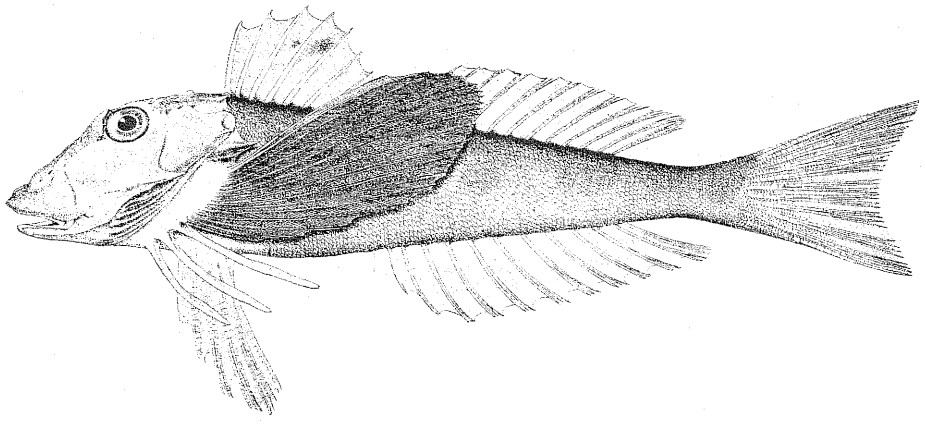

BIOLOGICAL & FISHERIES DATA
ON
NORTHERN SEAROBIN *Prionotus carolinus* (Linnaeus)

JUNE 1978

Biological and Fisheries Data

on

northern searobin, *Prionotus carolinus* (Linnaeus)

by

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Highlands, N. J.

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APPENDIX TABLE

1. IDENTITY

1.1 Nomenclature

1.1.1 Valid Name

Prionotus carolinus Linnaeus, 1771.

Although *Trigla* was the first genus used in classification of searobins from American waters today it is not a recognized genus for North American searobins but rather the European counterpart to the American genus *Prionotus*. *Trigla* was first used by Linnaeus, after Artedi[1], in his tenth edition of Systema Naturae (1758-1759), in which binomial nomenclature has its recognized beginning[2]. *Prionotus* was first used by Lacépède in his "Histoire Naturelle des Poissons" (1798-1803)[3].

The following is a history of the valid name:

Trigla carolina

Linnaeus, 1771, "Mantissa plantarum", Pt. 2, p. 528 (Carolina).

Gmelin, 1788, ed. (in part) Caroli a Linné. Systema Naturae 1(3) Pisces, p. 1347[4].

Lacépède, 1798-1803, Histoire Naturelle des Poissons, *In* Hist. Nat. Buffon 7: 100. Paris.

Cuvier, 1828-1849, Regne Animal (name only).

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[1]Peter Artedi, a naturalist with a greater knowledge of fish than Linnaeus, devised the generic system of ichthyological names used by Linnaeus.

[2]*Trigla gurnardus* L. described.

[3]*Le Prionote volant* described. Other species were described under the genus *Trigla*, including *Trigla carolina*.

[4]*Trigla carolinus* did not appear in the 12th edition of Systema Naturae 1766-1968 but was added to the Systema Naturae in 1788 by Gmelin who compiled those species unrecognized or unknown by Linne.

Prionotus carolinus

Cuvier and Valenciennes, 1828-1849, Histoire naturelle des poissons 4: 90(66-68) (New York; Carolina).

Storer, 1839, Report of Fishes Mass., p. 305-306 (Martha's Vineyard).

DeKay, 1842, Zool. New York (Fishes) p. 46, plate V, fig. 15 (New York Harbor).

Ayres, 1842, Bost. J. Nat. Hist. 4: 258 (Brookhaven, L. I.).

Linsley, 1844, "Cat. Fish. of Conn. 1844".

Storer, 1846, "Synopsis, 51 1846".

Gunther, 1859-1870, Cat. Fish. Brit. Mus. 2: 192 (New York).

Gill, 1873, Cat. Fish. East Coast N. Am., p. 21 (name only).

Jordan and Gilbert, 1878, Proc. U. S. Nat. Mus. p. 373 (Beaufort Harbor).

Bean, 1880, Proc. U. S. Nat. Mus. p. 84 (Noank, Conn.; Woods Holl, Mass.).

