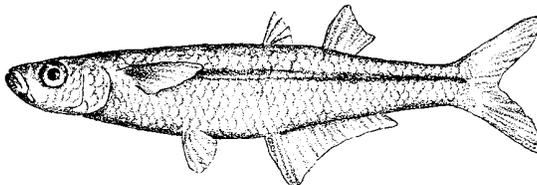
Names

Beryllina is the Latin word for green-colored.

Chirostoma beryllinum Cope, 1869b: 403 Potomac River

Menidia beryllina cerea Kendall, 1902: 261 Waquoit Bay, Massachusetts

Menidia beryllina cerea, Greeley, 1937: 99 Lower Hudson



ATLANTIC SILVERSIDE

Menidia menidia (Linnaeus, 1766)

Identification

With its short snout, large, nearly smooth-edged scales, and dorsal and anal fins without scaly sheaths, the Atlantic silverside can only be confused with the inland silverside, *Menidia beryllina*. Characters for separating the two species have been given under that species. Possibly the best differ-

ence is the presence of tubes in the lateral line scales of the Atlantic silverside and of pits only in the inland silverside.

Occurrence

Greeley noted that Atlantic silversides were fairly common in the Lower Hudson and in tributaries of Long Island Sound in August and September. On Long Island, the Survey found that it was less inclined to enter fresh water than was the inland silverside. Its overall range is Newfoundland to Florida.

Notes

Middaugh et al. studied the reproductive behavior of this species in the Edisto River estuary in South Carolina. Spawning occurred in the upper intertidal zone in April or May through July at northern latitudes, March through July farther south. About an hour before spawning, the fish began swimming in schools parallel to, and about 30 to 60 meters off the shoreline. Approximately 15 minutes before spawning, they moved to within 2 or 3 meters of the shoreline and continued to pass back and forth along a 100-meter section. Females deposited the eggs on stems of *Spartina alterniflora*, passing between the stems and releasing the eggs while fluttering the rear part of the body against the stems. Males followed close behind and released sperm in the same area. The eggs adhere to the plants by fine threads that form as the eggs are ovulated. Sometimes, groups of 6 to 15 males moved to a single plant and positioned their heads close to the plant, forming a rosette through which a dozen or so females swam, depositing their eggs as their heads broke through the surface of the water. Eggs were also deposited on detrital mats and in crab burrows, along the walls of the mats, 2 or 3 cm below the water surface. The eggs were deposited at average heights of 1.5 to 1.8 meters above mean low water so that they were exposed to the atmosphere for about 10 hours between high tides.

References

Hildebrand and Schroeder, 1928 (general account). Middaugh et al., 1981 (life history) Middaugh, 1981 (reproductive ecology). Conover and Ross, 1982 (population dynamics). Greeley, 1939 (Long Island).

Names

Menidia is an old fish name from New Latin.

Atherina menidia Linnaeus, 1766: 519 Charleston, South Carolina

Atherina notata Mitchill, 1815: 446 New York

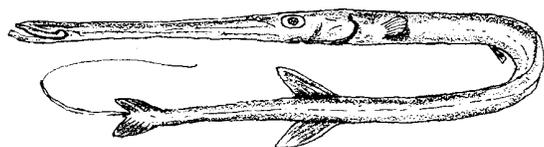
Atherina viridescens Mitchill, 1815: 447 New York

Menidia menidia notata, Greeley, 1937: 99 Lower Hudson

CORNETFISHES

FISTULARIIDAE

The cornetfishes are distant relatives of the pipefishes. They are long and slender, with a tubular face and a relatively small, oblique, terminal mouth. They are quite large fishes, some reaching 2 yards or more in length. Unlike the pipefishes, they are not encased in bony rings. In fact, they have no scales although they do have parts of the lateral line surrounded by bony tubes that are sharply pointed in some species. They are somewhat flattened in cross section. There are no fin spines. The dorsal and anal fins are far back on the body and short with about 14 rays in the dorsal. The tail is forked but the middle rays are drawn out into a long filament. The pectorals are small with a broad base, the pelvics abdominal with six rays. The anus is shortly behind the pelvics. Cornetfishes have 76 to 88 vertebrae of which the first four are greatly elongated. There are no gill rakers. Cornetfishes live in warm seas, occasionally drifting into temperate waters. Two species occur in the Western Atlantic; one has been recorded as a marine stray in the Hudson Estuary.



BLUESPOTTED CORNETFISH

Fistularia tabacaria
Linnaeus, 1758

Identification

The cornetfish is an extremely elongate fish with a rather stiff body, a long filament extending from the middle of the tail, and a small mouth at the end of a long tubular face. From a distance, the cornetfish might be confused with a needlefish but the needlefish has long jaws whereas the cornetfish has short jaws but a long face. The head of the cornetfish is about one-third of the body length and the snout constitutes about three-fourths of the head length.

The color is variable, greenish brown above with many pale blue spots and lines. One other species occurs in the Western Atlantic, *Fistularia petimba*, the red cornetfish. The red cornetfish lacks blue spots and has pronounced points on the bony ossifications along the lateral line. The corresponding ossifications in the bluespotted cornetfish are quite smooth.

Occurrence

During the summer of 1981, members of the Department of Environmental Conservation collected a specimen of this species in the Lower Hudson.

Notes

This is a coastal marine species that is generally found in tropical waters. Its presence in the Hudson is surely the result of its planktonic larval stage having been carried north by currents associated with the Gulf Stream.

References

Fritzsche, 1978 (identification).

Names

Tabacaria refers to tobacco, probably in reference to the shape of the fish which resembles a tobacco pipe.

Fistularia tabacaria Linnaeus, 1758: 312-313 tropical America

Fistularia neo-boracensis Mitchill, 1815: 437 New York

PIPEFISHES

SYNGNATHIDAE

Pipefishes and seahorses are highly specialized fishes that have the body enclosed in bony rings. They have tiny mouths at the tip of a long tubular facial region and this gives them the name tube snouts. A few species live in fresh water but both of our species are confined to salt water of the ocean and the lower reaches of the Hudson Estuary.

KEY TO THE SPECIES OF SEAHORSES AND PIPEFISHES IN NEW YORK

A. Body straight, tail not prehensile, caudal fin present.

Syngnathus fuscus Northern pipefish, p. 419



A'. "Neck" bent so that the head is at right angles to the body. Tail prehensile, without a developed caudal fin.

Hippocampus erectus Lined seahorse, p. 418

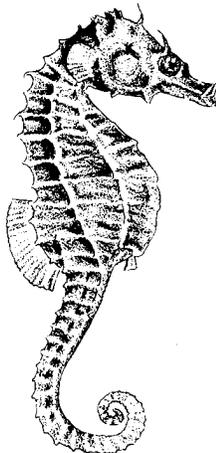


LINED SEAHORSE

Hippocampus erectus Perry, 1810

Identification

Looking like a marine version of a chess knight, the seahorse is one of the most bizarre fishes in existence. There is nothing but another seahorse with which it can be confused. The head is bent at a right angle to the body, the tail prehensile and curved under most circumstances, and there is no tail fin. Its posture is upright and the dorsal fin is the main propulsion unit. Like the pipefish, the body and tail are encased in bony rings, about 12 on the body and 33 to 36 on the tail. The dorsal fin has 18 or 19 unbranched rays. The tiny mouth is at the end of a long tubular face. The egg pouch is on the abdomen and nearly completely enclosed.



There are three North Atlantic species but only the lined seahorse occurs in our area. The only other species that might stray into our area is the longsnout seahorse, *Hippocampus reidi*, which is a more southern (Cape Hatteras to Rio de Janeiro) species with a bold pattern of spots and an even longer snout (snout length 0.41 to 0.49 of the head length in *reidi*, 0.33 to 0.46 in *erectus*).

Occurrence

The seahorse is not uncommon in the Lower Hudson in the vicinity of George Washington Bridge. Mearns (1898) reported it from Consook (now Con Hook) during the summers of 1895 and 1896. Texas Instruments personnel collected a specimen at River Mile 42 on 27 April 1980.

References

Vari, 1982 (general account).

Names

The species name is Latin meaning erect.

Hippocampus erectus Perry, 1810, pl. XLV American seas

Hippocampus hudsonius DeKay, 1842: 322 Hudson River



NORTHERN PIPEFISH

Syngnathus fuscus Storer, 1839

Identification

The pipefish looks first like a piece of twig and second like a straightened-out seahorse. Its body is long and slender but stiff, because it is encased in bony rings: 10 on the trunk and 35 to 38 on the tail. It is polygonal in cross section because there are keel-like ridges running along the body and tail. Its strongly oblique mouth is tiny and at the end of an elongate face. Pipefishes have no pelvic fins but they do have well-developed pectoral and dorsal fins (with 13 or 14 and 33 to 49 rays, respectively). There is a conspicuous caudal fin and a minute anal fin that lies just behind the vent. In males, the anal fin is within the egg pouch located on the ventral side of the first 15 tail rings.

Occurrence

This species, which ranges from Prince Edward Island to Jupiter Inlet in Florida, is reasonably common in the Hudson at least as far north as Indian Point.

Notes

The Survey found males from Haverstraw Bay with eggs in their brood pouches on 25 August. On 16 July 1936, males with eyed eggs were taken at the mouth of a stream in Mamaroneck.

References

Dawson, 1982 (general account).

Names

The species name, *fuscus* is the Latin word for brown, dark, or dusky.

Syngnathus typhle (not of Linnaeus), Mitchill, 1814: 475 New York

Syngnathus peckii Storer, 1839: 162 (nomen nudum)

Syngnathus fuscus Storer, 1839: 162 Massachusetts

Syngnathus peckianus Storer, 1839: 163 Woods Hole

Syngnathus fasciatus (not of Risso, 1818), DeKay, 1842: 319

Syngnathus viridescens DeKay, 1842: 321

Syngnathus pechianus, DeKay, 1842: 321 (misspelling)

Syngnathus DeKayi Dumeril, 1870: 568-569 (replacement for *S. fasciatus* DeKay, preoccupied)

Syngnathus Milbertianus Dumeril, 1870: 568,573 (replacement name for New York specimens of *S. fasciatus* Kaup)

Syngnathus peckianus, Ayres, 1843: 282 Long Island Sound

Siphostoma fuscum Bean, 1903: 347-472

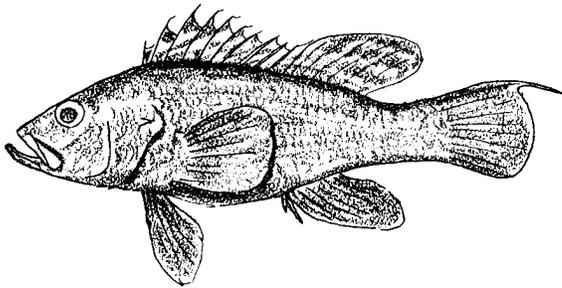
Syrictes fuscus Breder, 1938: 26,28 Lower Hudson

Syngnathus pekianus, Greeley, 1937: 98 Lower Hudson (misspelling)

SEA BASSES

SERRANIDAE

The sea basses are often considered to be the typical spiny-rayed fishes. They have thoracic pelvic fins and a single dorsal fin with 9 to 11 spines and no, or a very shallow, notch between the spines and rays. There are 3 anal fin spines and 9 or 10 anal rays. The maxillary is exposed, that is, it is not covered by the preorbital bone when the mouth is closed. Most sea basses are tropical but a few live in temperate waters. The family includes the giant groupers as well as a large number of smaller species. Many, including some populations of the black sea bass, are hermaphroditic, beginning life as females and transforming to males after they have spawned as females. Other sea basses are male and female at the same time. At present, about 370 species are placed here but their relationships are poorly understood.



BLACK SEA BASS

Centropristis striata (Linnaeus, 1758)

Identification

The black sea bass is a rather somber fish with the spiny and soft parts of the dorsal fin continuous. The caudal fin of adults is distinctive; there is a short filament at the upper corner. Smaller teeth and 10 spines in the dorsal fin serve to differentiate the black sea bass from the blackfish (tautog), which has 16 or 17 spines and 7 or 8 soft rays in its dorsal fin. Adult sea bass are nearly black with pale gray centers on the scales and a white margin on the tail. Older males develop a pronounced hump behind the head. The pelvic fins are large and originate in front of the pectorals, which are high on the sides and have vertical bases.

Occurrence

The black sea bass apparently has not been reported from the Hudson River above the George Washington Bridge, but it has been taken in the Arthur Kill and in New York Harbor.

Notes

Black sea bass are protogynous hermaphrodites. They begin life as females and transform into males after they have spawned as females.

References

Kendall, 1972, 1979 (larvae). Bigelow and Schroeder, 1953b (general summary). Briggs, 1960 (nomenclature).

Names

Striatus is New Latin for striped.

Labrus striatus Linnaeus, 1758: 285 America

Perca fulva Walbaum, 1792: 336 New York (after Schoepf)

Coryphaena nigrescens Bloch and Schneider, 1801: 297 New York

Perca varia Mitchill, 1815: 415 New York

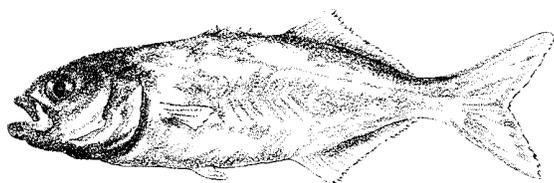
Centropristes striatus, Bigelow and Schroeder, 1953b: 407-409

Centropristis striata, Briggs, 1960: 358 (correct spelling of name)

BLUEFISHES

POMATOMIDAE

This is a small family of about three species. They occur worldwide in tropical and temperate oceans. The bluefish is a silvery, streamlined, spiny-rayed fish with small scales, a rather small spiny dorsal fin, and a long soft dorsal. The preopercle has a flap that overlaps the operculum. Bluefish have very efficient jaw teeth and are legendary for their voraciousness.



BLUEFISH

Pomatomus saltatrix (Linnaeus, 1758)

Identification

Bluefish are overall silvery with a bluish or greenish cast dorsally and a black, smudge-like spot at the base of the pectoral fin. The body is compressed and moderately elongate with a deeply forked tail and a rather deep caudal peduncle. The spiny dorsal fin has 7 or 8 short spines, the second dorsal has 23 to 26 soft rays, and the anal has 2 very short spines that are separated from the rest of the fin which has one spine and 25 to 27 rays. The bluefish is remarkable for its teeth. The jaws are armed with a single series of flattened, pointed teeth and there are patches of fine villiform teeth on the floor of the mouth between the ends of the gill slits. Bluefish have small deciduous scales and the bases of the dorsal and anal fins are densely scaled. Its lateral line is nearly straight.

Occurrence

Snapper blues (juveniles up to 10 inches long) are quite common in the Lower Hudson each summer and larger fish are sometimes found as far upstream as Haverstraw Bay.

Notes

Bluefish are notorious carnivores and are said to feed on smaller fishes, often continuing to strike

and slash after their stomachs are full. Apparently, bluefish winter off Florida and return to the New York area each April or May.

References

Bigelow and Schroeder, 1953b (general account).
Lund, 1961 (races). Kendall and Walford, 1979 (distribution of larvae). Richards, 1976 (age and growth).

Names

Saltatrix comes from the Latin *salto*, to dance, and means dancing girl.

Perca saltatrix Linnaeus, 1758: 293 Carolinas

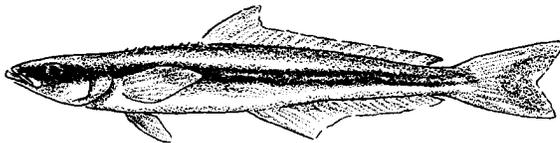
Temnodon saltator DeKay, 1842: 130-132

Pomatomus saltatrix, Greeley, 1937: 100 Lower Hudson

COBIAS

RACHYCENTRIDAE

The cobia is placed in its own family which is usually considered closely related to the remoras to which it bears a remarkable resemblance except that it does not have the suctorial modification of the dorsal fin. It has rather small smooth scales and its dorsal spines are short and not connected by membrane. It occurs in the Atlantic, Pacific, and Indian Oceans.



COBIA

Rachycentron canadum (Linnaeus, 1766)

Identification

The cobia is a rugged, heavy-bodied, elongate fish with a projecting lower jaw and a broad flat head. The spiny dorsal consists of a series of short, stout spines that are not connected by membrane. The second dorsal has one spine and about 30 rays, with a blunt lobe anteriorly. The anal is also long and contains 1 spine and about 23 rays. The tail is forked in adults but pointed in juveniles less than 4 or 5 inches long.

Cobias are grayish brown, paler below, with a broad, dark, lateral stripe from the tip of the snout to the base of the tail. A lighter stripe above this sets it off from the darker middorsal region. In shape and coloration, this species bears a remarkable resemblance to the sharksucker, *Echeneis naucrates*.

Occurrence

The cobia is a widespread species sought as a game fish along our southern Atlantic and gulf coasts. It is included in the inland fauna on the basis of a single specimen, a 95-mm juvenile collected in Croton River Cove about 1 mile north of Sing Sing in June 1876.

Notes

This is a circumtropical species. The IGFA all-tackle

record is a 110-pound 5-ounce fish from Mombasa, Kenya.

References

Fisher, 1891 (Hudson River). Bigelow and Schroeder, 1953b (general account).

Names

Jordan and Evermann point out that the name is for Canada where the species is not found.

Gasterosteus canadus Linnaeus, 1766: 491 Carolinas

Centronotus spinosus Mitchill, 1815: 490-492 New York

Elecate atlantica Cuvier in Cuvier and Valenciennes, 1834: 334

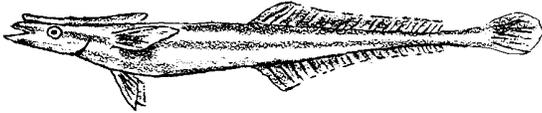
Elecate canada, Fisher, 1891: 195 Hudson River

Rachycentron canadum, Greeley, 1937: 100 Lower Hudson

REMORAS

ECHENEIDAE

Remoras are highly specialized fishes that have the first dorsal fin modified into a sucking disk with which they attach to other fish and sometimes to boats and swimmers. Some species are host-specific and found only on certain whales, but the sharksucker is less particular and sometimes clings to boats or swimmers. The family is currently divided into seven genera and seven or eight species. They are circumtropical in warm and temperate seas.



SHARKSUCKER

Echeneis naucrates
Linnaeus, 1758

Identification

The sharksucker is a slender terete fish with a pointed to lunate tail (sharper in young), long symmetrical dorsal and anal fins, and a conspicuously projecting lower jaw. Its most outstanding characteristic is the sucking disk on top of the head. This is an oval structure with about 20 pairs of transverse plates that suggest a venetian blind. This disk is a modified dorsal fin.

Other remoras occur off our coast but they have shorter disks and lack the bold, striped pattern of the sharksucker. In the present species, there is a broad dark lateral stripe from the snout through the eye and the base of the pectoral fin to the tail. White stripes above and below this midlateral stripe separate it from the dark pigment of the belly and the back. There are white corners on the tail that contrast sharply with its otherwise dark color.

Occurrence

Allen Beebe has called my attention to an old record of the sharksucker in the Hudson River. DeKay (1842) mentions one that "had ascended a considerable distance up the Hudson River."

Notes

If this species still enters the river, it must do so only rarely, because there are no recent records. Although the sharksucker leaves its host for extended periods, it is unlikely that it would ascend far up the river by itself. Hence, its presence would depend upon larger fish, especially sharks.

References

Cressy and Lachner, 1970 (hosts and food habits).
Maul, 1956 (systematics).

Names

Naucrates is Latin for pilot, from the Greek *naus*, a ship, and *krates*, to guide.

Echeneis naucrates Linnaeus, 1758: 261 (misprint for *naucrates*)

Echeneis albicauda Mitchill: 1817: 244 New York

JACKS

CARANGIDAE

Jacks are a rather diverse family of fast-swimming marine species with a few species that spend part of the year in brackish water. They are spiny-rayed fishes with the the first two anal spines separated from the rest of the anal fin. Most jacks are strongly compressed, silvery fishes with deeply forked tails

and some enlarged scales (scutes) along the lateral line. Some are quite bizarre in their shapes. The family also includes the somewhat less-specialized amberjacks which are more torpedo-shaped and lack the lateral line scutes. There are about 24 genera and 200 species.