Goode and Bean, 1879, Bull. Essex Inst., p. 12 (Salem).

Jordan and Hughes, 1887, Proc. U. S. Nat. Mus. 9: 333 (Cape Ann to S. Carolina).

Jordan and Evermann, 1896-1900, Bull. U. S. Nat. Mus. 47: 2156, pl. 318, fig. 768 (Maine to S. Carolina).

Hildebrand and Schroeder, 1928, Bull. U. S. Bur. Fish. 43(1): 314, fig. 187 (Bay of Fundy to S. Carolina).

Ginsburg, 1950, Tex. J. Sci. 2(4): 500-502 (Mass. to Fla.).

Teague, 1951, Comun. Zool. Mus. Hist. Nat. Montev 3(61): 28-30.

1.1.2 Objective Synonymy

Trigla palmipes

Mitchill, 1814, Trans. Lit. Philos. Soc. N. Y. 1: 431, pl. 4, fig. 5 (New York Harbor).

Prionotus pilatus

Storer, 1848, Proc. Boston Soc. Nat. Hist. 2: 77 (Mass. Bay).

Storer, 1846, "Synopsis, 270, 1846".

Storer, 1867, Hist. Fish. Mass. p. 68, pl. 6, fig. 1 (Mass. Bay).

Gill, 1873, Cat. Fish. East Coast N. Am. p. 21 (name only).

Goode and Bean, 1879, Bull. Essex Inst. p. 12.

Prionotus palmipes

Storer, 1867, Hist. Fish. Mass., p. 66, pl. 5, fig. 1 (Tisbury, Mass.).

Jordan and Gilbert, 1883b, Proc. U. S. Nat. Mus. p. 614.

Jordan and Gilbert, 1883c, Synop. Fish. N. Am. p. 734.

Jordan, 1887b, Cat. Fish. N. A., p. 114 (name only).

Goode, 1885, Nat. Hist. Aquatic Animals, p. 255, pl. 71 (Beesley's Point, N. J.).

Prionotus affinis

Hildebrand and Schroeder, 1928, Bull. U. S. Bur. Fish. 43(1): 315, fig. 188 (off Kent Island, Md. and Old Point Comfort, Va.).

1.2 Taxonomy

1.2.1 Affinities, including key to northwest Atlantic species

Suprageneric - several classifications have been suggested which include the following:

Berg, 1947

Class: Teleostomi
Subclass: Actinopterygii
Order: Perciformes
Suborder: Cottoidei
Superfamily: Scorpaenoidae
Family: Triglidae
Subfamilies: Triglini, Peristediini

Greenwood, Rosen, Weitzman and Myers, 1966

Superorder: Acanthopterygii
Order: Scorpaeniformes
Suborder: Scorpaenoidei
Family: Triglidae

American Fisheries Society (Bailey et al.), 1970

Class: Osteichthyes
Order: Perciformes
Family: Triglidae

Gosline, 1971

Order: Scorpaeniformes
Family: Triglidae

Generic

Twenty-two genera proposed or used for the family Triglidae are listed in Jordan (1923). Only two of these, Prionotus and Bellator and a third, Peristedion (not listed) formerly in the Peristediidae, are used for North American species.

Prionotus - Typically with broad, moderately spiny heads, slender bodies more or less triangular in cross-section, large fan-like pectorals with the lower three rays separate and modified for feeling or "walking" on the bottom, two separate dorsal fins (one spiny and one soft-rayed), and ventral fins located under the pectoral fins. Heads armored with rough bony and spiny plates. DX; 12-13. A 11-12. P(13+3)-(14+3) (Bigelow and Schroeder, 1953).

Bellator - Similar to Prionotus, also has lower three rays of pectoral separate and modified. The first and/or second dorsal spines are often greatly extended depending on sex. Differs from Prionotus chiefly in normally having 11, instead of 10 dorsal spines. DXI; 11-12. A 9-11. P(11+3)-(13+3) (Ginsburg, 1950). Scales large and very rough. Short snout, abruptly descending (Jordan and Evermann, 1896-1900).

Peristedion - Differs from Prionotus in having entire body enclosed in spined bony plates; only two modified pectoral rays; protruding processes on snout; two long barbels on chin (Bigelow and Schroeder, 1953).