KEY TO THE SPECIES OF JACKS IN THE INLAND WATERS OF NEW YORK

A. Lateral line with a series of greatly enlarged scutes on its posterior part. Back and belly rounded.

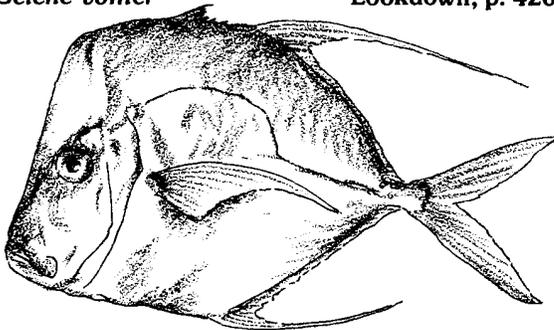
C.

A'. Lateral line without greatly enlarged scutes. Caudal peduncle may have a few slightly enlarged scales along the lateral line. Back and belly sharp edged.

B. Second dorsal and anal fins with high lobes in front. Caudal peduncle without enlarged scales in the lateral line.

Selene vomer

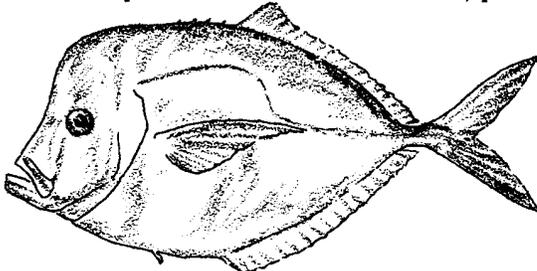
Lookdown, p. 426



B'. Second dorsal and anal fins without high lobes. Lateral line on caudal peduncle with slightly enlarged scales.

Selene setapinnis

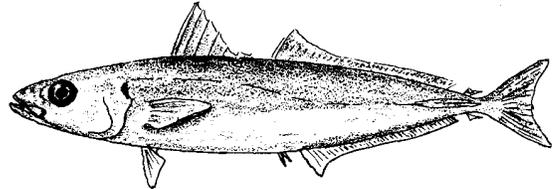
Atlantic moonfish, p. 425



C. (A. Lateral line with enlarged scutes.) Last rays of dorsal and anal fin detached as separate finlets. Lateral line with about 30 scutes on the caudal peduncle.

*Decapterus macarellus**

Mackerel scad

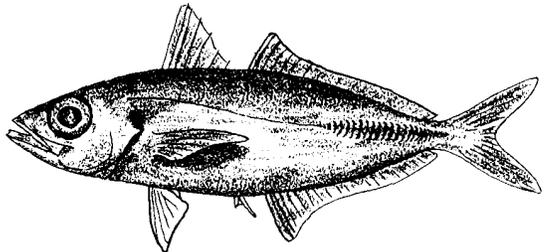


C'. No detached finlets behind dorsal and anal fins.

D. Shoulder girdle (under gill cover and behind the gills) with a deep transverse furrow near its ventral end and a fleshy knob above this. Body rather elongate and forehead sloping, only moderately steep.

*Selar crumenophthalmus**

Bigeye scad



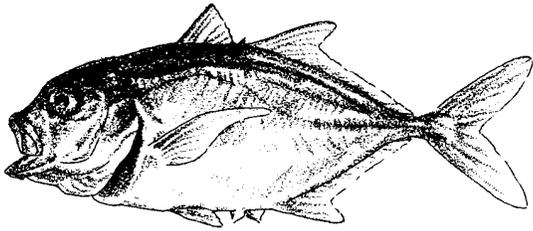
D'. Shoulder girdle without transverse furrow and

*The presence of the mackerel scad and/or the bigeye scad has not been verified and these species are not treated here.

fleshy knob. Body deep, compressed, the forehead very steep.

Caranx hippos

Crevalle jack, p. 425



CREVALLE JACK

Caranx hippos (Linnaeus, 1766)

Identification

The crevalle jack is a highly compressed fish with a blunt face, a deeply forked tail, and an extremely slender caudal peduncle with strong scutes (modified, plate-like scales) along the posterior part of the lateral line. Its pectoral fin is long and scythe shaped. It has a large black spot at the upper corner of the gill cover and another on the upper pectoral fin rays. The shape of the crevalle jack is distinctive and it can be separated from similar species that might stray into our area by the lack of scales on its breast.

Occurrence

Crevalle jacks are common summer residents of the Lower Hudson. Mr. Tom Lake has informed me that in 1982 they were especially abundant as far upstream as River Mile 68 in early October and were still present at River Mile 66 in early November.

References

Ginsburg, 1952b (systematics). Lake, 1982 (sport fishery in Hudson River).

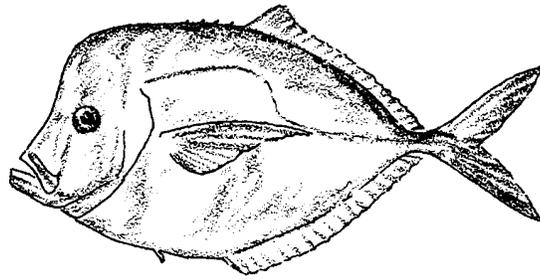
Names

Hippos is Greek for horse.

Scomber hippos Linnaeus, 1766: 494 Charleston, South Carolina

Caranx defensor DeKay, 1842:120 New York

Caranx hippos, Greeley, 1937:100 Haverstraw Bay



ATLANTIC MOONFISH

Selene setapinnis (Mitchill, 1815)

Identification

The moonfish rather resembles the lookdown in that both species are deep-bodied, highly compressed fishes with deeply forked tails and slender caudal peduncles. The moonfish is not quite as deep bodied as the lookdown, however, and it lacks the high lobes at the front of the dorsal and anal fins although the anterior rays of those fins are slightly longer than the rest of the rays. The moonfish also has small scutes along the posterior straight part of the lateral line. Scutes are not present in the lookdown and they are much larger in all of the other species of jacks in our area. Like the lookdown, the moonfish has a very small spiny dorsal fin and minute pelvics. Its facial profile is somewhat concave and the part above the eye is nearly vertical.

Occurrence

The moonfish ranges from Cape Cod to Uruguay and occasionally strays to Nova Scotia. It is, however, a fish of warmer waters and is not common north of Chesapeake Bay. Allen Beebe reports that there is a specimen in the New York State Museum from River Mile 15.

References

Ginsburg, 1952b (systematics). Bigelow and Schroeder, 1953b: 378-379 (general account).

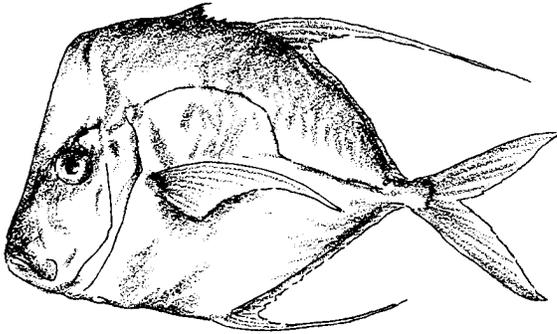
Names

Setapinnis is from Latin *seta*, bristle, and *pinna*, a wing or fin.

Zeus setapinnis Mitchill, 1815: 384-385 New York

Vomer brownii Cuvier in Cuvier and Valenciennes, 1833: 189 New York

Vomer setapinnis, Ginsburg, 1952b: 109-112



LOOKDOWN

Selene vomer (Linnaeus, 1758)

Identification

The lookdown is one of the more improbable fishes. Its body is short and very deep, almost diamond shaped and extremely compressed. The front of the head is nearly vertical. The anterior rays of both the dorsal and the anal fins extend into long slender lobes. The first dorsal fin is very small and the pelvic fins are tiny in adults although in the juveniles they are prolonged into filaments that are longer than the body. The anterior half of the lateral line is arched and the posterior half is quite straight. Unlike other jacks in our area there are no scutes along the lateral line.

Occurrence

Lookdowns are much more common south of Chesapeake Bay, but they occasionally are found as far north as Cape Cod. It has been recorded several times from the Hudson River as far north as Indian Point (River Mile 42).

References

Ginsburg, 1952b (systematics). Aleveras, 1973 (Hudson River).

Names

Vomer is Latin for plowshare, an obvious reference to the shape of the lookdown.

Zeus vomer Linnaeus, 1758: 266 America

Argyreiosus vomer, DeKay, 1842: 124-125 New York

Zeus capillaris Mitchill, 1815: 383 New York

Zeus rostratus Mitchill, 1815: 384 New York

Zeus geometricus Mitchill, 1818a: 245 New York

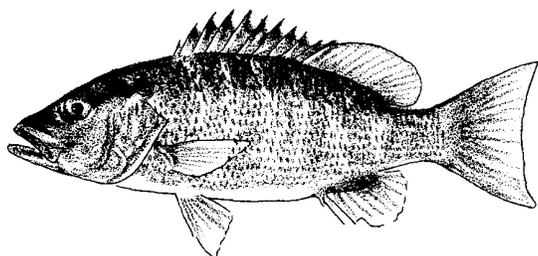
Argyriosus mitchilli DeKay, 1842: 126 New York

SNAPPERS

LUTJANIDAE

The snappers are closely related to the sea basses but they differ in having most of the maxillary covered by the preorbital region when the mouth is closed. Members of the genus *Lutjanus* have a characteristic shape and large canine teeth near the tip of the upper jaw. The rest of the teeth are villiform or caniniform.

Snappers are a tropical family but one species occasionally strays into the Lower Hudson. Worldwide, there are more than 230 species.



GRAY SNAPPER

Lutjanus griseus (Linnaeus, 1758)

Identification

Snappers are bass-like marine fishes with a rather pointed head (at least in this genus), 10 or 11 dorsal spines, and the maxillary bone almost hidden by suborbital bones when the mouth is closed. The upper jaw has strong canine teeth anteriorly. The dorsal fin is continuous with only a shallow notch between the spines and rays. The preopercle is finely serrated with a notch above its angle that receives a point of the subopercular bone. There are three spines and seven rays in the anal fin.

The general color of the gray snapper is indeed gray, often with purplish or reddish-brown overtones. The scales of the upper sides are spotted and these spots form definite longitudinal lines. There is a prominent bar from the tip of the snout through the eye to just below the origin of the dorsal fin. The margin of the dorsal is black as far back as the middle of the soft dorsal. The caudal and anal fins have dusky margins with a narrow white edge. In small specimens, there is a narrow pale blue line (dark in preserved specimens) from the center of the upper jaw to the point of the operculum and another be-

low this from the upper jaw to below the rear margin of the eye.

Occurrence

The gray snapper has a planktonic larval stage and occasionally the young drift as far north as the New York Bight. Records from the Hudson River include a juvenile from near Tarrytown (Boyle, 1969), one specimen collected by LMS at Bowline Pond, and three collected by Texas Instruments (two from River Mile 42 and one from River Mile 28).

References

Starck and Schroeder, 1970 (life history and food habits).

Names

Griseus is a Middle Latin word meaning gray.

Labrus griseus Linnaeus, 1758: 283 Carolinas (after Catesby)

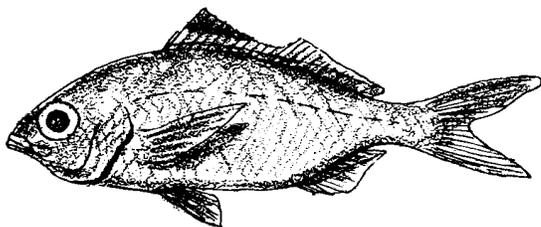
Neomanis griseus, Bean, 1903: 548-550 New York

Lutjanus griseus, Boyle, 1969: 229-230 Hudson River

MOJARRAS

GERREIDAE

Mojarras are also tropical fishes but one or two species occasionally stray into the Hudson Estuary. They are rather diamond-shaped, silvery fishes with smooth scales. The head is scaled and there are pronounced scaly sheaths along the bases of the dorsal and anal fins. Their outstanding characteristic is the mouth, which can be extended into a short tube. The lower jaw has a distinctive concave profile. This is a small group of about 40 species.



SPOTFIN MOJARRA

Eucinostomus argenteus
Baird, 1855

Identification

The outstanding feature of the mojarra is its mouth, which can be extended downward and forward into a tube. Mojarras are rather silvery, diamond-shaped fishes with strong anal spines and moderately forked tails. The dorsal fin is single with the spines becoming progressively shorter and the last spine is considerably shorter than the first soft ray. There are scaly sheaths along the bases of the dorsal and anal fins and a large pelvic axillary process. In the spotfin mojarra, there is a scaleless groove on top of the snout; the head is otherwise covered with scales. This species is somewhat more slender than some other species of mojarras and has a conspicuous black blotch on the anterior part of the dorsal fin. There are traces of inclined, irregular bars on the upper sides of the body.

Occurrence

Mojarras are tropical species and only a few juvenile specimens have been taken in the Lower Hudson at Bowline Pond and Indian Point.

Notes

Mojarras are distinctive fishes but the species are difficult to distinguish especially when they are small. The identification of this species is accepted with reservation. Although they are tropical, the type of *E. argenteus* was collected in New Jersey.

Hubbs and Miller noted that although the description of the species *argenteus* is usually attributed to Baird and Girard, it is clear that Baird alone is the describer.

References

Bohlke and Chaplin, 1968: 394 (identification).
Hubbs and Miller, 1965 (nomenclature).

Names

Argenteus is Latin for silvery.

Eucinostomus argenteus Baird, 1855: 335 Beesleys Point, New Jersey

PORGIES

SPARIDAE

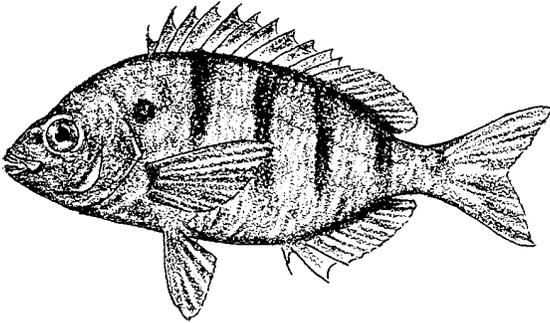
The porgies are also a family of about 100 species of rather typical spiny-rayed fishes. Porgies characteristically have a rather deep head which gives them a distinctive, somewhat vacuous look. The anterior teeth of the lower jaw are chisel-like, while those at the back of the jaw are molar-like. Some species are hermaphroditic.

KEY TO THE SPECIES OF PORGIES IN NEW YORK

A. Front teeth deeply notched. Color pattern consisting of a prominent spot behind the gill covers followed by four or five vertical, dark bands, each narrower than the interspaces.

Lagodon rhomboides

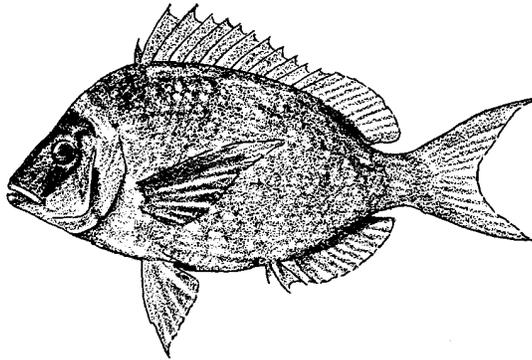
Pinfish, p. 429



A'. Front teeth not notched. Color pattern plain in the adults, young with about six vague dark cross-bars. No prominent spot behind the gill covers.

Stenotomus chrysops

Scup, p. 430



PINFISH

Lagodon rhomboides (Linnaeus, 1766)

Identification

The pinfish is a rather deep-bodied, compressed fish with a long dorsal fin and a moderately forked tail. The mouth is low and almost horizontal and the dorsal profile is highly arched. The premaxillaries are protractile and the maxillary is almost covered by the suborbital region when the mouth is closed. There are three anal spines.

The teeth at the front of the jaw of the pinfish are flat and chisel-like with a deep notch in each. There are eight incisors followed by a double row of blunt molariform teeth on the sides of the jaws.

Pinfish are dusky greenish, shading to silvery ventrally with four to six darker crossbars. There is a conspicuous round dark spot nearly as large as the eye behind the gill openings. In life, the body has narrow light blue and yellow longitudinal lines.

Occurrence

The pinfish is another tropical stray that occasionally makes its way into the Hudson Estuary. Bath et al. (1977) list it from the Hudson, and Mr. Allen Beebe has informed me that this record is based on a specimen collected at Tompkins Cove 15 September 1969.

References

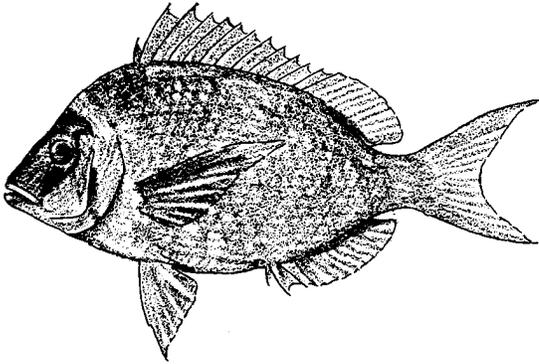
Caldwell, 1957 (life history). Hildebrand and Cable, 1938 (development). Stoner, 1980 (feeding ecology). Hansen, 1969 (ecology). Kjelson and Johnson, 1976 (feeding ecology of young).

Names

Rhomboides probably refers to the shape of the body but it comes from a Greek word *rhombos*, which means whorling or turning.

Sparus rhomboides Linnaeus, 1766: 470-471
Charleston, South Carolina

Lagodon rhomboides, Holbrook, 1855: 56
Charleston, South Carolina



SCUP

Stenotomus chrysops (Linnaeus, 1766)

Identification

Although the scup resembles the pinfish in general appearance, its back is even more highly arched and its incisor teeth are not notched. The scup is plain bluish silvery above, sometimes with a pinkish cast, and silvery white below. There is no spot behind the gill opening although the axil of the pectoral fin is dark. Young scup sometimes have a few dusky crossbars.

Occurrence

Scup are rather common along the coast where they are a valued sport and food fish. Allen Beebe (M.S.) lists two specimens, one from River Mile 29, the other from River Mile 31, both taken on 26 July 1976.

References

Bigelow and Schroeder, 1953b: 411-416 (general account). Finkelstein, 1969a (life history); 1969b (age at maturity). Briggs, 1968 (sport fishery).

Names

Chrysops is from the Greek *chrysos*, gold and *ops*, eye.

Sparus chrysops Linnaeus, 1766: 471 Charleston, South Carolina

Labrus versicolor Mitchill, 1815: 404 New York

Sargus ambassis Gunther, 1859: 449-452 New York

DRUMS

SCIAENIDAE

This family includes a large number of species that live in marine and estuarine habitats and on the continental slopes. Most of the species live in temperate waters but a few are found in the tropics. There is one truly freshwater drum in our area.

Most drums have highly specialized swim bladders that serve as sound-producing organs, and this has led to the common name of croakers. The kingfish, however, has lost the ability to produce sound

and, in fact, its swim bladder disappears as it reaches adulthood.

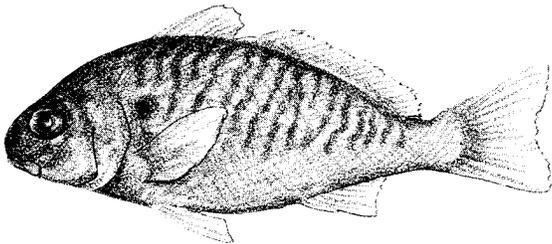
Drums characteristically have the soft dorsal longer than the spiny dorsal and two spines in the anal fin. The lateral line continues out to the tip of the caudal fin rays, and some species have pointed tails. They also have very large sensory canals on the head.

KEY TO THE SPECIES OF DRUMS IN NEW YORK

A. A conspicuous dark spot behind the upper part of the gill opening. Upper sides with 12 or more narrow, dark, not quite vertical lines.

Leiostomus xanthurus

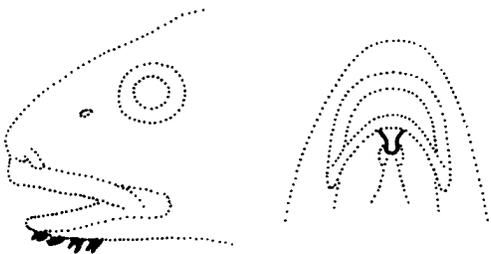
Spot, p. 433



A'. No dark spot behind the gill openings and no dark vertical bars, except that some species have more or less distinct broad saddle-shaped marks or rows of spots that tend to form vertical lines.

B. Lower jaw without barbels.

B'. Lower jaw with one or more barbels.

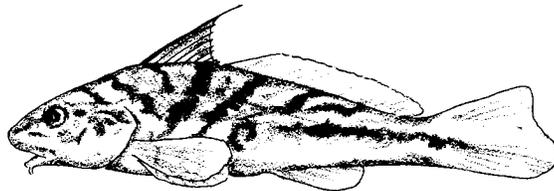


Barbels of croaker (left) and kingfish.

C. Lower jaw with a single prominent peg-like barbel at the front.

Menticirrhus saxatilis

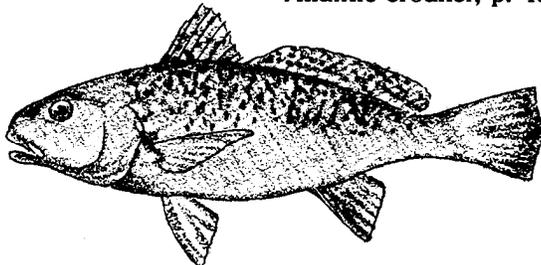
Northern kingfish, p. 434



C'. Lower jaw with a row of small but distinct barbels on each side.

Micropogonias undulatus

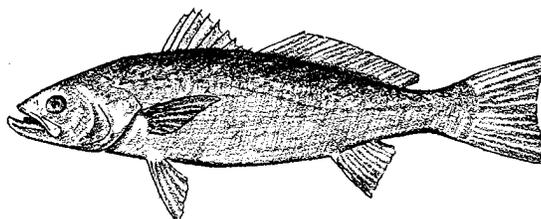
Atlantic croaker, p. 434

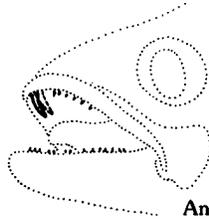


D. (B. No barbels.) Upper jaw with two large canine teeth at the front

Cynoscion regalis

Weakfish, p. 433



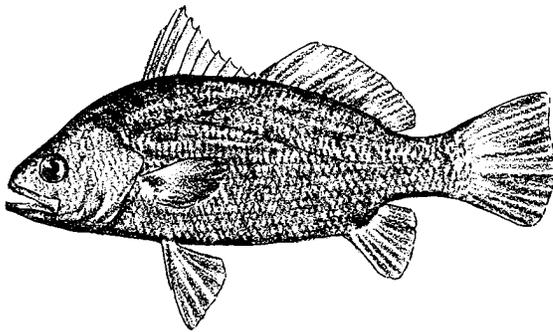


Anterior canines of weakfish.

D'. No large canine teeth at the front of the upper jaw.

E. Dorsal spines 11 or 12, dorsal soft rays 19 to 21. Mouth terminal. Marine, entering Hudson Estuary.

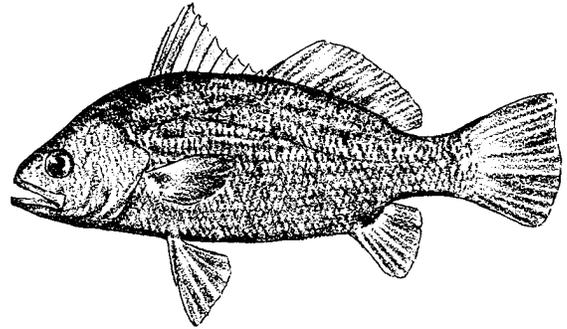
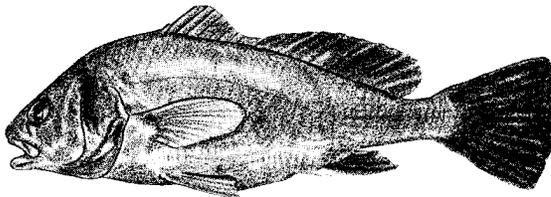
Bairdiella chrysoura Silver perch, p. 432



E'. Dorsal spines 8 or 9, dorsal soft rays 24 to 32. Mouth subterminal, the snout projecting beyond the upper jaw. Fresh water.

Aplodinotus grunniens

Freshwater drum, p. 351



SILVER PERCH

Bairdiella chrysoura
(Lacepède, 1803)

Identification

In general appearance, the silver perch most resembles the freshwater drum, *Aplodinotus grunniens*, in shape, in lacking barbels, and in the size and position of the mouth. The silver perch, however, differs from the freshwater drum in that the snout is shorter so that it does not overhang the mouth, in having a serrate preopercle, and in having a shorter second dorsal fin (19 to 21 rays in the silver perch, 27 to 33 in the freshwater drum).

Occurrence

Juvenile silver perch are not uncommon in the Hudson in the summer, and they have been collected at Indian Point by Texas Instruments.

Notes

In this genus and its near relatives, the swim bladder is divided into two chambers by a constriction. The anterior one is transversely elongate; the posterior is a simple tapering shape.

References

Chao, 1978 (systematics). Kuntz, 1914a (embryology). Welsch and Breder, 1923 (life history). Hildebrand and Cable, 1930 (development). Powles, 1980 (larvae). Chao and Musick, 1977 (ecology of juveniles).

Names

The species name is from the Greek *chrysos*, gold, and *oura*, tail.

Perca punctatus Linnaeus, 1766: 482 South Carolina (preoccupied)

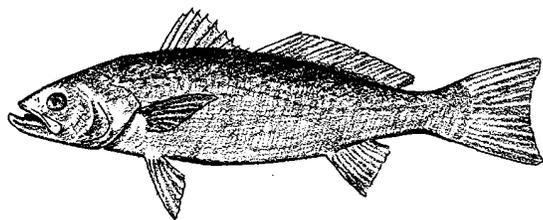
Dipterodon chrysourus Lacepède, 1803: 166 South Carolina

Bodianus argyro-leucas Mitchill, 1815: 417 New York

Bodianus exiguus Mitchill, 1815: 419 New York

Bodianus pallidus Mitchill, 1815: 420 New York

Corvina argyroleuca, DeKay, 1842: 74 New York



WEAKFISH

Cynoscion regalis (Bloch and Schneider, 1801)

Identification

The weakfish is rather long and slender for a drum and that is probably why some members of the genus are called sea trout. There are no barbels and the mouth is large and somewhat oblique with a pair of large canine teeth, at least twice as large as the other teeth, at the tip of the upper jaw. The preopercle is not serrated. The anterior and posterior dorsal fins are separate but close together. Weakfish have ctenoid scales and the scales extend onto the basal one-third of the second dorsal and anal fins. There are 11 or 12 anal soft rays and the pectoral fins are longer than the pelvics. The weakfish and their close allies are characterized by having the swim bladder with a pair of anterolateral diverticula tapering forward from the anterior corners of the main chamber to the back of the skull. Weakfish are gray above and silvery below with small spots forming wavy oblique lines on the upper sides. The tail is pointed in juveniles but becomes emarginate or lunate in adults.

Occurrence

The weakfish is a common summer resident in the Lower Hudson, where it has been taken as far north as Indian Point. Boyle reported it from Haverstraw Bay. It was not listed by the 1936 Survey.

References

Welsch and Breder, 1923 (life history). Chao, 1978 (systematics). Pearson, 1941 (ecology of young). Merriner, 1975 (food); 1976 (reproductive biology). Perlmutter, 1953 (summary). Perlmutter, Miller, and Poole, 1956 (ecology). Nesbit, 1939 (ecology, fishery). Massmann, 1963 (annulus formation). Hildebrand and Cable, 1934 (reproduction). Chao and Musick, 1977 (ecology of juveniles). Boyle, 1969 (Hudson River).

Names

Regalis is Latin for royal.

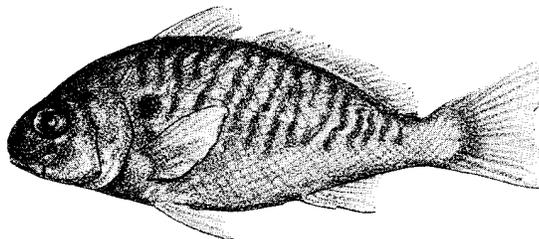
Johnius regalis Bloch and Schneider, 1801: 75 New York

Otolithus regalis DeKay, 1842: 71-72 New York

Roccus comes Mitchill, 1814: 25-26 New York

Labrus squeteague Mitchill, 1815: 396-398 New York

Cynoscion regalis Boyle, 1969



SPOT

Leiostomus xanthurus Lacepède, 1802

Identification

The spot is a rather small, compressed fish with the dorsal profile strongly arched and the ventral outline nearly straight. There are no barbels and the mouth is small, almost horizontal, and slightly overhung by the snout. The body is silvery with faint oblique bars on the upper sides and a pronounced black spot above the upper angle of the gill opening. The teeth are small and those of the lower jaw become obsolescent in adults. The dorsal fins are continuous, the first rather high with 10 spines. The tail is square in young and concave in adults.

Occurrence

The spot has a wide distribution in the Northwestern Atlantic in coastal and estuarine waters. Some years, it is quite common in the Hudson at least as far north as Haverstraw Bay.

Notes

The spot is commonly called Lafayette in our area. According to Boyle, this name came about because there was a great run of them in the river when General Lafayette visited New York in 1824. They were said to have been absent for many years; then they became quite abundant in the summer of 1975.

References

Chao, 1978: 29 (systematics). Boyle, 1969 (presence in Hudson River). Welsch and Breder, 1923 (life history). Hildebrand and Cable, 1930 (development). Kjelson and Johnson, 1976 (feeding ecology). Pacheco, 1962 (age and growth in Chesapeake Bay). Chao and Musick, 1977 (life history).

Names

Xanthurus is from the Greek, *xanthos*, yellow and *oura*, tail.

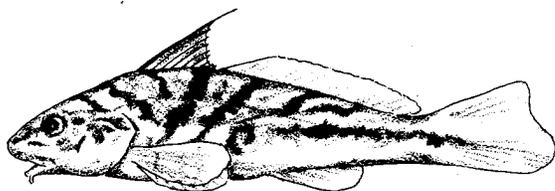
Leiostomus xanthurus Lacepède, 1802: 439 Carolina (Types in the MNHN, Paris.)

Mugil obliquus Mitchill, 1815: 405 New York

Leiostomus obliquus, DeKay, 1842: 69-70 New York

Leiostomus humeralis Cuvier in Cuvier and Valenciennes, 1830: 105 New York (Types in the MNHN, Paris.)

Leiostomus xanthurus, Greeley, 1937: 103 Lower Hudson



NORTHERN KINGFISH

Menticirrhus saxatilis
(Bloch and Schneider, 1801)

Identification

The kingfish is a rangy, elongate fish with a single stout peg-like barbel at the tip of the chin. The anal fin has a single spine and eight soft rays, and the swim bladder is absent or rudimentary in adults. In this species, the third dorsal spine is prolonged into a filament that reaches well beyond the origin of the second dorsal. The caudal fin is asymmetrical, with the upper lobe angular and the lower lobe rounded. The upper jaw is longer than the lower and the snout overhangs the mouth. There are no canine teeth.

The northern kingfish is a boldly marked species, dark gray above and silvery below, with irregular dark crossbars. The first slopes downward and backward, the rest slope downward and forward so there is a V-shaped configuration on the body below the dorsal fin. Usually, there is a dark longitudinal streak below the lateral line posteriorly.

Occurrence

The northern kingfish occurs along the Atlantic and Gulf coasts to Yucatan, Mexico. There are a few records of juveniles as far upstream as Croton Bay (Beebe, M.S.).

Notes

Unlike other sciaenids, members of this genus lack sonic muscles.

References

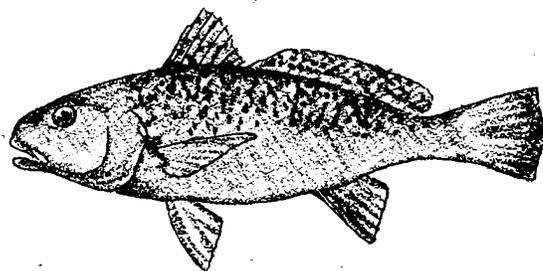
Chao, 1978: 31 (systematics). Schaefer, 1965a (age and growth); 1965b (swim bladder present in juveniles). Chao and Musick, 1977 (ecology of juveniles). Welsch and Breder, 1923 (life history).

Names

Saxatilis is Latin, meaning dwelling among rocks.

Johnius saxatilis Bloch and Schneider, 1801: 75. New York. (The holotype is a stuffed skin in the Humboldt-Universität, Berlin.)

Sciaena nebulosa Mitchill, 1815: 408-409 New York



ATLANTIC CROAKER

Micropogonias undulatus
(Linnaeus, 1766)

Identification

This species somewhat resembles the kingfish and the weakfish but, unlike them, it has a row of small barbels along the inside edge of each side of the lower jaw. It also has strong serrations on the preopercle. There are 50 to 56 pored scales in the lateral line and 2 anal spines. The body is silvery with a pinkish cast in life and the back has numerous brassy or brownish spots arranged in rows to form oblique wavy lines. The young are merely spotted.

The swim bladder of this species is highly specialized, this no doubt associated with its well-known ability to produce croaking sounds. There are slender diverticula, one on each side, arising near the middle of the swim bladder and curving forward. The posterior end of the swim bladder tapers to a tail-like point. The lateral diverticula extend forward as far as the transverse septum but do not reach the skull before curving backward again toward the front of the swim bladder.

Occurrence

Small croakers, most less than 21 mm standard length, were collected between River Miles 29 and 38 by Texas Instruments personnel in 1973 and 1976.

Notes

This species has long been known as *Micropogon undulatus*, but Chao noted that the genus *Micropogon* is preoccupied in birds and that Bonaparte proposed *Micropogonias* as a substitute name in 1831.

References

Chao, 1978 (systematics and anatomy). Morse, 1980a (reproduction). Hansen, 1969 (ecology). White and Chittenden, 1977 (age and growth). Chao and Musick, 1977 (juvenile ecology). Welsch and Breder, 1923 (life history). Hildebrand and Cable, 1930 (development).

Names

The name *undulatus* is the Latin word for wavy, in reference to the color pattern.

Perca undulata Linnaeus, 1766: 483 South Carolina

Bodianus costatus Mitchill, 1815: 417-418 New York

Micropogon lineatus Cuvier in Cuvier and Valenciennes, 1830: 160 New York

Micropogon undulatus, Bath et al., 1977: 4 Hudson River

WRASSES

LABRIDAE

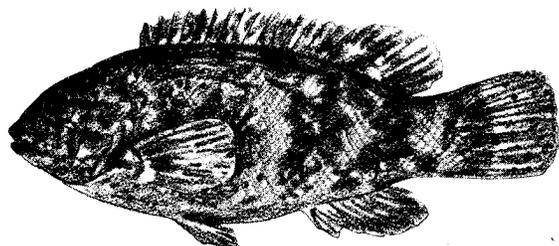
The wrasses are essentially a tropical family with a few species in temperate waters. They have a single dorsal fin with more spines than rays, and they are characterized by their dentition which includes both caniniform teeth in the jaws and molariform teeth on the pharyngeal bones which are fused into a single solid, triangular plate. The family is extremely diverse and contains about 400 species.

KEY TO THE SPECIES OF WRASSES IN NEW YORK

A. Scales small, about 70 in lateral line. Margin of preopercle smooth, without dentations. Cheeks and gill covers with only a few scales. Forehead profile steep.

Tautoga onitis

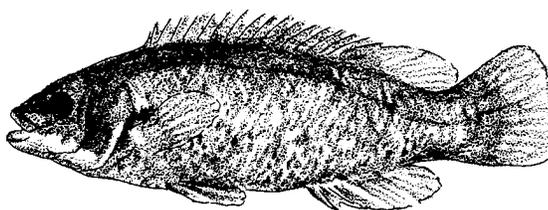
Tautog, p. 435



A'. Scales larger, about 40 in lateral line. Margin of preopercle serrated. Cheeks and opercles nearly covered with scales. Head pointed, profile of forehead not so steep.

Tautoglabrus adspersus

Cunner, p. 436



TAUTOG

Tautoga onitis (Linnaeus, 1758)

Identification

The tautog is a rather rectangular fish with a deep, moderately compressed body, a steep forehead, and a single long dorsal fin with 16 to 18 spines and 11 rays. The tail is rounded with only 12 branched rays. The pharyngeal bones of the tautog are fused and pharyngeal teeth are bluntly conical or molariform in larger specimens. The lateral line is high anteriorly and parallels the dorsal profile, then drops suddenly to the midside of the caudal peduncle.

Tautogs differ from cunners, the only other northern wrasse, in having a blunter head, deeper and more compressed body, and finer scales (about 70 in the lateral line). The cheeks and opercles of the tautog are naked or with only a few scales. The preopercular margin is smooth.

Occurrence

Tautogs have been taken in the river as far upstream as Indian Point. Mr. John Cronin has informed me that during the exceptionally dry summer of 1981 tautogs were quite common as far north as the Tappan Zee Bridge.

Notes

The tautog is a shelter-loving fish of rocky reefs. They are active during the day and quiescent at night. Individuals less than 10 inches long feed near their nocturnal homes, but larger fish may travel as much as 500 meters from their resting sites. When the temperature drops below 10 C in the fall, the large tautog move offshore but small fish become inactive in their normal shelter sites.

Tautog feed principally on blue mussels, selecting smaller shells because they are apparently unable to crush the larger ones. Tautogs are long-lived fish, some reaching as much as 34 years. At age XXII,

males averaged 548 mm; females 501 mm. Females, however, were somewhat heavier than males at the same lengths.

References

Olla, Bejda, and Martin, 1974 (activity and movements); 1975 (ecology and behavior); 1979 (dispersal and habitat selection). Olla et al., 1980 (temperature). Cooper, 1966 (migration); 1967 (age and growth). Olla and Samet, 1977 (courtship).

Names

The derivation of the species name is unexplained. *Onitis* is a kind of plant.

Labrus onitis Linnaeus, 1758: 286 (no locality)

Labrus americanus Bloch and Schneider, 1801: 261

Labrus tautoga Mitchill, 1815: 399-402 Long Island

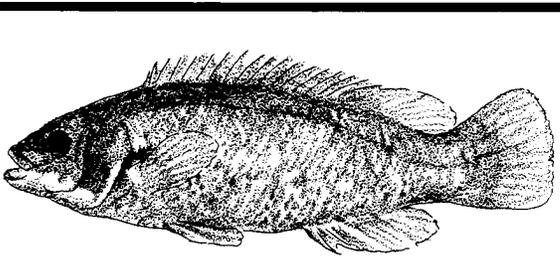
Tautoga fusca Mitchill, 1814: 24 New York

Tautoga rubens Mitchill, 1814: 24 New York

Tautoga alius Mitchill, 1814: 24 New York

Tautoga niger Mitchill, 1814: 23 New York

Tautoga americana DeKay, 1842: 175-176 New York



CUNNER

Tautogolabrus adspersus (Walbaum, 1792)

Identification

The cunner is also a wrasse with a single long dorsal fin with 16 to 18 spines and 9 to 11 soft rays. The cunner is a more elongate fish than the tautog and has a more pointed head. It also has larger scales, about 40 in the lateral line. The cheeks and opercles of the cunner are mostly scaled and the margin of the preopercle is serrated.

Occurrence

The cunner was reported from the Arthur Kill by Howells (1981) and it occasionally strays into the Hudson River. Texas Instruments personnel collected a 73-mm specimen at River Mile 42 on 29 February 1980.

Notes

The cunner is also very much a reef fish and seldom ventures more than a few meters from some shelter, be it natural outcrops or manmade structures such as wrecks, pilings, or boat docks. Cunnners are active during the day but during the hours of darkness they are quiescent and lie against objects or in crevices. In the winter, when the temperature is below 5

or 6 C, they remain inactive all the time and sometimes even become covered with a layer of silt.

Cunnners feed both on the bottom and in the water column. There is some social facilitation of feeding. One or two individuals will start to feed and the intensity of their feeding activity will increase as they are joined by others. Although they feed at various levels in the water column, cunnners tend to maintain their orientation facing into the current. Cunnners feed on a variety of organisms including mussels, isopods, microcrustaceans, barnacles, crabs, fish remains, fish eggs, and carideans, but the diet is dominated by the mussel, *Mytilus edulis*, and the isopod, *Idotea baltica*.

References

Olla et al., 1975 (habits, ecology). Johansen, 1925 (natural history). Shumway and Stickney, 1975 (food habits). Serchuk and Frame, 1973 (bibliography). Chao, 1973 (food habits). Dew, 1976 (life history, ecology). Green and Farewell, 1971 (winter habits).