Specific

The following fifteen species of Prionotus occur in the western Atlantic (Ginsburg, 1950); however, only twelve of these occur off the coast of the United States. The remainder range from the Caribbean to South America.

P. carolinus (Linnaeus), 1771, northern searobin, Massachusetts to Florida.

P. scitulus Jordan and Gilbert, 1883a, leopard searobin, North Carolina to Florida.

P. roseus Jordan and Evermann, 1887, bluespotted searobin, North Carolina to Florida.

P. ophryas Jordan and Swain, 1885, bandtail searobin, South Carolina to Florida.

P. stearnsi Jordan and Swain, 1885, shortwing searobin, west Florida[5].

P. salmonicolor Fowler, 1903, blackwing searobin, North Carolina to Texas[6].

P. tribulus Cuvier, 1829, bighead searobin, North Carolina to Florida.

P. evolans (Linnaeus), 1766-1768, striped searobin, Massachusetts to Florida.

P. alatus Goode and Bean, 1882, spiny searobin, North Carolina to Louisiana.

P. martis Ginsburg, 1950, barred searobin, west Florida.

P. rubio Jordan, 1887a, blackfin searobin, west Florida.

P. paralatus Ginsburg, 1950, Mexican searobin, Texas.

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[5]Specimens have been taken off Charleston, South Carolina and Jacksonville, Florida in trawl surveys (1972) by the National Marine Fisheries Service.

[6]P. pectoralis is a synonym of P. salmonicolor (Bailey et al., 1970).

P. punctatus Bloch, 1797, Cuba to South America.

P. beanii Goode, Goode and Bean, 1895, sicklefin searobin, Trinidad, South America.

P. nudigula Ginsburg, 1950, Argentina.

P. carolinus differs from other Prionotus species chiefly in two respects: 1) it is one of two species having a distribution in the western Atlantic north of Cape Hatteras, North Carolina (the other is P. evolans) and 2) it is one of two species having 14 normal and 3 modified pectoral rays (the other is P. ophryas). P. carolinus also has a unique combination of finray counts DX; 13. A 12. P(14+3). Other distinguishing morphological characteristics are given in section 1.3.1.

I am aware of only one published pictorial guide to American searobins, Key to the Estuarine and Marine Fishes of Texas, Parker, 1972. p. 138-40. While it appears to be adequate for Gulf species, the following guide to Prionotus species along the Atlantic coast of the United States includes several not found in Parker's key: P. carolinus, P. evolans, and P. alatus.

1.2.2 Taxonomic Status

The northern searobin was originally classified as Trigla carolina in 1771. Since then the genus has been changed to Prionotus (Cuvier and Valenciennes, 1828-1849) and several species names have been used. The first review of the genus was made in 1887 by Jordan and Hughes in which the name Prionotus carolinus was used. With the exception of Hildebrand and Schroeder (1928) who called it Prionotus affinis, the name Prionotus carolinus has been accepted since 1887.

No information is available pertaining to interspecific gradients, however, the northern searobin appears to be a well defined species.

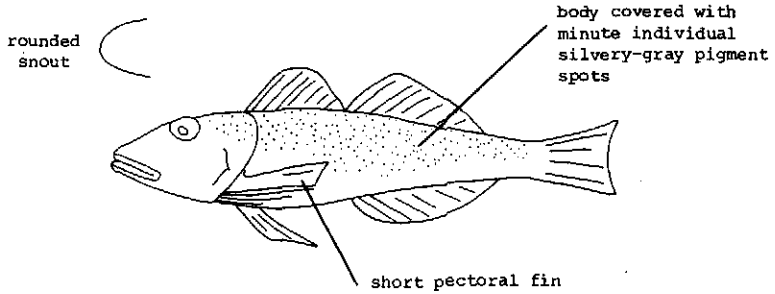
Intraspecific variation is discussed by Ginsburg (see below).

No genetic information is available.