Names

Adspersus is a Latin word meaning a sprinkling upon.

Labrus adspersus Walbaum, 1792: 254-255 (after Schoepf)

Tautoga coerulea Mitchill, 1814: 24 New York

Labrus chogset Mitchill, 1815: 403 New York

Labrus chogset fulva Mitchill, 1815: 403 New York

Ctenolabrus uninotus Valenciennes in Cuvier and Valenciennes, 1839: 174 (239) New York

MULLETS

MUGILIDAE

Mullets are silvery, bullet-shaped fishes with a small spiny dorsal fin with four spines. The dorsal fins are separated by a wide space. Their pelvic fins are sub-abdominal (well behind the pectoral girdle), with one spine and five rays. Most species have a rather

flat head and a thick adipose layer that almost covers the eye. Marine mullets often have gizzards similar to those of the gizzard shad. There are about 13 genera and between 70 and 100 species.

KEY TO THE SPECIES OF MULLETS IN NEW YORK

A. Anal fin with 3 spines and $\frac{7}{9}$ soft rays or 2 spines and 9 rays in very small individuals. Second dorsal and anal fins with only a few scales on their interradiar membranes. Scales on sides of body with dark spots that form longitudinal stripes.

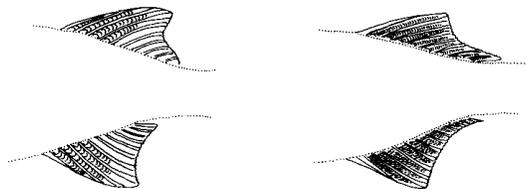
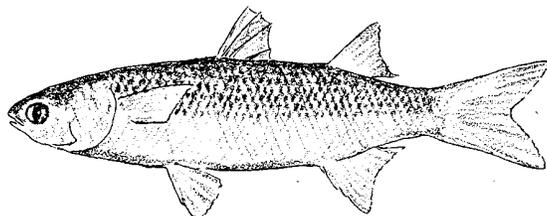
Mugil cephalus

Striped mullet, p. 437

A'. Anal fin with 3 spines and 9 soft rays or 2 spines and 10 rays in small individuals. Second dorsal and anal fins densely covered with scales. Color uniform, without stripes.

Mugil curema

White mullet, p. 438



Scales at the base of the dorsal and anal fins of the striped (left) and white mullets.

STRIPED MULLET

Mugil cephalus Linnaeus, 1758

Identification

Mullets are cigar-shaped fishes with two well-separated dorsal fins, large scales and a forked tail. The body is nearly round in cross section, becoming compressed toward the tail. The head is bluntly pointed and more or less triangular in cross section. Each eye is nearly covered with a fatty tissue with a vertical, lenticular opening in the center. The pectoral fins are high on the sides and the pelvic fins are well behind them.

The striped mullet is easy to separate from the white mullet by its pattern of dark lines formed by dark centers on the scales of the sides, and by the anal count of III,8 rather than III,9. Striped mullet have few scales on the membranes of the second dorsal and anal fins.

Occurrence

The following specimens from the Hudson River are in the collections of the American Museum of Natural History: AMNH 35957, 212 mm, River Mile 36, collected 23 September 1976 by Lander and Texas Instruments field crew. AMNH 43062 (2), 114 to 121 mm, Bowline Point, 29 July 1977 by LMS personnel.

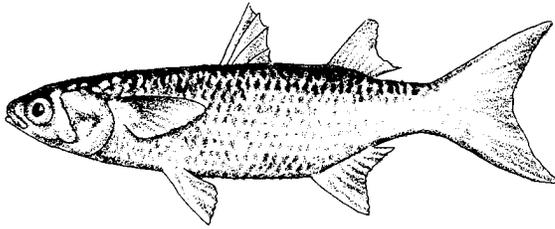
Names

Cephalus is an old name from the Greek *kephale*, head.

Mugil cephalus Linnaeus, 1758: 316 European oceans

Mugil albula Linnaeus, 1766: 520 Charleston, South Carolina

Mugil lineatus Mitchill in Cuvier and Valenciennes, 1836: 96 New York



WHITE MULLET

Mugil curema Valenciennes, 1836

Identification

The elongate shape, silvery color, two well-separated dorsal fins, conspicuous adipose eyelid, and abdominal pelvic fins all identify the white mullet as a member of the Mugilidae. The white mullet closely resembles the striped mullet but it differs in color (lacking conspicuous stripes), in having dense scales on the bases of the membranes of the second dorsal and anal fins, and in having more anal fin rays.

Young mullets are compressed and bright silvery. This juvenile stage is called a querimana. During development, the third element of the anal fin changes from a ray to a spine. In the white mullet, the young have 2 spines and 10 rays and the adults have 3 spines and 9 rays. In the striped mullet, the young have two spines and nine rays, the adults three spines and eight rays.

Occurrence

Two specimens from the Hudson River are in the American Museum. AMNH 37243 is from River Mile 15 and was collected 2 October 1975. AMNH 37244 is from River Mile 15 and was collected 17 October 1975, both by Texas Instruments personnel.

Names

Curema is a Portuguese name used by Marcgrave, and is probably related to the Spanish name Queriman.

Mugil curema Valenciennes in Cuvier and Valenciennes, 1836: 87 Brazil, Martinique, Cuba

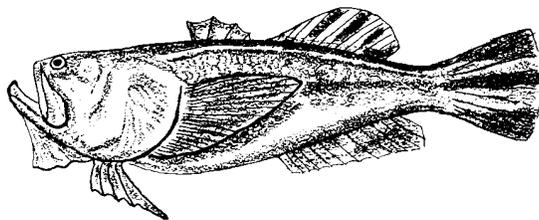
STARGAZERS

URANOSCOPIDAE

The stargazers get their name from their ability to produce a noticeable electric shock. This is done by special organs derived from eye muscles and located on the top of the head behind the rather small eyes. These fishes spend much of their time buried in sand just below the surface of the bottom, waiting to ambush their prey. Their mouth is large and

nearly vertical and the lips have a fringe of tentacles that apparently aids in keeping the sand out of the mouth. They also have venomous spines on the shoulder girdle.

This is a small family of 8 genera and 25 species. They occur in all of the major oceans.



NORTHERN STARGAZER

Astroscopus guttatus

Abbott, 1860

Identification

The northern stargazer is a bizarre fish with a large, almost vertical mouth surrounded by fringed lips. Its head is broad and flat on top with a smooth flat space behind each of its tiny eyes. These smooth areas are separated by a Y-shaped bony ridge and they cover electric organs that can produce a noticeable shock when the fish is 8 or 10 inches long.

Occurrence

The northern stargazer ranges from New York to Virginia and it is included in the inland fauna on the basis of a few juveniles collected in the estuary by Texas Instruments personnel as far upstream as River Mile 24.

Names

Guttatus is a Latin word meaning spotted, as with raindrops.

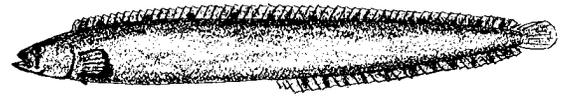
Astroscopus guttatus Abbott, 1860: 365 Cape May, New Jersey

GUNNELS

PHOLIDAE

Gunnels are compressed, ribbon-shaped fishes with tiny pelvic fins. The dorsal and anal fins are long and separated from the tail fin. The dorsal fin has no soft rays, only spines. The anal fin has 2 spines and 37 to 44 rays.

This family name is sometimes spelled Pholididae. Pholids are referred to as northern blennies, indicating their relationship to the blennies of tropical waters.



ROCK GUNNEL

***Pholis gunnellus* (Linnaeus, 1758)**

Identification

The rock gunnel is sometimes called rock eel but it is actually related to the tropical blennies. It is quite elongate, its body 8 to 10 times as long as deep, with a long dorsal fin that contains 73 to 86 spines and no soft rays. The anal fin is correspondingly elongate, with 2 spines and 37 to 44 soft rays. Both the dorsal and the anal are joined to the rather small, squarish caudal fin. The pectorals are paddle-shaped and about half as long as the body is deep. The pelvics are well forward and tiny, with one spine and one ray each. The head is short, the mouth large and obliquely terminal. The body is covered with small, inconspicuous scales, the head naked. Rock gunnels can attain a length of 12 inches but most are smaller.

The color of the gunnel varies from yellow to greenish to red. There are 10 to 14 dark spots along the base of the dorsal fin and about 15 indistinct vertical bars across the anal fin. A dark vertical bar extends from the top of the head through the eye to the angle of the mouth.

Occurrence

Rock gunnels have been taken a few times in the Lower Hudson.

References

Bigelow and Schroeder, 1953b: 492-494. Sawyer, 1967 (life history).

Names

The name *gunnellus* is a Latinization of the English name for this or a similar species and is thought to be a corruption of gunwale.

Blennius gunnellus Linnaeus, 1758: 257 Atlantic Ocean

Ophidium mucronatum Mitchill, 1815: 361-362 New York

SAND LANCES

AMMODYTIDAE

Sand lances are small, elongate, and compressed fishes with no teeth, usually no pelvic fins, no fin spines, and a forked tail. The body has oblique fleshy folds, and there is a longitudinal fleshy ridge on each side of the belly. The lateral line is close to the base of the dorsal fin.

Sand lances occur in temperate and colder parts of the Atlantic and Pacific Oceans and in the Indian Ocean. There are three genera, one of which has pelvic fins.



AMERICAN SAND LANCE

Ammodytes americanus
DeKay, 1842

Identification

The species of sand lances are incompletely known. There is a general trend for the sand lances from northern and offshore waters to be more slender (body depth 6.1 to 10.5 percent of the standard length, mode 8.3) and to have more dorsal fin rays (60 to 69, mode 64), vertebrae (70-78, mode 73), and anal rays (30-37, mode 34). In contrast, the sand lances from southern and inshore waters have deeper bodies (8.2 to 14.4, average 12.3 percent of the standard length), fewer dorsal rays (52 to 60), fewer vertebrae (63 to 72), and fewer anal rays (25-33). Some studies have cast doubt on these differences and it has been suggested that there is only a single variable inshore species that is possibly conspecific with another nominal form, *A. marinus*, from Greenland.

Occurrence

Sand lances are not uncommon in the lower part of the Hudson, although there have been few published records of its occurrence there. Texas Instruments crews have collected the following specimens from River Mile 42: AMNH 48285, 130 mm, collected 26 January 1979; and AMNH 48205, 107 mm, collected 13 April 1979.

References

Richards and Kendall, 1973 (larval distribution). Meyer, Cooper, and Langston, 1979 (abundance, behavior and food in the Gulf of Maine). Scott, 1972 (variation). Winters, 1970 (variation). Westin et al., 1979 (biology).

Names

Americanus means of America.

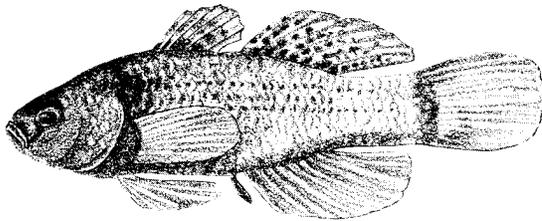
Ammodytes americanus DeKay, 1842: 317-318 Connecticut

Ammodytes vittatus DeKay, 1842: 318 New York

SLEEPERS

ELEOTRIDAE

Sleepers are closely related to the gobies but they do not have the inner rays of the pelvic fins joined by membranes as most (but not all) gobies do. The fat sleeper is a stray in the Hudson River; it is normally found in Central America and the Caribbean where it occurs in fresh as well as salt water.



FAT SLEEPER

Dormitator maculatus
(Bloch, 1785)

Identification

The fat sleeper is a stubby little fish with two separate dorsal fins and a conspicuously flat head covered with scales. In general appearance, it resembles the gobies but the gobies of our area have no scales and their pelvic fins are fused into a disk. The sleeper has separate pelvic fins and a rounded tail. The entire fish is a somber brown, with lighter spots in life, and a large darker blotch above the pectoral fin.

Occurrence

The fat sleeper has been taken from the Hudson River at River Mile 52 and River Mile 47 (Beebe, M.S.).

Names

Maculatus is Latin for spotted.

Sciaena maculata Bloch, 1785: 299 West Indies

GOBIES

GOBIIDAE

Gobies are small fishes that usually have the inner rays of the pelvic fins connected by membrane so that they form a cup-like sucker. This, however, is quite different from the highly developed sucker of the snailfishes as the pelvic fins of the gobies are otherwise unmodified. Gobies have two separate dorsal fins and our species have no scales.

The family is a large one with an estimated 800 species. Most of them are tropical and new species are still being discovered.

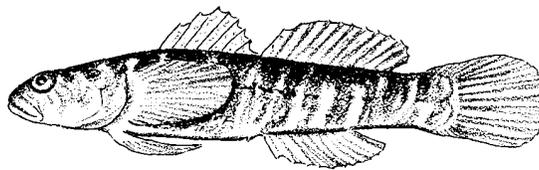
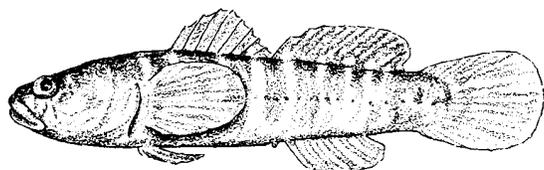
KEY TO THE SPECIES OF GOBIES IN NEW YORK

A. Pelvic disk short, reaching about halfway from its base to the anus. Second dorsal usually with 13 rays. Body deep, its depth contained 3.9 to 4.8 times in the standard length.

Gobiosoma bosci Naked goby, p. 443

A'. Pelvic disk longer, reaching two-thirds of the way from its base to the anus. Second dorsal fin usually with 12 rays. Body slender, its depth 6 to 7.2 in length.

Gobiosoma ginsburgi Seaboard goby, p. 444



NAKED GOBY

Gobiosoma bosci (Lacepède, 1798)

Identification

The naked goby is a small fish, rarely reaching 2 inches total length. Both the naked goby and the seaboard goby lack scales. In general appearance, they are quite similar but they differ in body proportions. The naked goby is deeper, its greatest depth contained about 4 or 5 times in the standard length (6 to more than 7 in the seaboard) and the pelvic disk is shorter (reaching halfway to the vent in the naked goby, three-fourths of the way in the sea-

board). Also, the dorsal rays are modally 13 in the naked goby, 12 in the seaboard goby.

Occurrence

The naked goby was listed for the Lower Hudson by Bath et al. (1977).

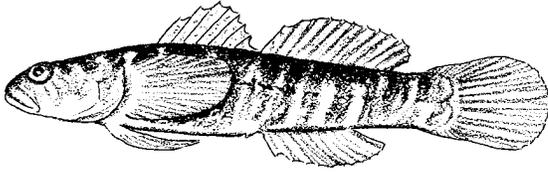
Reference

Dahlberg and Conyers, 1973 (ecology).

Names

This species is named in honor of M. Bosc, French consul at Charleston in the 18th century, an ardent naturalist.

Gobius bosci Lacepède, 1798: 555



SEABOARD GOBY

Gobiosoma ginsburgi Hildebrand and Schroeder, 1928

Identification

The seaboard goby is more slender than the naked goby, its greatest body depth contained about 6 to more than 7 times in the standard length. The pelvic disk is longer, reaching about three-fourths of the way from its origin to the vent. Its dorsal soft rays are modally 12 and the fins are somewhat higher than those of the naked goby.

Occurrence

The seaboard goby was recorded from the Lower Hudson by Bath et al. (1977).

References

Dahlberg and Conyers, 1973 (ecology). Hoff, 1976 (biology).

Names

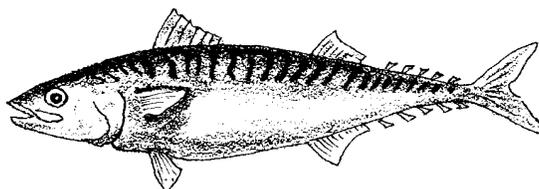
The seaboard goby is named in honor of Isaac Ginsburg, a leading student of gobies of the Atlantic coast.

Gobiosoma ginsburgi Hildebrand and Schroeder, 1928: 324-325 Cape Charles, Virginia

MACKERELS

SCOMBRIDAE

Mackerels are graceful torpedo-shaped fishes with two well-separated dorsal fins and seven or eight detached finlets behind the dorsal and anal fins. The color is generally blue, in keeping with their open ocean habitat, and they often have wavy stripes on the upper sides. The mouth is terminal but not protractile. The caudal peduncle is very slender and the tail deeply forked. This family includes the tunas. There are about 45 species.



ATLANTIC MACKEREL

Scomber scombrus
Linnaeus, 1758

Identification

The Atlantic mackerel is a slender torpedo-shaped fish, blue above with diagonal, wavy, dark lines crossing the back. The sides below the midline are silvery without definite dark spots. There are two dorsal fins, separated by a space longer than the base of the first dorsal. There are five separate finlets behind the dorsal fin and five behind the anal fin. There are two short, longitudinal keels on each side of the slender caudal peduncle. The entire body is covered with small scales. Atlantic mackerel reach a length of nearly 22 inches but the usual size is about 14 inches.

Occurrence

A specimen 440 mm in total length was taken at River Mile 44 on 16 July 1977 by Texas Instruments personnel.

Notes

Mackerel are important commercial fish on the east coast.

References

Sette, 1943; 1950 (general account, migration patterns). Bigelow and Schroeder, 1953b (general account). Morse, 1980a, 1980b (spawning and fecundity). Berrien, 1975 (eggs and larvae).

Names

Both the genus and species come from the Greek *skombros* and Latin *scomber*, mackerel.

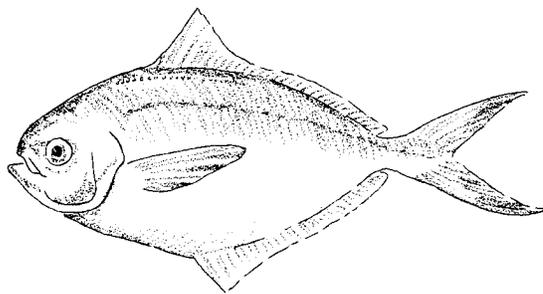
Scomber scombrus Linnaeus, 1758: 297 Atlantic Ocean

Scomber vernalis Mitchill, 1815: 423 Sandy Hook, New Jersey

BUTTERFISHES

STROMATEIDAE

The butterfishes are deep-bodied, compressed fishes with a specialized outpocketing of the esophagus. This is a small family with three genera and a dozen or so species. Our butterfish is rather specialized with no pelvic fin and a row of pores along the back near the base of the dorsal fin.



BUTTERFISH

Peprilus triacanthus (Peck, 1804)

Identification

The butterfish, a silvery, compressed, teardrop-shaped fish with a blunt head, a forked tail and long dorsal and anal fins, has been described as looking like a flounder swimming on edge. Its two outstanding features are the absence of pelvic fins and the presence of a conspicuous row of pores on the upper sides of the body. In life, the butterfish has dark spots but these fade soon after death. The maximum size is around 12 inches; most are smaller.

Occurrence

Mearns reported that it was quite common at West Point in the summers of 1882 and 1883. It is still taken occasionally in the Lower Hudson, and Dr. Joseph O'Connor (pers comm.) has reported that it was common in trawl samples taken between Bowline Point and the Tappan Zee Bridge from late July to early September 1984. Dr. O'Connor's specimens were small, ranging from early postlarval to about 3.5 inches total length. The smallest specimens were found farthest upstream.

The butterfish ranges from Nova Scotia and Prince Edward Island to peninsular Florida. It is re-

placed in the Gulf of Mexico by another species, *Peprilus burti*. There is a gap around Florida where neither species occurs. Butterfish appear to prefer sandy bottoms but they are not closely associated with the bottom, at least when they are inshore during the summer. There is some indication that they remain near the bottom during the day and move upward at night.

Notes

There are at least two populations of the butterfish, one north and the other south of Cape Hatteras. The northern population shows a definite migratory pattern, moving inshore and northward in the spring and summer, and offshore to the edge of the continental shelf in late autumn and winter. Spawning takes place May to July with the peak in June. Growth is rapid and some fish mature by the end of their first year, the rest during the second year although in Chesapeake Bay spawning may be delayed another year. The maximum age is about 6 years.

Butterfish feed on a variety of invertebrates, including tunicates, crustaceans, chaetognaths, polychaetes, ctenophores, and cnidarians. They are eaten by such larger fishes as haddock, silver hake, swordfish, bluefish, and weakfish.

The butterfish is an important commercial species and they are taken in pound nets and trapnets, gill nets, otter trawls and haul seines. A considerable number are caught incidental to the squid fishery.

References

Mearns, 1898 (Hudson River). Murawski and Waring, 1979 (fishery, life history, ecology). Oviatt and Kremer, 1973 (feed on ctenophores). Caldwell, 1961 (populations). Honey, 1963 (eggs and larvae). Colton and Honey, 1963 (eggs and larvae). DuPaul and McEachran, 1973 (age and growth).

Names

Triacanthus is from the Greek *treis*, three, and *akantha*, horn or spine.

Stromateus triacanthus Peck, 1804: 48 Piscataqua

Rhombus triacanthus, Mearns, 1898: 319 Hudson Highlands

Poronotus triacanthus, Greeley, 1937: 100 Lower Hudson (after Mearns)

Stromateus cryptosus, Mitchill, 1815: 365 New York Bay

SEAROBINS

TRIGLIDAE

Searobins have greatly enlarged, wing-like pectoral fins although they do not fly. Some of the head bones are superficial and exquisitely sculptured plates, and the lower rays of the pectoral fins are

separate fingers not connected by membrane. There are two dorsal fins and no free spines. About 10 genera and 70 species occur in warm and temperate seas.

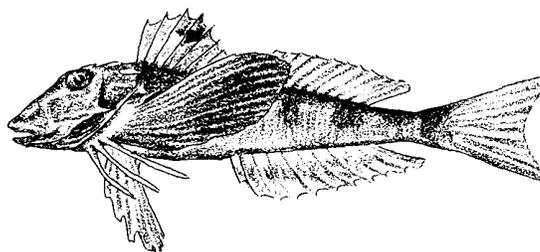
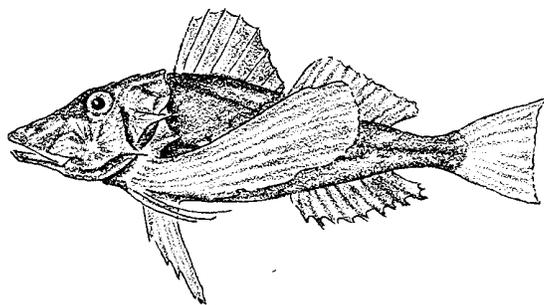
KEY TO THE SPECIES OF SEAROBINS IN NEW YORK

A. Sides of body with two dark longitudinal lines. Pectoral fin long, extending back to about the ninth ray of the second dorsal fin when folded.

Prionotus evolans Striped searobin, p. 448

A'. Sides of body without dark lines, plain or with indistinct mottlings. Pectoral fin shorter, reaching only to the sixth ray of the second dorsal fin when folded.

Prionotus carolinus Northern searobin, p. 447



NORTHERN SEAROBIN

Prionotus carolinus
(Linnaeus, 1771)

Identification

The northern searobin differs from the striped searobin in having a shorter head, two dark bars across the pectoral fin instead of one, and in lacking a prominent brown line along the side of the body. There is a black spot between the fourth and fifth dorsal spines.

Occurrence

The range of this species is from the Bay of Fundy to South Carolina, but it is uncommon north of

Cape Cod. In the Hudson, it has been taken at least as far north as River Mile 15 off Bergen County, New Jersey.

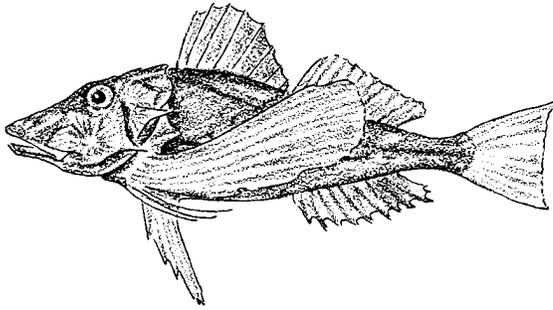
References

Bigelow and Schroeder, 1953b: 467-470. Marshall, 1946 (comparative ecology). Richards, Mann, and Walker, 1979 (spawning and growth).

Names

The species name is for the Carolinas where Linnaeus' specimens were collected.

Trigla carolina Linnaeus, 1771: 528 Carolina
Trigla palmipes Mitchill, 1815: 431 New York



STRIPED SEAROBIN

Prionotus evolans (Linnaeus, 1766)

Identification

The striped searobin resembles the northern searobin but differs in having a larger head, larger mouth, and longer pectoral fins. In this species, the pectoral fins reach to the rear third of the second dorsal fin, but in the northern searobin they extend only to the front third. The tail is more square in the striped searobin, and the free pectoral rays taper toward their tips (in the northern searobin they are somewhat club-shaped). These filaments are banded in the striped searobin, plain in the northern searobin. As the name implies, the striped searobin has a conspicuous narrow reddish-brown stripe along the side below the lateral line. There is only one dark bar crossing the pectoral fin and usually it is so diffuse as to be a mere darkening of the center of the fin rather than a definite pattern.

Occurrence

This species has about the same range as the northern searobin —Carolina to the Gulf of Maine—, except that it is rare north of Cape Cod. It is known from the Hudson Estuary where two specimens have been taken at the Indian Point power plant at River Mile 42 by Texas Instruments personnel. One of these is AMNH 37279 and the other is New York State Museum 33451.

References

Bigelow and Schroeder, 1953b: 470-471. (general account). Marshall, 1946 (comparative ecology). McEachran and Davis, 1970 (age and growth). Richards, Mann, and Walker, 1979 (spawning and growth).

Names

Evolans is the Latin word meaning flying, apparently a reference to the wing-like pectoral fins although, of course, the searobin does not fly.

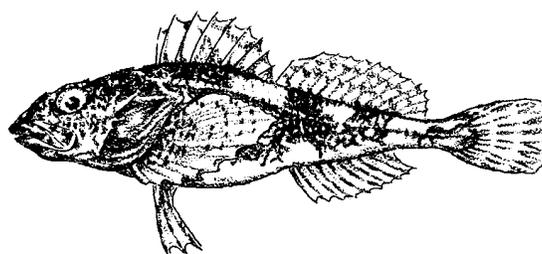
Trigla evolans Linnaeus, 1766: 498 Carolinas

SCULPINS

COTTIDAE

Sculpins are bottom-dwelling fishes with large pectoral fins and naked or prickly skins. Their relationships are in doubt; some features of the jaw muscles are similar to those of codfishes and this has led some classifiers to regard them as rather primitive spiny-rayed fishes. In other respects, they are quite advanced, having lost their scales and having modified pectoral fins. Because they have a bony strut connecting the bones around the eye with the preopercle, they are placed with the mail-cheeked fishes, but this arrangement is not entirely satisfactory. Worldwide, the family has about 67 genera and perhaps 300 species. In our fauna, there are four freshwater species and two marine species that are frequently taken in the Lower Hudson.

A key to all of the species of sculpins from the inland waters of New York will be found in the freshwater section.



GRUBBY

Myoxocephalus aeneus
(Mitchill, 1814)

Identification

The grubby differs from the fourhorn sculpin in having only three spines along the preopercular margin and in having the dorsal fins close together. Both of these features are also shared by the longhorn sculpin. The most conspicuous difference between the grubby and the longhorn sculpin is the length of the upper preopercular spine, which is about twice as long as the spine below it in the grubby, but more than four times as long in the longhorn. The anal fin of the grubby has 10 or 11 rays, that of the longhorn has about 14.

All of the species of *Myoxocephalus* differ from members of the genus *Cottus* in having the gill membranes free from the isthmus and from each other.

Occurrence

The grubby is a northern species that ranges from New Jersey to Nova Scotia and the Gulf of St. Lawrence. In the Hudson, it is occasionally taken by commercial fishermen in Haverstraw Bay and there are specimens in the AMNH and the New York State Museum from Indian Point. It is quite common in the North River (the upper part of New York Harbor) where it spawns in late winter.

Notes

This is the smallest of the common sculpins of the Atlantic coast. It seldom reaches more than 6 or 7 inches.

References

Bigelow and Schroeder, 1953b: 443-445 (general account). Lund and Marcy, 1975 (development).

Names

Aeneus is a Latin word meaning of bronze or copper.

Cottus aeneus Mitchill, 1814: 8 New York

Cottus anceps Sauvage, 1878: 145 New York

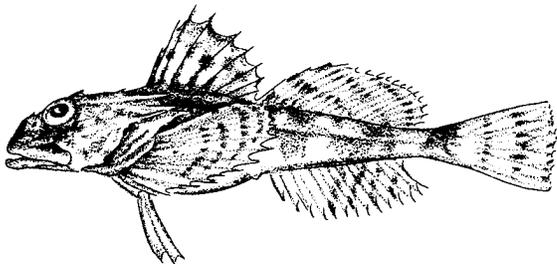
Acanthocottus aeneus, Jordan, Evermann, and Clark, 1930: 386 (nomenclature)

refers to the spines on the head, of which there are 20, not 18.

Cottus octodecim-spinosus Mitchill, 1815: 380 New York

Myoxocephalus octodecemspinosus Boyle, 1969: 210 Verplanck

Acanthocottus octodecemspinosus, Jordan, Evermann, and Clark, 1930: 386

**LONGHORN SCULPIN*****Myoxocephalus octodecemspinosus* (Mitchill, 1815)****Identification**

The longhorn sculpin is quite similar to the grubby, sharing with it the general shape and color and the presence of three, rather than four, spines along the edge of the preopercle. It differs from the grubby in that the upper preopercular spine is much longer (about 4 times) than the second spine. It also has 14 rather than 10 or 11 anal rays, and is a considerably larger species, reaching nearly 18 inches total length.

The longhorn sculpin also resembles the short-horn sculpin, *Myoxocephalus scorpius*, which has not yet been reported from inland waters but it can be distinguished from that species by the position of the anal fin origin which is below the second or third ray of the second dorsal rather than below the fourth or fifth. Furthermore, in the longhorn sculpin, there is a series of cartilaginous plates along the lateral line whereas the shorthorn sculpin has prickly scales in its lateral line.

The one feature that distinguishes the longhorn sculpin is the extremely long upper preopercular spine. The outer part of this spine is not covered with skin.

Occurrence

The longhorn sculpin is a northern species ranging from Newfoundland to New Jersey and occasionally south to Virginia. It is sometimes taken in the Lower Hudson in Haverstraw Bay.

References

Boyle, 1969 (taken by commercial fishermen in Haverstraw Bay). Bigelow and Schroeder, 1953b: 449-452 (general account). Morrow, 1951 (biology).

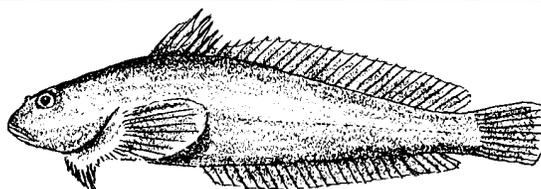
Names

The specific name is Latin for eighteen-spined and

SNAILFISHES

CYCLOPTERIDAE

Members of this family are characterized by having the pelvic fins joined into a sucking disk. They are quite varied, some species globose with rows of bony plates, others elongate and sometimes gelatinous. They are all marine and tend to occur in the colder oceans, especially the Arctic.



SEASNAIL

Liparis atlanticus
(Jordan and Evermann, 1898)

Identification

Seasnails are small tadpole-like fishes with soft scaleless bodies and a complex ventral sucker that is formed partly by the modified pelvic fins.

They have a single dorsal fin with about six spines differentiated from the soft rays by a slight notch. This species reaches a maximum length of about 5 inches.

Occurrence

Seasnails are marine fishes ranging from Newfoundland to New Jersey. This species has been taken in the Lower Hudson a few times.

Notes

Although this species has been reported to live in the mantle cavities of sea scallops, Able found that more than 6,000 specimens of seasnail from scallops were a distinct species, *Liparis inquilinus*, not *Liparis atlanticus*.

References

Able, 1973 (characters distinguishing *L. atlanticus* and *L. inquilinus*).

Names

Atlanticus refers to its geographic distribution.

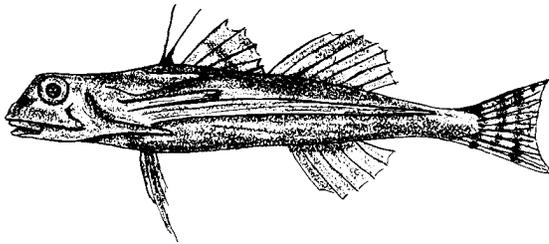
Neoliparis atlanticus Jordan and Evermann, 1898: 2107 Godbout, Quebec (Type USNM 37215.)

Liparis atlanticus, Able, 1973

FLYING GURNARDS

DACTYLOPTERIDAE

The flying gurnard rather resembles the searobins in having expanded pectoral fins and sculptured superficial head bones. It does not, however, have free lower pectoral rays although there is a separate dorsal section of the pectoral fin. There is a large spine-like expansion of the head bones above the pectoral fin and a large spine at the angle of the preopercle that extends past the gill opening to below the pectoral fin. The first two spines of the first dorsal fin are not connected by membrane. There are prominent keels on the scales of the body. This is a small group with about four monotypic genera.



FLYING GURNARD

Dactylopterus volitans
(Linnaeus, 1758)

Identification

With its armored head and greatly expanded pectoral fins, the flying gurnard resembles a searobin but it does not have the free, fingerlike pectoral rays of searobins and closer inspection will soon reveal a number of other important differences. Not only are the pectoral fins huge, they are divided with the first (upper) six rays forming a separate small lobe. The dorsal fin is also divided with the first two spines separate from each other and from the rest of the fin. The pelvic fins have one spine and four rather than five, rays.

The head of the gurnard is covered with sculptured superficial bones and is noticeably concave between the eyes. At the back of the skull, a long blade-like extension of the dorsal head armour reaches to below the dorsal fin. The angle of the preopercle also extends backward as a strong, flat spine that reaches to below the pectoral fin. The scales of the dorsal surface of the terete body are armed with keels that end in sharp points.

The pectoral fins are dark but conspicuously marked with spots and streaks that are blue in life. The body is grayish brown, a little lighter ventrally.

Occurrence

One specimen of this species was taken in the Hudson River in 1981. The flying gurnard is a tropical species that commonly strays north to the Carolinas and occasionally as far north as Massachusetts.

References

Bigelow and Schroeder, 1953b: 472-473 (general account).

Names

Volitans is Latin for flying.

Trigla volitans Linnaeus, 1758: 302 Mediterranean

Polynemus sexradiatus Mitchill, 1815: pl.4, fig.10 New York

LEFTEYE FLOUNDERS

BOTHIDAE

As the name implies, the lefteye flounders normally have their eyes on the left side of the body. This is a fairly large family with more than 200 species. The summer flounder, commonly called fluke in the New York area, is an important game fish.

KEY TO THE SPECIES OF LEFTEYE FLOUNDERS IN THE INLAND WATERS OF NEW YORK

A. Lateral line nearly straight, scales large, about 40 to 45 in lateral line.

B.

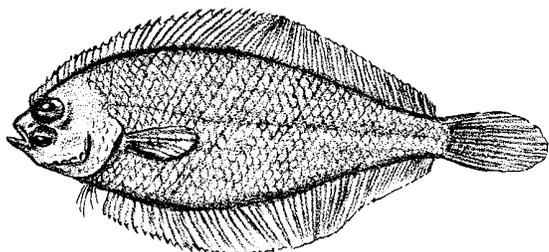
A'. Lateral line with a definite arch over the pectoral fin. Scales small, more than 50 in the lateral line.

C.

B. Mouth moderately small, maxillary contained 1.75 to 3.3 times in the head. Jaws about equally curved (in the frontal plane). Teeth about equally developed on both sides, becoming somewhat larger anteriorly. Tip of snout with a bony knob.

Citharichthys arcifrons

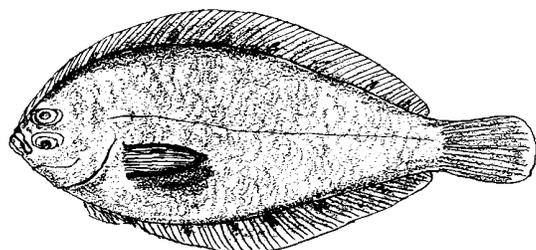
Gulf Stream flounder, p. 454



B'. Mouth small, maxillary 3.5 to 4.2 times in head length. Jaw of the blind side more strongly curved. Teeth better developed on the blind side, not larger anteriorly. Snout without bony knob.

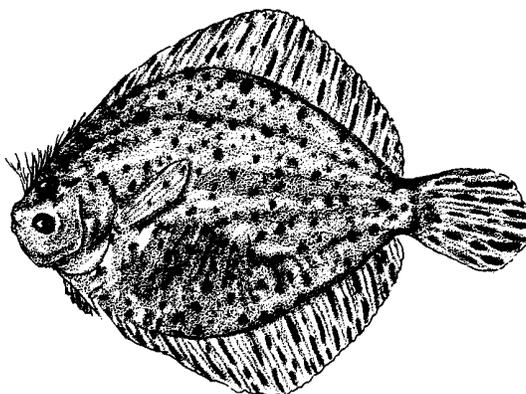
Etropus microstomus

Smallmouth flounder, p. 454



C. Left pelvic fin continuous with the anal fin, right pelvic fin separate. Body deep, its outline nearly round. Upper surface with many diffuse spots. Anterior rays of the dorsal fin branched and free at their tips.

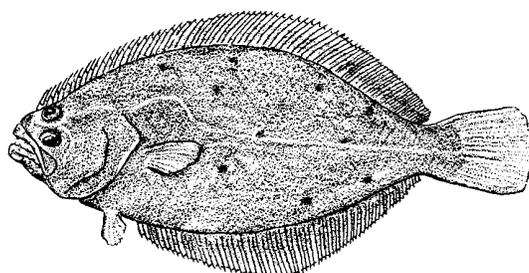
Scophthalmus aquosus Windowpane, p. 455

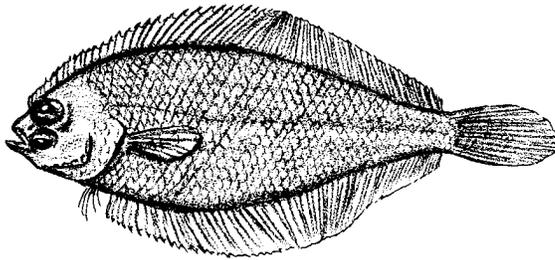


C'. Both pelvic fins separate from the anal fin. Shape more elongate, not nearly round. Upper surface with distinct black spots. Anterior dorsal rays neither branched nor free at their tips.

Paralichthys dentatus

Summer flounder (Fluke), p. 454





GULF STREAM FLOUNDER

Citharichthys arctifrons
Goode, 1880

Identification

The left-eyed Gulf Stream flounder has a tapering body with a rather small head. Its mouth reaches as far back as the level of the eyes. Its most characteristic feature is the large scales, about 40 in the nearly straight lateral line. Both pectoral fins are developed but the left is considerably longer. The left pelvic fin is on the midline, the right slightly up on the blind side. In females, the pelvic fins are about the same size but in males the right pelvic is longer. The species is rather plain brownish above and white on the blind side. The Gulf Stream flounder differs from other members of the genus *Citharichthys* in having a bony protuberance on its snout, its upper jaw less than one third the head length, and its body depth usually less than 40 percent of the standard length.

Occurrence

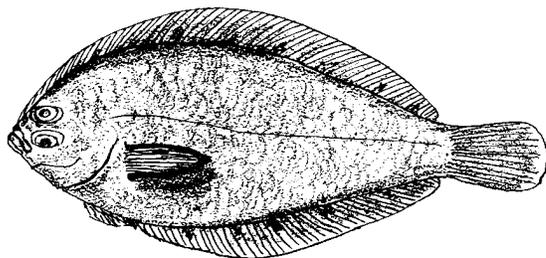
This species was listed from the Lower Hudson by Bath et al. (1977).

References

Gutherz and Blackman, 1970 (systematics).

Names

The species name means narrow forehead, from the Latin *arctus*, narrow, confined, and *frons*, forehead.