PROVISIONAL GUIDE TO PRIONOTUS SPECIES ALONG THE ATLANTIC COAST OF THE UNITED STATES FROM MAINE TO FLORIDA

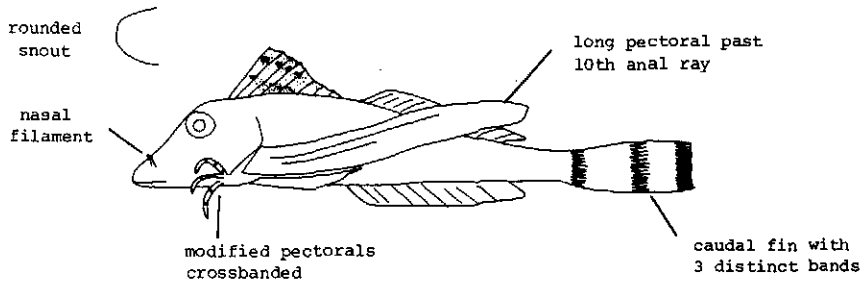
1. P. stearnsi (shortfin searobin)

Pectoral very short - to 1st or 2nd dorsal ray at maximum. Other species with longer pectoral. Occurs SC to FL. DX; 12. All. P(13+3).



2. P. ophryas (bandtail searobin)

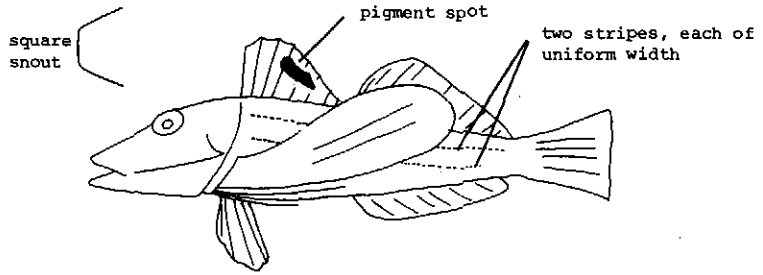
Three distinct bands on caudal fin. Modified pectorals also crossbanded. Diffuse pigment across span of 1st dorsal fin. Filament protruding from anterior nostril. Occurs SC to FL. DX; 12. All. P(14+3).



3. One or two lateral stripes along length of body. Pigment spot between 4th and 6th dorsal spines often spreading. Lachrymal plates extending anteriorly to give a square snout in fish >4" (102 mm).

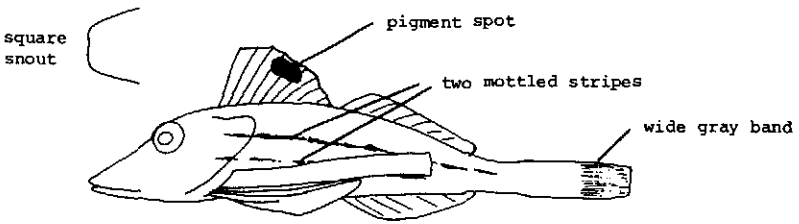
3a. P. evolans (striped searobin)

Two well defined lateral stripes continuous or dashed and of uniform narrow width. Caudal fin of uniform color (no distinct band). Occurs MA to SC. DX; 12-13. All. P(13+3).



3b. P. tribulus (bighead searobin)

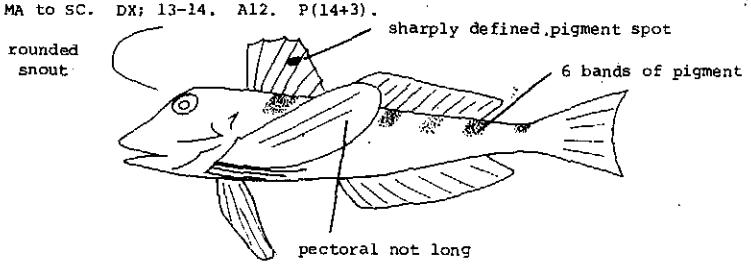
Two mottled or broken lateral stripes of varying width. Caudal fin with distinct wide distal pigment band. Occurs NC to FL. DX; 12. All. P(13+3).



4. Well defined black pigment spot confined between 4th and 5th first dorsal spines.

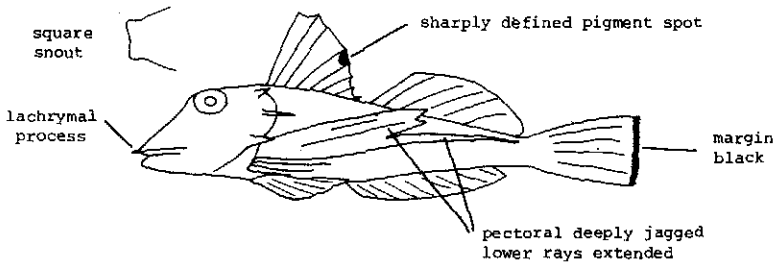
4a. P. carolinus (northern searobin)

Six alternate dark and light bands of pigment dorsally in young specimens - remnants remaining in older specimens. Unique high fin counts. Occurs MA to SC. DX; 13-14. A12. P(14+3).