SMALLMOUTH FLOUNDER

Etropus microstomus (Gill, 1865)

Identification

This left-eyed species has a small head and an even smaller mouth. Its eyes are close together with only a narrow ridge separating them. Its lateral line

is nearly straight with 41 to 45 scales. There is no anal spine. The left pelvic fin is on the edge of the abdomen and the right is on the blind side. The smallmouth flounder differs from its near relative, *Etropus crossotus*, in that it has about 13 rakers on the lower limb of the first gill arch whereas *crossotus* has only 8. The smallmouth is also more slender, with its greatest body depth less than half the standard length.

Occurrence

Texas Instruments personnel collected specimens at River Mile 42 on 10 December 1972 and at River Mile 16 on 3 September 1980. These are cataloged as AMNH 48300 and 48301, respectively. The species ranges from New York to Virginia and perhaps farther south.

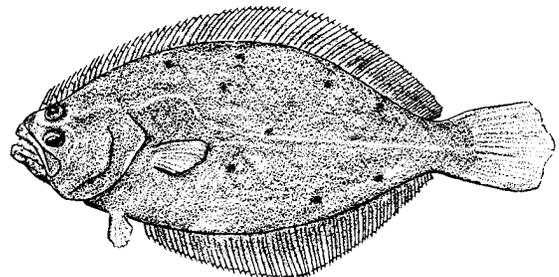
References

Scherer and Bourne, 1980 (eggs and early larvae).

Names

The species name means smallmouth from the Greek *mikros*, small, and *stoma*, mouth.

Citharichthys microstomus Gill, 1865: 223 Beesleys Point, New Jersey



SUMMER FLOUNDER (FLUKE)

Paralichthys dentatus
(Linnaeus, 1766)

Identification

Flukes are left-eyed with a large mouth and a prominent arch in the anterior part of the lateral line. The jaws are somewhat curved. The eyes are separated by a distance equal to three-fourths the eye diameter in large specimens. The gill rakers are rather long and slender, 14 to 18 on the lower limb of the first arch. The tail is round in young, but in older fish it tends to become pointed (concave above and below the center). The pelvic fins are symmetrical. There are pectoral fins on both sides but the left is slightly larger.

Most individuals have round black spots surrounded by light rings scattered over a brownish background. Three prominent spots form a triangle on the back of the body with the anteriormost apex on the lateral line.

Occurrence

This species is fairly common in the Lower Hudson from the George Washington Bridge to the Tappan Zee Bridge. The Survey collected it in Croton Bay.

References

Ginsburg, 1952a (systematics). Poole, 1961 (age and growth); 1962 (sport fishery); 1964 (feeding). Hildebrand and Cable, 1930 (development). Smith and Daiber, 1977 (Delaware Bay). Powell and Schwartz, 1979 (food habits). Scarlett, 1982 (bibliography).

Names

The species name, *dentatus*, is the Latin word for toothed.

Pleuronectes dentatus Linnaeus, 1766: 458-459 Carolinas

Platessa dentata, DeKay, 1842: 298 New York

Pleuronectes melanogaster Mitchill, 1815: 390-391 New York

Platessa ocellaris DeKay, 1842: 300 New York

Paralichthys dentatus, Greeley, 1937: 99 Croton Bay

Occurrence

This species was listed from the Lower Hudson by Bath et al. (1977).

References

Bigelow and Schroeder, 1953b: 290-294 (general account under the name *Lophopsetta maculata*, sand flounder). Hickey, 1975 (feeding habits).

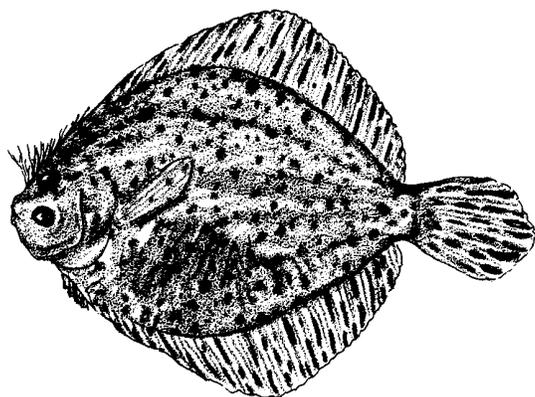
Names

The name *aquosus* is from the Latin *aqua*, water and *-osus*, full of, possibly in reference to its transparent or translucent flesh.

Pleuronectes maculatus Mitchill, 1814: 9 New York

Pleuronectes aquosus Mitchill, 1815: 389 New York

Lophopsetta maculata, Gill, 1865: 220 (classification)

**WINDOWPANE*****Scophthalmus aquosus*
(Mitchill, 1814)****Identification**

The windowpane is more deep bodied and diamond shaped than most of the other flounders of our area. The anterior dorsal fin rays are branched and free at their outer ends so they look like a decorative fringe. The lateral line is strongly arched over the pectoral fin. Pectoral fins are present on both sides with the left slightly larger. The left pelvic fin is on the midline of the abdomen, but the right one is off center on the blind side. The bases of the pelvics are as wide as their tips. The rays of both the dorsal and anal fins are longest near the middle of the fins and this enhances the diamond shape of the fish. The tail is rounded.

The eyed left side is translucent olive or greenish, sometimes tinged with reddish brown, and has darker mottlings and small spots.

RIGHTEYE FLOUNDERS

PLEURONECTIDAE

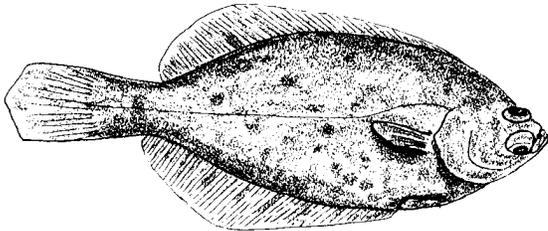
Although occasional individuals have the eyes on the left, the occurrence of reversed individuals is quite rare and most individuals have their eyes on the right. The winter flounder is one of the most common inshore flatfishes in the New York area and frequently moves into the Lower Hudson. The other species reported from the estuary are encountered less frequently.

KEY TO THE SPECIES OF RIGHTEYE FLOUNDERS IN THE INLAND WATERS OF NEW YORK

A. Lateral line nearly straight, without a definite arch over the pectoral fin. No sharp bony projection in front of the anal fin. Snout rather blunt, body fairly thick.

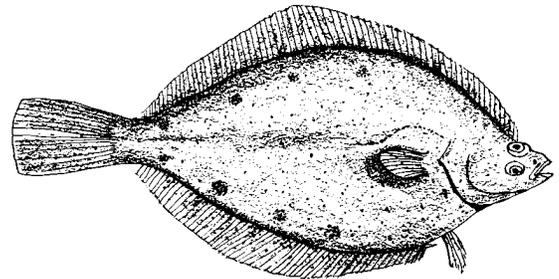
Pseudopleuronectes americanus

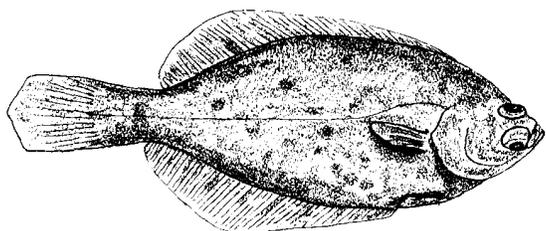
Winter flounder, p. 457



A'. Lateral line with a distinct arch over the pectoral fin. A definite spine-like bony projection in front of the anal fin. Snout relatively pointed, body thin.

Limanda ferruginea Yellowtail flounder, p. 457





WINTER FLOUNDER

Pseudopleuronectes americanus (Walbaum, 1792)

Identification

In the New York area, this species is the plain "flounder", whereas the names of other flatfishes have some modifying term to specify which flounder is meant or do not contain the word flounder. The flounder is a righteyed species with a small asymmetrical mouth and teeth only on the left side. Its lateral line is nearly straight and the caudal fin is convex. The pelvic fins are symmetrical and originate below the pectorals. They reach to or beyond the anal origin. The left pectoral fin is present but smaller than the right. The scales of the eyed side are strongly ctenoid, and there are rows of scales along the fin rays.

Occurrence

Winter flounders are not uncommon in the Lower Hudson and the Survey collected them in August. The species is found from Ungava Bay, Labrador, south to Georgia.

Notes

The winter flounder is one of the most important sport and commercial species in the northeast. Breder described the spawning of this species in tanks at Woods Hole, Massachusetts. Although there were other flounders in the tank at the time, three males and two females participated in the spawning which took place at 3:00 to 3:30 am in spite of the lights that were shining on the tank. Each of the five fish swam in a tight circle about one foot in diameter at a slight upward angle so they gradually rose in the water column. The movement was counter-clockwise so the vent was at the outside of the circle. As the fish swam in intersecting circles, the eggs were extruded and ran along the upper side of the anal fin and on out over the edge of the caudal fin. The motion of the fish seemed to fling the eggs outward so the spawning fish resembled a spinning Fourth of July pinwheel.

References

Sullivan, 1915 (young). Breder, 1922 (spawning). Bigelow and Schroeder, 1953b: 276-283 (general account). Wells et al., 1973 (feeding). Rogers, 1976 (temperature, salinity, and survival). Lux, 1973 (age and growth). Olla, Wicklund, and Wilk, 1969 (behavior).

Names

The species name reflects the country where it was first collected.

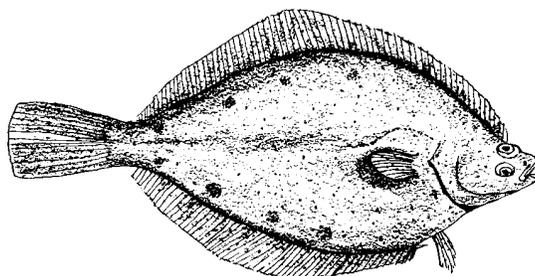
Pleuronectes americanus Walbaum, 1792: 113 (after Schoepf)

Pleuronectes planus Mitchill, 1815: 387-388 New York

Platessa plana, DeKay, 1842: 295-296 New York

Platessa pusilla DeKay, 1842: 296 New York

Pseudopleuronectes americanus, Greeley, 1937: 99 New York



YELLOWTAIL FLOUNDER

Limanda ferruginea (Storer, 1839)

Identification

The yellowtail is a righteyed flounder with 76 to 85 dorsal rays and 56 to 63 anal rays. There is a small but sharp anteriorly directed spine just in front of the anal fin.

Adults are rather diamond shaped with the dorsal profile of the frontal region somewhat concave so that the head is rather pointed. The interorbital region is scaly and the lateral line is arched anteriorly. It somewhat resembles the witch flounder, *Glyptocephalus cynoglossus*, but that species has large mucus pits on the blind side that are not present in the yellowtail.

Occurrence

A juvenile 11 mm in total length was collected at River Mile 16 on 8 May 1974 by Texas Instruments personnel. It is in the AMNH where it bears the number 48288.

References

Bigelow and Schroeder, 1953b: 271-275 (general account). Lux, 1963 (stocks). Howell and Kessler, 1977 (fecundity). Royce, Buller, and Premetz, 1959 (fishery).

Names

The species name is from the Latin *ferrugo* meaning iron rust.

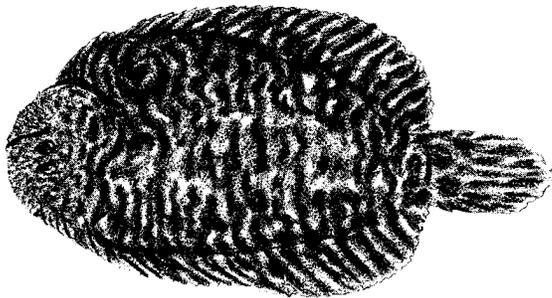
Platessa ferruginea Storer, 1839: 141 Cape Ann

SOLES

SOLEIDAE

Soles are rather specialized flatfishes with their eyes on the right side of the head. Their jaws and pelvic fins are asymmetrical and their general shape is a broad oval.

One species, the hogchoker, *Trinectes maculatus*, lives in the Lower Hudson where it is quite abundant and apparently occurs year-round. It often occurs in fresh water although never far from saltwater influence.



HOGCHOKER

Trinectes maculatus
(Bloch and Schneider, 1801)

Identification

The hogchoker is a stubby little sole with its eyes on the right side, no pectoral fins, and no obvious snout. Its body is almost oval and its dorsal fin extends to the tip of the snout. The pelvic fins are asymmetrical with the right one on the midline and more or less continuous with the anal fin. The tail is short and rounded but separate from the dorsal and anal fins. The eyes of the hogchoker are tiny and close together and its mouth is curved and quite asymmetrical with teeth only on the blind side. The skin has fine fleshy papillae which are longest on the head and the front of the body, giving the hogchoker a definite furry appearance.

Its color is variable, the eyed side brownish with 7 to 11 narrow crosslines, or with a variegated pattern of transverse lines and irregular marblings. The dorsal fin has 15 or more bold lines formed by dark interradiating membranes alternating with pale ones. The fin rays themselves are generally pale. The anal, right pelvic, and caudal fins have similar bars, the left pelvic is white. The blind side is creamy white with dark spots varying from indistinct flecks

and smudges to large circular spots.

In the Hudson, the hogchoker reaches about 5.5 inches. The maximum length for the species is about 8 inches.

Occurrence

The hogchoker lives along the coast and is most abundant in bays and estuaries where the water is brackish. It frequently occurs in fresh water. Juveniles can be taken in seines in late summer and make delightful aquarium fish.

In the Hudson River, the hogchoker occurs as far upstream as Newburgh. It ranges from Massachusetts to Panama, but there are few records north of Cape Cod.

Notes

The spawning season is May to October with the peak in July and early August. Koski studied the growth of the hogchoker in the Hudson. Scales are valid for age determination but some individuals had false annuli. Females were slightly heavier than males and lived longer; the oldest females were age VI and the oldest males age IV. In general, the hogchoker matures at age II but some males may spawn at age I.

Hildebrand and Schroeder reported that the hogchoker feeds on annelids and small crustaceans.

In aquaria, the juveniles an inch or so long are able to travel up the sides of the tank and upside-down on the surface film as if it were a solid surface.

References

Hildebrand and Schoeder, 1928 (general account).
Koski, 1974 (sinistrality and albinism in the Hudson River); 1978 (age, growth, and maturity in the Hudson River).
Dovel, Mihursky, and McErlean, 1969 (life history).

Names

The name *maculatus* is the Latin word for spotted, in reference to the color pattern of the blind side.

Pleuronectes maculatus Bloch and Schneider, 1801: 157

Achirus fasciatus Lacepède, 1803: 659 Charleston, South Carolina

Achirus fasciatus, Greeley, 1937: 99 Lower Hudson drainage

Pleuronectes lineatus Schoepf, 1788: 148 Long Island

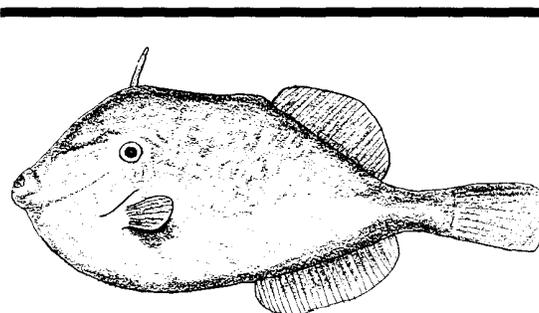
Pleuronectes mollis Mitchill, 1814: 9

Achirus mollis, DeKay, 1842: 303-304

LEATHERJACKETS

BALISTIDAE

This family includes the filefishes and triggerfishes which are too closely related to be placed in separate families. They have rather modified scales. Those of the triggerfishes are hard and plate-like; those of the filefishes are small and bristly. Filefishes have only one or two dorsal spines and no pelvic fins. The mouth is small with prominent teeth. The gill opening is reduced to a small slit in front of the pectoral fin base. Filefishes are rather inflexible fishes that swim with a peculiar motion of the dorsal and anal fins.



ORANGE FILEFISH

Aluterus schoepfi (Walbaum, 1792)

Identification

The orange filefish is a highly compressed paddle-shaped fish with two dorsal spines (the first much larger than the second) and no pelvic fin remnant. There are 32 to 39 soft rays in the second dorsal fin and 35 to 41 in the anal fin. In small specimens, the tail is very large, more than half the standard length.

Occurrence

In the Hudson Estuary, the species is known from one specimen, now a dry skeleton AMNH 21552SD. It was collected in the North River 21 August 1966. The species ranges from Nova Scotia to Brazil.

References

Berry and Voegelé, 1961 (systematics).

Names

This species is named for Johann Schoepf, a physician who worked on Long Island during the Revolutionary War and wrote several papers on the fishes of New York.

Balistes schoepfii Walbaum, 1792: 461 Long Island (after Schoepf)

Balistes aurantiacus Mitchill, 1815: 468-470 New York

Aluterus cuspidata DeKay, 1842: 338 New York

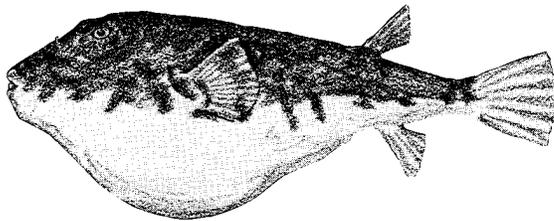
Aluterus cultrifrons Hollard, 1855: 8 New York and Bahia

Ceratacanthus schoepfii Jordan, Evermann, and Clark, 1930: 495 (nomenclature)

PUFFERS

TETRAODONTIDAE

Puffers are rather terete fishes with no pelvic fins and two beak-like teeth in each jaw. They are related to the balistids but have lost the dorsal spines completely and have also developed the capacity to inflate themselves with air or water. They have no scales but there are small prickles in the skin.



NORTHERN PUFFER

Sphoeroides maculatus (Bloch and Schneider, 1801)

Identification

Sometimes called blowfish, the puffer has the ability to inflate itself with air or water until it resembles a ball with a tail. Its eyes are rather small and can be partially closed. The puffer has no fin spines and no pelvic fins. The dorsal and anal fins are set far back on the body; the tail is slightly convex. Although puffers have no regular scales, the body is covered with fine prickles so that it feels bristly. The gill openings are mere small slits in front of the base of the pectoral fins. The nostrils are small double openings at the tip of a Y-shaped tube that is set in a shallow pit. Puffers have two large teeth in each jaw. Together they form beak-like structures. In life, the northern puffer is dusky to greenish olive above with darker spots and mottlings. The belly is pure white. There are partial vertical bars of irregular length and width along the boundary between the dark back and the pale belly. There is an especially prominent blotch behind the pectoral fin.

Occurrence

Specimens were collected by Texas Instruments personnel at Haverstraw Bay 7 April 1980 and at River Mile 30 on 4 September 1980.

References

Shipp and Yerger, 1969 (systematics). Welsch and Breder, 1922 (life history). Laroche and Davis, 1973 (age, growth, and reproduction). Merriner and Laroche, 1977 (fecundity).

Names

Maculatus is the Latin word for spotted.

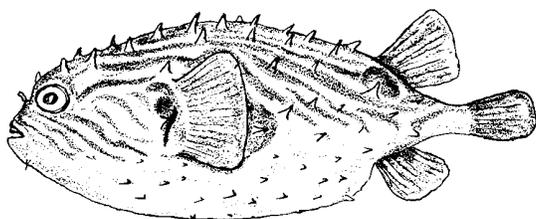
Tetrodon hispidus var. *maculatus* Bloch and Schneider, 1801: 504 Rhode Island

Tetrodon turgidus Mitchill, 1815: 473-474 New York

PORCUPINEFISHES

DIODONTIDAE

Porcupinefishes resemble puffers in their ability to inflate themselves with air or water but differ in that there is only a single tooth plate in each jaw and the scales are modified as large spines that erect as the body is inflated. There are about 5 genera and 15 species.



STRIPED BURRFISH

Chilomycterus schoepfi (Walbaum, 1792)

Identification

The burrfish is a small football-shaped fish with short stout spines over most of its head and body. Its dorsal and anal fins are far back, the dorsal directly over the anal. The tail is rounded and the pectorals are broad and paddle shaped and high on the side of the body. It has no pelvic fins. Each jaw has a single beak-like tooth plate. The nostrils are tubular.

The burrfish is strikingly marked with broad wavy lines running lengthwise on the back and on the sides of the head. Large black spots are present: one below the base of the dorsal fin and another above the base of the anal fin; one above and one behind the pectoral fin. The usual length of the burrfish is less than 10 inches.

Occurrence

The burrfish is a coastal species ranging from Florida to New York and occasionally strays a little farther north. A specimen was reported from the Hudson Estuary in 1981.

References

Bigelow and Schroeder, 1953b: 527-528.

Names

This is another species named for J. Schoepf, an early student of fishes.

Diodon schoepfii Walbaum, 1792: 601 Long Island (after Schoepf)

Diodon geometricus lineatus Bloch and Schneider, 1801: 513 New York

Diodon maculato striatus Mitchill, 1814: 470 New York

Diodon rivulatus Cuvier, 1818: 129 New York

Diodon nigrolineatus Ayres, 1843: 68 Brookhaven, Long Island

Diodon verrucosus DeKay, 1842: 325 (after Mitchill)

MARINE FISHES IN THE INLAND WATERS OF NEW YORK

CARCHARHINIDAE

1. *Carcharhinus* species

RAJIDAE

2. *Raja laevis* Mitchill, barndoor skate

ELOPIDAE

3. *Elops saurus* Linnaeus, ladyfish

CONGRIDAE

4. *Conger oceanicus* (Mitchill), conger eel

CLUPEIDAE

5. *Brevoortia tyrannus* (Latrobe), Atlantic menhaden
6. *Clupea harengus* Linnaeus, Atlantic herring
7. *Etrumeus teres* (DeKay), round herring

ENGRAULIDAE

8. *Anchoa mitchilli* (Valenciennes), bay anchovy
9. *Anchoa hepsetus* (Linnaeus), striped anchovy

SYNODONTIDAE

10. *Synodus foetens* (Linnaeus), inshore lizardfish

LOPHIIDAE

11. *Lophius americanus* Valenciennes, goosefish

GADIDAE

12. *Enchelyopus cimbrius* (Linnaeus), fourbeard rockling
13. *Gadus morhua* Linnaeus, Atlantic cod
14. *Microgadus tomcod* (Walbaum), Atlantic tomcod
15. *Pollachius virens* (Linnaeus), pollock
16. *Urophycis chuss* (Walbaum), red hake
17. *Urophycis regia* (Walbaum), spotted hake
18. *Merluccius bilinearis* (Mitchill), silver hake

OPHIDIIDAE

19. *Ophidion marginatum* (DeKay), striped cusk-eel

BELONIDAE

20. *Strongylura marina* (Walbaum), Atlantic needlefish

CYPRINODONTIDAE

21. *Cyprinodon variegatus* Lacepède, sheepshead minnow
22. *Fundulus heteroclitus* (Linnaeus), mummichog
23. *Fundulus luciae* (Baird), spotfin killifish
24. *Fundulus majalis* (Walbaum), striped killifish
25. *Lucania parva* (Baird), rainwater killifish

ATHERINIDAE

26. *Membras martinica* (Valenciennes), rough silverside
27. *Menidia beryllina* (Cope), inland silverside
28. *Menidia menidia* (Linnaeus), Atlantic silverside

SYNGNATHIDAE

29. *Hippocampus erectus* Perry, lined seahorse
30. *Syngnathus fuscus* Storer, northern pipefish

FISTULARIIDAE

31. *Fistularia tabacaria* Linnaeus, bluespotted cornetfish

SERRANIDAE

32. *Centropristis striata* (Linnaeus), black sea bass

POMATOMIDAE

33. *Pomatomus saltatrix* (Linnaeus), bluefish

RACHYCENTRIDAE

34. *Rachycentron canadum* (Linnaeus), cobia

CARANGIDAE

35. *Caranx hippos* (Linnaeus), crevalle jack
36. *Selene setapinnis* (Mitchill), Atlantic moonfish
37. *Selene vomer* (Linnaeus), lookdown

ECHENEIDAE

38. *Echeneis naucrates* Linnaeus, sharksucker

LUTJANIDAE

39. *Lutjanus griseus* (Linnaeus), gray snapper

GERREIDAE

40. *Eucinostomus argenteus* Baird, spotfin mojarra

SPARIDAE

41. *Lagodon rhomboides* (Linnaeus), pinfish
 42. *Stenotomus chrysops* (Linnaeus), scup

SCIAENIDAE

43. *Bairdiella chrysoura* (Lacepède), silver perch
 44. *Cynoscion regalis* (Bloch and Schneider), weakfish
 45. *Leiostomus xanthurus* Lacepède, spot
 46. *Menticirrhus saxatilis* (Bloch and Schneider), northern kingfish
 47. *Micropogonias undulatus* (Linnaeus), Atlantic croaker

LABRIDAE

48. *Tautoga onitis* (Linnaeus), tautog
 49. *Tautoglabrus adspersus* (Walbaum), cunner

MUGILIDAE

50. *Mugil cephalus* Linnaeus, striped mullet
 51. *Mugil curema* Valenciennes, white mullet

URANOSCOPIDAE

52. *Astroscopus guttatus* Abbott, northern stargazer

PHOLIDAE

53. *Pholis gunnellus* (Linnaeus), rock gunnel

AMMODYTIDAE

54. *Ammodytes americanus* DeKay, American sand lance

ELEOTRIDAE

55. *Dormitator maculatus* (Bloch), fat sleeper

GOBIIDAE

56. *Gobiosoma bosci* (Lacepède), naked goby
 57. *Gobiosoma ginsburgi* Hildebrand and Schroeder, sea-board goby

SCOMBRIDAE

58. *Scomber scombrus* Linnaeus, Atlantic mackerel

STROMATEIDAE

59. *Peprilus triacanthus* (Peck), butterfish

TRIGLIDAE

60. *Prionotus carolinus* (Linnaeus), northern searobin
 61. *Prionotus evolans* (Linnaeus), striped searobin

COTTIDAE

62. *Myoxocephalus aeneus* (Mitchill), grubby
 63. *Myoxocephalus octodecemspinosus* (Mitchill), long-horn sculpin

CYCLOPTERIDAE

64. *Liparis atlanticus* (Jordan and Evermann), seasnail

DACTYLOPTERIDAE

65. *Dactylopterus volitans* (Linnaeus), flying gurnard

BOTHIDAE

66. *Citharichthys arcifrons* Goode, Gulf Stream flounder
 67. *Etropus microstomus* (Gill), smallmouth flounder
 68. *Paralichthys dentatus* (Linnaeus), summer flounder
 69. *Scophthalmus aquosus* (Mitchill), windowpane

PLEURONECTIDAE

70. *Limanda ferruginea* (Storer), yellowtail flounder
 71. *Pseudopleuronectes americanus* (Walbaum), winter flounder

SOLEIDAE

72. *Trinectes maculatus* (Bloch and Schneider), hog-choker

BALISTIDAE

73. *Aluterus schoepfi* (Walbaum), orange filefish

TETRAODONTIDAE

74. *Sphoeroides maculatus* (Bloch and Schneider), northern puffer

DIODONTIDAE

75. *Chilomycterus schoepfi* (Walbaum), striped burrfish

Abbreviate heterocercal — The tail fin of gars and bowfins has the vertebral column bent upward but the fin itself is externally only slightly asymmetrical with the upper part of the base longer.

Adipose fin — Small fatty fin on the middorsal line behind the dorsal fin. Adipose fins occur in catfishes, salmonids, lizardfishes and pirate perches. In catfishes they are either keel-like (adnate) or flag-like (adnexed); the others have adnexed adipose fins.

Adnate — Keel-like. See adipose fin.

Adnexed — Flag-like. See adipose fin.

Age — The age of fishes is usually given as its age group which is usually the number of annual rings on its hard parts. Thus a II + fish has two annuli and is in its third summer.

Anadromous — Fishes that spend most of their life in the ocean but come into fresh water to spawn are said to be anadromous.

Anal fin — Unpaired fin on the midventral line behind the anus. Anal fins are characterized by their length (the distance between the bases of the first and last rays), height (length of the longest rays), and shape. They are described as deltoid if the height is about equal to or longer than the length, trapezoid if the length is greater than the height and the last ray is more than half the longest. Anal fins sometime have the anterior rays distinctly longer than the rest of rays forming a definite lobe, in which case the fin is said to be lobate or falcate. The shape can also be described according to whether the margin of the fin (when erect) is straight, concave, or convex and whether the front and rear corners are sharply angled or rounded.

Antorse — Directed forward. Often used for spines on the lower limb of the preopercle.

Aufwuchs — Organisms growing on underwater surfaces that project above the bottom such as stones or rooted plants.

Barbels — Thin fleshy projections on the head of catfishes, and some codfishes and minnows. While the barbels are prominent in the catfishes, they can be extremely small in some minnows. Their number and location is important in classification and identification.

Base of the caudal fin (Caudal base) — The base

of the caudal fin is marked by a fold that forms when the tail is gently flexed. It marks the line where the bases of the caudal rays overlap the bony supports, the "hypural plate." The standard length and other measurements are taken to the middle of the caudal base, that is, the point on the fold halfway between the dorsal and ventral margins of the caudal peduncle.

Benthic — Pertaining to or living on the bottom.

Body shape — The configuration of the body of a fish is characteristic and consists of descriptors for its cross section: terete, slab sided, compressed or depressed, its general profile: elongate, robust, stubby, rhombic or rectangular, the comparison of the curvature of the dorsal and ventral profiles, whether they are curved evenly, whether they are curved equally and where the greatest depth of the body lies.

Branchiostegal rays — Thin bony rods that support the gill membranes.

Catadromous — Running out to sea to spawn. In our area the American eel is catadromous.

Caudal fin — The tail fin. Caudal fins vary in shape. Pointed, asymmetrically pointed, rounded, squarish, lunate, forked, and deeply forked are commonly used descriptive terms.

Caudal peduncle — The region of the body between the end of the anal fin and the beginning of the caudal fin. Its shape is described as the relation of its depth to its length and its cross section.

Circuli — Bony ridges on fish scales. Not to be confused with year marks or annuli.

Classification — Arranging things in an orderly scheme. See identification.

Compressed — Flattened from side to side.

Center — In describing color patterns on fins the center is the third of the fin that is midway between the anterior and posterior edges.

Clinal — Showing a trend in variation of some feature. Often individual fish from the northern part of the species' range have more scales. If there is a trend without sharp breaks, the variation is said to be clinal. Normally, populations showing clinal variation are not named even though specimens from the extreme ends of the range may be as different as some full species.

Decurved — Dipping downward. The lateral line of the golden shiner is strongly decurved, almost parallel to the ventral profile of the body.

Depressed — Flattened from dorsal to ventral.

Described — When an ichthyologist discovers a species that is new to science and gives it a name in a formal announcement, he is describing the species and the name will be recognized as of the date of publication. To be valid, a description must meet rigid conditions set forth by the International Commission on Zoological Nomenclature.

Diadromous — Moving into water of a different salinity to spawn. Anadromous fishes move from salt to fresh water and catadromous fishes move from fresh to salt. Diadromous is the general term that includes both.

Dorsal fin — Dorsal fins are median, unpaired, fins. In lower fishes, they are supported by soft rays only and in more advanced fishes the anterior supporting elements may be spines. Sometimes, the spiny and soft parts are separated as two fins and sometimes they are joined into a single continuous fin where they may be partly separated by a notch. The same descriptive terms used for the anal fin are applied to describe the shape of the dorsal fin.

Emarginate — With a slight notch. Usually used for caudal fins in which the central rays are slightly shorter so that the outline of the fin has a slight concavity.

Epilimnion — The upper layer of warm water in a lake or pond that is thermally stratified. That part of the water mass that is above the thermocline.

Exserted — Fin rays that extend beyond the connecting membrane are said to be exserted.

Eyed eggs — Eggs in which the eyes of the developing embryo are clearly visible. This is a stage that is resistant to shock and eggs are commonly shipped after they reach the eyed stage.

Eyes — Eyes are described according to size, position, and shape of the pupil.

Fimbriate — Fringed. The opercular bone of sunfishes is said to be fimbriate if its margin has finger-like projections along its edge.

Fin rays (rays and spines) — Bony supporting elements of fins. Soft rays are jointed, branched, and have right and left halves. Spines are solid, never branched, and single.

Fin position — The pectoral fin is supported by the bones of the pectoral girdle. Therefore, its base is nearly always close behind the gill opening. The position of the dorsal fin can be described in relation to the pectoral fin, whether the dorsal begins over the base, the middle, the tip, or behind the pectoral, or it can be described in terms of the distance to the base of the tail compared with the distance to the tip of the snout or some other definite point. The anal fin position can be described by the relation of its beginning to the dorsal fin base. The position of the

pelvic can also be described in relation to the dorsal origin (under, in front of, or behind). If the pelvics are far forward, they can be placed in relation to the pelvic fin or the gill opening.

Fulcra — Hard, short, modified scales along the leading edges of the dorsal, anal, and caudal fins of gars (*Lepisosteidae*).

Fusiform — Spindle-shaped, i.e., slender, evenly tapered and thickest near the middle.

Gill arch — The bones and associated structures that support the gill filaments. Most modern fishes have four pairs of gill arches, each supporting two rows of filaments on its posterior side.

Gill cover — The gill cover is the flat structure that covers the gill chamber. It is supported by four bones, the upper, triangular opercle that sometimes bears spines, and the narrow subopercle. Other bones that support the gill cover are the interopercle that is just behind the lower jaw and the preopercle or cheek bone.

Gill membrane (opercular membrane or branchiostegal membrane) — The membrane that extends beyond the bones of the gill cover and forms a flexible edge and acts as a seal between the operculum and the body. The gill membrane is itself supported by bony rods, the branchiostegal rays.

Gill opening — The round or slit-like openings behind the head. Lampreys have seven pairs of round gill openings, sharks have five or six, and all other fishes have a single gill opening. Water that has been taken through the mouth and passed over the gills exits through the gill opening.

Gill rakers — Bony, finger-like projections on the front of the gill arches. They vary in number and shape and are useful taxonomic characters. Counts are often given as: number on the upper section + 1 at the angle + number on the lower section of the gill arch. Usually, rudimentary gill rakers are included in the count. Because it is sometimes difficult to distinguish between those of the upper limb and those of the lower limb, counts are usually given here as total counts, unless there is a compelling reason to do otherwise.

Gular plate — An unpaired superficial bone on the midline of the lower jaw of the bowfin and ladyfish.

Head canals — Tubular sensory organs that run beneath the surface of the head or in grooves in some fishes. The main branches are the lateral canal, which is a forward continuation of the lateral line on the body, and a temporal canal that extends from the lateral canal toward the dorsal midline across the occipital region of the head. A preopercular-mandibular canal runs in the cheek bone and continues out toward the tip of the lower jaw; supraorbital and suborbital canals run above and below the eye. The form of the canals is variable and is useful for identification of some species.

Homocercal — The advanced type of fish tail that is externally symmetrical at its base but internally

asymmetrical. It is supported by a complex of specialized bones.

Humeral scale — An enlarged scale over or just behind the shoulder girdle.

Head shape — The shape of the head can be described as blunt or pointed, narrow or broad (relative to the body width) and flat dorsally or ventrally.

Hypolimnion — That part of a thermally stratified body of water that is below the thermocline.

Identification — Determining that a specimen belongs to a species that is already known. See classification.

Incised — A fin membrane that is notched between the rays or spines is said to be incised.

Isthmus — The triangular area of the body that extends forward between the lower ends of the gill covers.

Lateral line — A tubular sensory organ that runs along the side of the body. Typically, it extends from the shoulder girdle to the base of the tail but in some species it is shorter or even lacking, or it can continue on to the tip of the tail fin.

Length (of a fish) — The length can be measured as total length from the extreme front of the head to the extreme end of the tail, fork length from the extreme front of the head to the end of the middle caudal rays, or standard length from the tip of the upper jaw to the fold at the base of the tail.

Margin (of fins) — The margin of the fin is the edge formed by the ends of the rays, the distal edge of the fin. The anterior and posterior limits of the fin are its edges.

Maxilla — The main bone of the upper jaw. In lower fishes, it forms part of the edge of the upper jaw but in advanced fishes a process of the premaxillary bone runs along its ventral side and takes its place as the margin of the upper jaw.

Middle — In describing color pattern on fins, the middle is the third of the fin that is midway between the base of the fin and its margin. The center is the third of the fin between the front and back.

Myomeres — Body muscle segments.

Myosepta — The connective tissue walls between successive myomeres.

Nauplii — Larval stages of crustaceans.

Nomen nudum — A name that was published without an accompanying description. Such names have no standing in nomenclature although they can be used later, in which case the name dates from the date of publication of the description.

Outlined — When fin rays or scales have a row of melanophore pigment cells along their margins, they are said to be outlined.

Pectoral fin — Paired fins that are supported by the shoulder girdle (the pectoral girdle). Paired fins may be low or high on the body with their bases horizontal, oblique, vertical, or sloped backward. Their

shape is described as asymmetrical if the upper rays are longer than the lower rays or if the longest rays are above the middle of the fin. The distal margin of the fin can be pointed, rounded, square, or emarginate. Some fishes have pectoral fins with the upper rays prolonged giving the fin a sickle shape. Such fins are called falcate.

Palynology — The study of pollen in sediments. Palynologists are thus able to tell what kind of vegetation occurred in the region in the past.

Pelvic fins — Paired fins on the ventral surface. Pelvic fins are described by position: abdominal, thoracic, jugular, or mental; number of rays; and shape. If the rays become shorter posteriorly, the fin is said to be retrogressive; if the rays are longer posteriorly, it is said to be progressive. The fin is pointed if the middle rays are the longest. Sometimes, the posteriormost ray is joined to the body by a membrane for some part of its length.

Pigmentation — In the descriptions, considerable emphasis is placed on describing the patterns of melanophores that are retained after the specimens are preserved.

Pod — A tight school of fish in which the individuals swim in actual physical contact with each other.

Premaxilla — The anteriormost bones of the upper jaw. In advanced fishes, the premaxilla send a process backward that excludes the maxilla from the margin of the upper jaw.

Preoccupied — A name that has been previously used for another organism is said to be preoccupied and is therefore not available for the second organism.

Preopercle — The cheekbone. A superficial, L-shaped bone on the side of the head. Its free edge marks the beginning of the gill cover and consists of a vertical and a horizontal lower limb. Many fishes have serrations along the edge of the preopercle.

Profiles — The outline of the fish as seen in silhouette. A comparison of the the upper and lower profiles is a good measure of the shape of the fish.

Procurent rays — In most fishes, the short unbranched rays at the front of the caudal fin.

Pseudobranchium — A remnant of a gill on the inside of the gill cover.

Pyloric caeca — Finger-like appendages of the digestive tract arising at the beginning of the intestine.

Rays — see fin rays.

Retrorse — Pointing backward. Opposite of antrorse.

River Mile — In the Hudson River, locations are specified by river miles above the Battery. For example, the Tappan Zee bridge is at River Mile 24.

Salt front — Because salt water is more dense than fresh water, it pushes upstream beneath the fresh water as a saltwater wedge. The upper limit of the saline intrusion is the salt front.

Scales — Scales are classified as placoid, the tooth-like scales of sharks and rays; cycloid, the smooth scales; and ctenoid, the rough scales that have tooth-like points on their exposed parts.

Slab sided — Somewhat compressed. A slab-sided fish is nearly oval in cross section with the sides flattened.

Sonic muscles — Specialized muscles, usually associated with the swim bladder, that enable a fish to produce sounds.

Subocular shelf — A bony flange that extends inward from the circumoral bones beneath the eye-ball. Not visible externally.

Substitute name — A name that is proposed to replace a name that is not available for some strictly legalistic reason, for example, a name that is preoccupied, having been used previously for a different organism.

Supramaxillary — A small bone lying along the upper edge of the rear part of the maxillary bone. Usually, the supramaxillary appears to be separated from the maxillary bone by a shallow, externally visible groove.

Survey — Used here to refer to the New York State Conservation Department watershed surveys conducted between 1926 and 1939. Specimens collected in the course of these surveys are simply listed as having been collected by "the Survey".

Sympatric — Occurring in the same geographic region.

Syntopic — Occurring together in the same habitat.

Teardrop — A dark bar below the eye of a fish. Also called the subocular bar.

Teeth — Teeth can occur on several bones: the premaxillary, the maxillary, the vomer, the palatines, the pterygoids, the tongue, the dentary, and the basibranchials. Teeth themselves can be blunt in patches (cardiform or villiform), pointed (caniniform), molar-like (molariform), chisel-like (incisi-

form) or triple-pointed (tricuspid). Fish also have upper and lower pharyngeal teeth above and behind the gills.