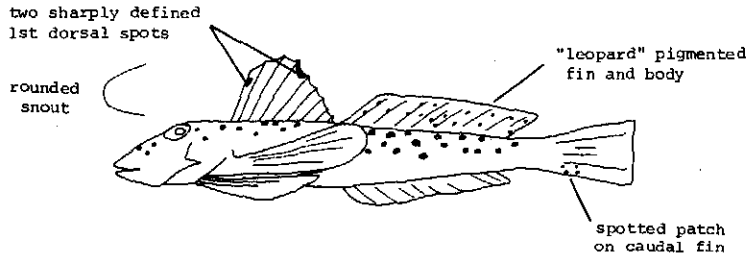
4b. P. alatus (spiny searobin)

Pectoral fin deeply jagged. Caudal fin with black spot or margin distally. Dorsal snout with protruding lachrymal processes. Occurs NC to FL. DX; 12. A11. P(13+3).



4c. P. scitulus (leopard searobin)

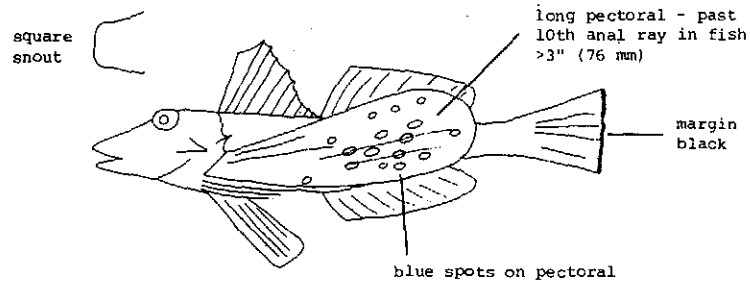
Additional black pigment spot between 1st and 2nd dorsal spines. Upper body and 2nd dorsal fin "leopard" spotted. Slender body. Occurs NC to FL. DX; 13. A12. P(13+3).



5. Pectoral fin long - close to end of anal fin base. Lachrymal plates extending forward to give a square snout.

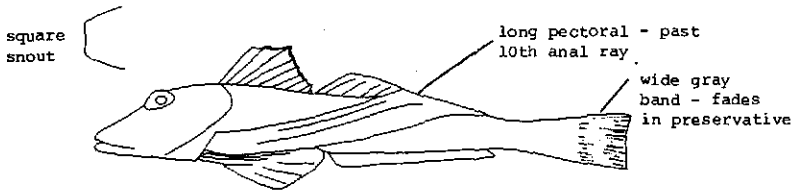
5a. P. roseus (blue spotted searobin)

Blue spots on pectoral. Caudal with black spot on margin distally. Occurs NC to FL. DX; 12. A11. P(13+3).



5b. P. salmonicolor (blackwing searobin)

Uniform or mottled pectoral (not blue spots). Caudal with distinct wide gray distal band. Occurs NC to FL. DX; 12. A11. P(13+3).



1.2.3 Subspecies

Ginsburg (1950) notes "the scale count and the pectoral length of P. carolinus differs with the population, the former decreasing and the latter increasing from north to south." He does not feel this constitutes sufficient grounds for splitting P. carolinus into subspecies.

1.2.4 Standard Common Names, Vernacular Names

The standard common name adopted by the American Fisheries Society is northern searobin (Bailey et al., 1970). Vernacular names include: web-fingered searobin (Jordan and Evermann, 1896-1900); grunter, cuckoo-fish (Goode, 1884); common gurnard, red-winged searobin, pigfish, flying-fish, flying-toad, American gurnard (Smith, 1907); searobin, gurnard, flying fish (Hildebrand and Schroeder, 1928); common searobin (Marshall, 1946); searobin, robin, green-eyes (Bigelow and Schroeder, 1953).

Members of the family Triglidae are often referred to as "gurnards" (akin to French "grogner"-to grunt, growl, grumble) because of the grunting sound they emit. They should not be confused with the "flying gurnard" (family Dactylopteridae, genus Dactylopterus). The only other fish sometimes referred to as gurnard is Callionymus draco. According to Bigelow and Schroeder (1953), "gurnard" is the European terminology and "searobin" American.

1.3 Morphology

1.3.1 External Adult Morphology

Searobins typically have broad, moderately spiny heads, slender bodies triangular in cross-section, large fan-like pectorals with the lower three rays separate and modified for feeling or "walking" on the bottom, two separate dorsal fins (one spiny and one soft-rayed), and ventral fins located under the pectoral fins.

Two detailed descriptions of P. carolinus have been published: Ginsburg (1950) and Teague (1951). That of Ginsburg follows:[7]

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[7]Ginsburg (1950) and Teague (1951) attribute different numbers of pectoral rays to P. carolinus. I have found P. carolinus occurring with 14+3 rays in accordance with Ginsburg rather than the 13+3 of Teague.

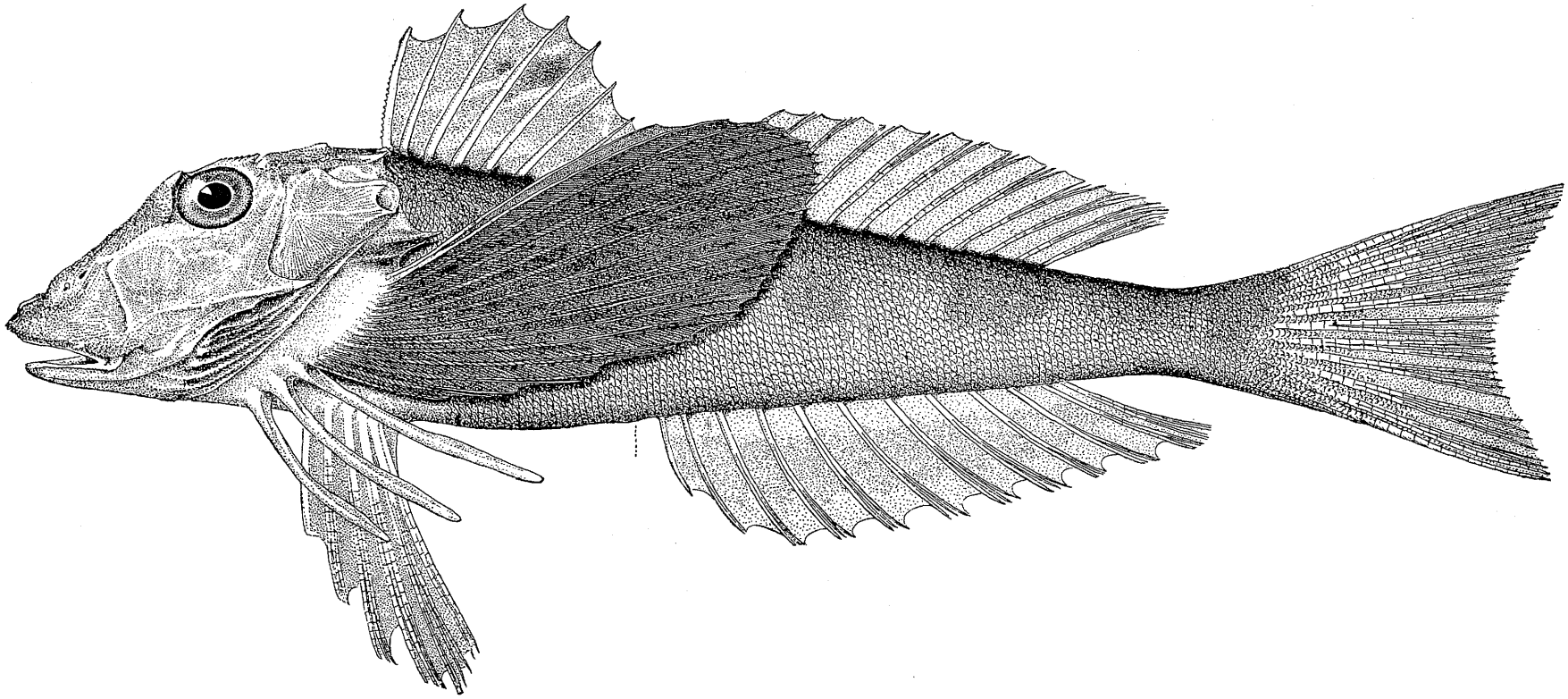

Figure 1. Adult northern searobin from Goode (1884). Drawing by H. L. Todd.