Thermocline — In a thermally stratified body of water, the layer of rapid change is the thermocline. Warm water above the thermocline is the epilimnion and water below is the hypolimnion.

Trass — A volcanic rock used in the manufacture of hydraulic cement used in the construction of canal locks.

Trinomial — A name consisting of three words: the genus name, the species name (trivial name), and the name of a subspecies.

Trivial name — The name of the species. A scientific name must consist of a genus name and a species name to be specific. Hence, it is not correct to refer to the species name as the specific name.

Unbranched ray — Soft fin rays are either branched or unbranched. Branched rays divide one or more times toward the margin of the fin; unbranched rays do not divide but they are segmented and have right and left halves.

Vermiculations — Worm-shaped marks, especially those of the upper surface of the brook trout.

Villiform — Teeth that are slender and blunt so they resemble the intestinal villi are said to be villiform.

Vomer — A median bone in the roof of the mouth just behind the upper jaw. In many fishes, the vomer bears teeth. Anatomically, the correct name of the tooth-bearing bone is prevomer.

Weberian apparatus — A chain of bones derived from the vertebral column and connecting the swim bladder with the ear in minnows, suckers, catfishes, and their relatives.

Yolk-sac larvae — Most fishes hatch while they still have a considerable amount of yolk remaining. At this stage, they are sometimes referred to as yolk-sac larvae.

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1967 Systematics of the percid fish, *Etheostoma maculatum* Kirtland, and related species of the subgenus *Nothonotus*. Am. Midl. Nat. 77(2): 296-322.

Alphabetical Serials Index

- Am. Fish Cult.** — American Fish Culturist
Am. Fish. Soc. Spec. Publ. — American Fisheries Society Special Publication
Am. Jour. Sci. Arts — American Journal of Science and Arts
Am. Midl. Nat. — The American Midland Naturalist
Am. Month. Mag. — The American Monthly Magazine
Am. Month. Mag. Crit. Rev. — The American Monthly Magazine and Critical Review (New York)
Am. Mus. Novit. — American Museum Novitates
Am. Nat. — The American Naturalist
Am. Zool. — American Zoologist
Ann. Lyc. Nat. Hist. N.Y. — Annals of the Lyceum of Natural History (New York)
Ann. N. Y. Acad. Sci. — Annals of the New York Academy of Science
Ann. Rep. Forest Fish Game Comm State N. Y. — Annual Report of the Forest, Fish and Game Commission of the State of New York
Ann. Science — Annals of Science
Ann. Wien. Mus. Natur. — Annalen des Naturhistorischen Museums in Wien
ASB Bull. — Association of Southeastern Biologists Bulletin
Biochem. Syst. Ecol. — Biochemical Systematics and Ecology
Biol. Bull. — The Biological Bulletin (Woods Hole, Mass.)
Biol. Conserv. — Biological Conservation
Boston J. Nat. Hist. — Boston Journal of Natural History
Brimleyana — Brimleyana
Bol. Inst. Oceanogr. — Boletim do Instituto Oceanografico (Sao Paolo)
Bol. Mus. Municipal do Funchal — Boletim Museo Municipal do Funchal
Br. J. Anim. Behav. — British Journal of Animal Behavior
Bull. Am. Mus. Nat. Hist. — Bulletin of the American Museum of Natural History
Bull. Ala. Mus. Nat. Hist. — Bulletin of the Alabama Museum of Natural History
Bull. Bingham Oceanogr. Coll. — Bulletin of the Bingham Oceanographic Collection of Yale University
Bull. Br. Mus. (Nat. Hist.) Zool. — Bulletin of the British Museum (Natural History) Zoology
Bull. Buffalo Soc. Nat. Sci. — Bulletin of the Buffalo Society of Natural Sciences
Bull. Fish. Res. Board Can. — Bulletin of the Fisheries Research Board of Canada
Bull. Fla. State Mus. Biol. Sci. — Bulletin of the Florida State Museum of Biological Sciences
Bull. Ill. Nat. Hist. Surv. — Bulletin of the Illinois Natural History Survey
Bull. Ill. State Lab. Nat. Hist. — Bulletin of the Illinois State Laboratory of Natural History
Bull. Inst. Fish. Res. Michigan Dept. Conserv. — Bulletin of the Institute for Fisheries Research of the Michigan Department of Conservation
Bull. Inst. Zool. Acad. Sinica (Taipei) — Bulletin of the Institute of Zoology, Academia Sinica (Taipei)
Bull. Mass. Div. Fish Game — Bulletin of the Massachusetts Division of Fish and Game
Bull. Mich. Dept. Conser. Inst. Fish. Res. — Bulletin of the Michigan Department of Conservation Institute for Fisheries Research
Bull. Mich. Fish Comm. — Bulletin of the Michigan Fish Commission
Bull. Mus. Comp. Zool. — Bulletin of the Museum of Comparative Zoology (Harvard University)
Bull. Nat. Mus. Can. — Bulletin of the National Museum of Canada
Bull. N. Y. Zool. Soc. — Bulletin of the New York Zoological Society
Bull. N. Y. State Mus. — Bulletin of the New York State Museum
Bull. Ohio Biol. Surv. — Bulletin of the Ohio Biological Survey
Bull. Okla. Fish. Res. Lab. — Bulletin of the Oklahoma Fisheries Research Laboratory
Bull. South. Calif. Acad. Sci. — Bulletin of the Southern California Academy of Science
Bull. U. S. Bur. Fish. — Bulletin of the United States Bureau of Fisheries
Bull. U. S. Fish Comm. — Bulletin of the United States Fish Commission
Bull. U. S. Natl. Mus. — Bulletin of the United States National Museum
Bull. Univ. Kans. Mus. Nat. Hist. — Bulletin of the University of Kansas Museum of Natural History
Calif. Dep. Fish Game Fish. Bull. — California Department of Fish and Game Fishery Bulletin
Calif. Fish Game — California Fish and Game
Can. Field-Nat. — Canadian Field-Naturalist
Can. Fish Cult. — Canadian Fish Culturist
Can. J. Earth Sci. — Canadian Journal of Earth Sciences
Can. J. Fish Aquat. Sci. — Canadian Journal of Fisheries and Aquatic Science
Can. J. Fish Biol. — Canadian Journal of Fish Biology
Can. J. Res. — Canadian Journal of Research
Can. J. Zool. — Canadian Journal of Zoology
Can. Nature — Canadian Nature
Can. Tech. Rept. Fish. Aquat. Sci. — Canadian Technical Report of Fisheries and Aquatic Sciences
Chesapeake Sci. — Chesapeake Science
Comp. Biochem. Physiol. — Comparative Biochemistry and Physiology
Conservationist — The Conservationist (Albany, New York)
Copeia — Copeia
Contrib. Can. Biol. — Contributions to Canadian Biology
Contrib. Can. Biol. Fish. — Contribution to Canadian Biology of Fishes
Contrib. Ichthyol. — Contributions to Ichthyology
Cont. Roy. Ont. Mus. Paleont. — Contributions of the Royal

- Ontario Museum of Paleontology
Cranbrook Inst. Sci. Bull. — Cranbrook Institute of Science Bulletin
Dept. Fish. Prov. Quebec Contrib. — Department of Fisheries of the Province of Quebec Contributions
Diss. Abstr. — Dissertation Abstracts B. The Sciences and Engineering
Ecology — Ecology
Ecol. Monogr. — Ecological Monographs
Environ. Biol. — Environmental Biology
Environ. Biol. Fish. — Environmental Biology of Fishes
Estuaries — Estuaries
FAO Fish. Synopsis. — Food and Agricultural Organization of the United Nations Fishery Synopsis
Fish. Bull. — U. S. Fish and Wildlife Service Fishery Bulletin (continued as National Marine Fisheries Service Fishery Bulletin)
Fisheries — Fisheries (Bethesda)
Geol. Assoc. Can. Spec. Pap. — Geological Association of Canada Special Paper
Great Lakes Fish. Comm. Spec. Publ. — Great Lakes Fishery Commission Special Publication
Great Lakes Fish. Comm. Tech. Rept. — Great Lakes Fishery Commission Technical Report.
Great Lakes Res. Div. Univ. Mich. Publ. — Publication of the Great Lakes Research Division of the University of Michigan
Ill. Biol. Monogr. — Illinois Biological Monographs
Iowa State Coll. J. Sci. — Iowa State College Journal of Science
Inst. R. Sci. Nat. Belg. Bull. — Institute Royal Science Natural Belgique Bulletin
Invest. Indiana Lakes Streams — Investigations of Indiana Lakes and Streams
J. Acad. Nat. Sci. Phila. — The Journal of the Academy of Natural Sciences of Philadelphia
J. Anim. Behav. — The Journal of Animal Behaviour
J. Anim. Ecol. — The Journal of Animal Ecology
J. Ariz. Acad. Sci. — Journal of the Arizona Academy of Sciences
J. Biogeogr. — Journal of Biogeography
J. Comp. Neurol. — The Journal of Comparative Neurology
J. Elisha Mitchell Sci. Soc. — Journal of the Elisha Mitchell Scientific Society
J. Exp. Mar. Biol. — Journal of Experimental Marine Biology
J. Exp. Zool. — The Journal of Experimental Zoology
J. Fish Biol. — Journal of Fish Biology
J. Fish Diseases — Journal of Fish Diseases
J. Fish. Res. Board Can. — Journal of the Fisheries Research Board of Canada
J. Freshwater Ecol. — Journal of Freshwater Ecology
J. Gen. Physiol. — Journal of General Physiology
J. Ichthyol. — Journal of Ichthyology (English translation of Voprosy Ikhtiologii)
J. Linn. Soc. London Zoology — The Journal of the Linnaean Society of London Zoology
J. Miss. Acad. Sci. — Journal of the Mississippi Academy of Science
J. Morphol. — The Journal of Morphology
J. Nat. Hist. Boston Soc. Nat. Hist. — Journal of Natural History of the Boston Society of Natural History
J. Physique — Journal du Physique
J. Sci. Lab. Denison Univ. — Journal of the Science Laboratory of Denison University
J. Wash. Acad. Sci. — Journal of the Washington Academy of Science
J. Wildl. Manage. — The Journal of Wildlife Management
J. Zool. (Lond.) — Journal of Zoology (London)
Limnos — Limnos
Lloydia — Lloydia (Cincinnati)
- Mar. Biol. (Berl.)** — Marine Biology International Journal on Life in the Oceans and Coastal Waters (Berlin)
Mem. Amer. Acad. Sci. — Memoirs of the American Academy of Sciences
Mem. Amer. Acad. Arts Sci. — Memoirs of the American Academy of Arts and Sciences
Mem. Mus. Nat. Hist. — Memoirs of the Museum of Natural History
Mem. Sears Found. Mar. Res. — Memoirs of the Sears Foundation for Marine Research
Mich. Acad. — Michigan Academician
Milwaukee Publ. Mus. Occas. Pap. Nat. Hist. — Milwaukee Public Museum Occasional Papers in Natural History
Misc. Publ. Mus. Zool. Univ. Mich. — Miscellaneous Publication of the Museum of Zoology of the University of Michigan
Misc. Publ. Roy. Ont. Mus. Life. Sci. — Miscellaneous Publication of the Royal Ontario Museum of Life Sciences
Monogr. Acad. Nat. Sci. Phila. — Monograph of the Academy of Natural Science of Philadelphia
Nat. Can. — Le Naturaliste Canadienne Biologie Aquatique
N. Y. DEC mimeo. — Mimeographed report of the New York Department of Environmental Conservation
N. Y. Fish. Bull. — New York Fishery Bulletin
N. Y. Fish Game J. — New York Fish and Game Journal
N. Y. Paleontol. Soc. Notes — New York Paleontological Society Notes
N. H. Fish Game Dept. Sur. Rept. — New Hampshire Fish and Game Department Survey Report
NOAA Tech. Rept. NMFS Tech. Circ. (United States) — National Oceanic and Atmospheric Administration Technical Report National Marine Fisheries Service Technical Report
Nouv. Arch. Mus. Hist. Nat. Paris — Nouvelle Archives Museum d'Histoire Naturelle de Paris
Northeast. Environ. Sci. — Northeastern Environmental Science
Occas. Pap. Biol. Field Sta. — Occasional Papers of the Biological Field Station at Cooperstown
Occas. Pap. Mus. Nat. Hist. Univ. Kansas — Occasional Papers of the Museum of Natural History of the University of Kansas
Occas. Pap. Mus. Zool. Univ. Mich. — Occasional Papers of the Museum of Zoology of the University of Michigan
Ohio J. Sci. — Ohio Journal of Science
Okla. Fish. Res. Lab. Bull. — Oklahoma Fisheries Research Laboratory Bulletin
Ont. Mus. Life Sci. Misc. Publ. — Ontario Museum of Life Sciences Miscellaneous Publication
Pap. Mich. Acad. Sci. Arts Lett. — Papers of the Michigan Academy of Science, Arts and Letters
Physiol. Zool. — Physiological Zoology
Proc. Acad. Nat. Sci. Phila. — Proceedings of the Academy of Natural Sciences of Philadelphia
Proc. Amer. Acad. Arts Sci. — Proceedings of the American Academy of Arts and Sciences
Proc. Am. Assoc. Adv. Sci. — Proceedings of the American Association for the Advancement of Science
Proc. Am. Philos. Soc. — Proceedings of the American Philosophical Society
Proc. Ann. Conf. Southeast. Assoc. Game Fish. Comm. — Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners
Proc. Biol. Soc. Wash. — Proceedings of the Biological Society of Washington
Proc. Boston Soc. Nat. Hist. — Proceedings of the Boston Society of Natural History
Proc. Calif. Acad. Sci. — Proceedings of the California Academy of Sciences
Proc. Fla. Acad. Sci. — Proceedings of the Florida Academy of Science

- Proc. Iowa Acad. Sci.** — Proceedings of the Iowa Academy of Science
- Proc. Linnaean Soc. London** — Proceedings of the Linnaean Society of London
- Proc. Minn. Acad. Sci.** — Proceedings of the Minnesota Academy of Science
- Proc. Mont. Acad. Sci.** — Proceedings of the Montana Academy of Sciences
- Proc. Pa. Acad. Sci.** — Proceedings of the Pennsylvania Academy of Science
- Proc. Staten Island Inst. Arts Sci.** — Proceedings of the Staten Island Academy of Arts and Sciences
- Proc. U. S. Natl. Mus.** — Proceedings of the United States National Museum
- Prog. Fish-Cult.** — Progressive Fish-Culturist, U.S. Fish and Wildlife Service
- Publ. Chesapeake Biol. Lab.** — Publications of the Chesapeake Biological Laboratory
- Publ. Inst. Mar. Sci.** — Publications of the Institute of Marine Science
- Publ. Ont. Fish. Res. Lab.** — Publications of the Ontario Fishery Research Laboratory
- Publ. Univ. Kans. Mus. Nat. Hist.** — Publications of the University of Kansas Museum of Natural History
- Publ. Wis. Conserv. Dep.** — Publications of the Wisconsin Conservation Department
- Quart. J. Fla. Acad. Sci.** — Quarterly Journal of the Florida Academy of Sciences
- Quart. J. Sci. Lit. Arts Roy. Inst. London** — Quarterly Journal of Science Literature and Arts of the Royal Institute of London
- Quart. Rev. Biol.** — Quarterly Review of Biology
- Repts. Flora Fauna Wis.** — Reports on the Flora and Fauna of Wisconsin
- Rept. Comm. Fish. State N. Y.** — Report of the Commissioners of Fisheries of the State of New York
- Rept. Mich. Acad. Sci.** — Report of the Michigan Academy of Sciences
- Rept. U. S. Comm. Fish.** — Report of the United States Commissioner of Fisheries
- Rept. U. S. Comm. Fish Fish.** — Report of the United States Commissioner of Fish and Fisheries
- Rept. U. S. Fish. Comm.** — Report of the United States Fish Commission.
- Rev. Can. Biol.** — Revue Canadienne de Biologie
- Roos. Wildl. Ann.** — Roosevelt Wildlife Annals
- Roos. Wildl. Bull.** — Roosevelt Wildlife Bulletin
- Schritt. Ges. Naturf. Freunde Berlin** — Schriften der Berlinischen Gesellschaft Naturforschender Freunde. Berlin
- Science** — Science (Washington, D.C.)
- Sci. Stud.** — Science Studies St. Bonaventure University
- Sci. Amer.** — Scientific American
- Sci. Monthly** — Scientific Monthly
- Smithson. Contrib. Know.** — Smithsonian Contributions to Knowledge
- Smithson. Contrib. Zool.** — Smithsonian Contributions to Zoology
- Smithson. Misc. Coll.** — Smithsonian Miscellaneous Collections
- Smithson. Inst. Ann. Rept.** — Smithsonian Institution Annual Report
- Southwest. Nat.** — Southwestern Naturalist
- Stud. Trop. Oceanogr. Miami** — Studies in Tropical Oceanography University of Miami
- Suppl. Ann. Rept. N.Y. State Conserv. Dept.** — Supplement to the Annual Report of the New York State Conservation Department
- Syllogus** — Syllogus
- Syst. Zool.** — Systematic Zoology
- Tech. Bull. Dept. Nat. Res. Wis.** — Technical Bulletin of the Wisconsin Department of Natural Resources, Madison
- Tex. Rept. Biol. Med.** — Texas Reports on Biology and Medicine
- Tex. Parks Wildl.** — Texas Parks and Wildlife
- Trans. Am. Fish. Soc.** — Transactions of the American Fisheries Society
- Trans. Am. Philos. Soc.** — Transactions of the American Philosophical Society
- Trans. Am. Micr. Soc.** — Transactions of the American Microscopical Society
- Trans. Cleveland Acad. Nat. Sci.** — Transactions of the Cleveland Academy of Natural Science
- Trans. Ill. State Acad. Sci.** — Transactions of the Illinois State Academy of Science
- Trans. Kan. Acad. Sci.** — Transactions of the Kansas Academy of Science
- Trans. Ky. Acad. Sci.** — Transactions of the Kentucky Academy of Science
- Trans. Lit. Philos. Soc.** — Transactions of the Literary and Philosophical Society of New York
- Trans. Roy. Can. Inst.** — Transactions of the Royal Canadian Institute
- Trans. Roy. Soc. London** — Transactions of the Royal Society of London
- Trans. Wis. Acad. Sci. Arts Lett.** — Transactions of the Wisconsin Academy of Science, Arts and Letters
- Trav. Pecheries Que.** — Travaux sur les Pecheries du Quebec
- Tulane Stud. Zool. Bot.** — Tulane Studies in Zoology and Botany
- Underwater Nat.** — Underwater Naturalist
- Univ. Iowa Stud. Nat. Hist.** — University of Iowa Studies in Natural History
- Univ. Kans. Bull. Mus. Nat. Hist.** — University of Kansas Museum of Natural History Bulletin
- Univ. Toronto Stud. Biol. Ser.** — University of Toronto Studies. Biological Series
- U. S. Bur. Sport Fish. Wildl. Tech. Pap.** — United States Bureau of Sport Fisheries and Wildlife Technical Papers
- U. S. Fish Wildl. Serv. Circ.** — United States Fish and Wildlife Service Circular (U. S. Dept. Interior, Fish and Wildlife Service Bureau of Commercial Fisheries Circular)
- U. S. Fish Wildl. Serv. Spec. Sci. Rept.** — United States Fish and Wildlife Service Special Scientific Report
- U. S. Natl. Mar. Fish. Serv. Spec. Sci. Rept.** — United States National Marine Fisheries Service Special Scientific Report
- Va. Agric. Exp. Stn. Tech. Bull.** — Virginia Agricultural Experiment Station Technical Bulletin
- Va. J. Sci.** — Virginia Journal of Science
- Wildl. Monogr.** — Wildlife Monograph
- Wis. Acad. Sci. Arts Lett.** — Wisconsin Academy of Science, Arts, and Letters
- Wis. Conserv. Dep. Tech. Bull.** — Wisconsin Conservation Department Technical Bulletin
- Wis. Conserv. Dept. Publ.** — Wisconsin Conservation Department Publication
- Wis. Dept. Nat. Res. Tech. Bull.** — Wisconsin Department of Natural Resources Technical Bulletin
- Z. Tierpsychol.** — Zeitschrift für Tierpsychologie
- Zool. Jahrbuch** — Zoologische Jahrbuch
- Zoologica** — Zoologica. Scientific Contributions of the New York Zoological Society

Common and Scientific Names Index *

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