"D(IX) X: 13-14. A. 11-13. P. 13-15. GR 10-13. Sc 99-127. Dorsal rays usually 13, sometimes 14. Anal rays usually 12, infrequently 11 or 13 (in about 2 percent of specimens each).

Attached pectoral rays usually 14, sometimes 13 (in about 8 percent), or 15. Gill rakers usually 1 on upper limb, sometimes 2, rarely none, lower limb usually with 11 or 12, often 13, rarely 10; combined number on both limbs 11-15; tubercles 1-3 on upper limb and 3-6 on lower. Maxillary ending on a vertical nearer posterior nostril than eye, a little in advance of normal position of buccal spinule. Spines on head moderately developed: buccal, rostral and supplemental preopercular spines disappearing at about 70, 150, and 170 mm, respectively, but individual variability of size at disappearance very pronounced; lachrymal plate moderately projecting, its serrature moderately developed. Occipital groove fairly marked in the smaller specimens, its middle and greater portion disappearing with growth, generally only a small terminal part present in large specimens, sometimes a trace of middle part appreciable also in large specimens. Chest fully scaled. (The chest fully scaled in 2 specimens 28 mm, nearly as in adult; in 2 specimens 28 mm, and 4 specimens 27 mm, the chest is all scaled or nearly so but not as fully imbricated as in adult; in one each 26 and 23 mm, the chest naked). First three dorsal spines graduated, the third longest, fourth spine slightly shorter than or subequal to third. Anterior three dorsal spines and first ray moderately serrate; the first ray unbranched. Second ray branched except in infrequent variants. Pectoral not having its distal edge emarginate; fourth ray (from top) longest, the rays decreasing in length both ways, the lower posterior margin making a broad curve; the fin reaching to over base of fifth to eighth anal ray. Caudal well emarginate.

"Measurements of 6 specimens 131-198 mm: depth 18-20, head 33-35, maxillary 10.5-13, interorbital 4-5; eye 6-7. Pectoral measurements...segregated by geographic regions.

"Color pattern variable and changing with growth; young specimens typically with a cross banded pattern, upper part of body having alternate areas of dark and light shades, usually better marked when viewed from dorsal aspect; one dark area under spinous dorsal, two under soft dorsal, one each near its beginning and near its

end, a narrow one at caudal base; this pattern often well or fairly marked in the small specimens, varying from faint to being sharply outlined, often irregularly spotted or blotched; the juvenile pattern tending to disappear with growth, usually absent in large specimens or only a trace left in occasional examples; after disappearance of cross banded pattern, some variants having a row of whitish spots or areas at dorsal profile, usually one between the two fins, two at soft dorsal base, one at caudal base, occasionally white spots up to six in number, the white spots especially marked in dark variants; in addition to cross banded pattern, anterior upper part of body usually with many, small, crowded diffuse spots, only moderately darker than ground color, often the small spots few or absent; the larger specimen often with very small whitish or pearly spots following rows of scales. Pectoral almost uniformly dark to black; often a variable area along upper margin and sometimes also along lower margin whitish; sometimes one or two broad, irregular, oblique cross areas of a slightly lighter tinge; upper region sometimes with faintly outlined small spots of a slightly darker shade than ground color. Spinous dorsal spot confined between fourth and fifth spines, usually placed more or less below edge of fin, usually partly or wholly surrounded by a narrow hyaline or whitish area; this fin usually with lengthwise or oblique, continuous or broken hyaline bands."

Fresh coloration according to Bigelow and Schroeder (1953) is a grayish or reddish brown upper body with five dark saddlelike blotches along the back. Ventrally the body is dirty white or pale yellow. Dorsal fins are grayish with pale spots and stripes and with a black spot between the fourth and fifth spines. Caudal fin gray to brown; anal fin brown; ventrals yellow to brown. Pectorals yellow or orange marked with two broad dusky bars; one medially and one on the outer third. Pectoral filaments orange.

For description of eggs, larvae and juveniles see 3.1.7, 3,2.1, 3.2.2, 3.2.3.

1.3.2 Cytomorphology

No information available.

1.3.3 Protein Specificity

No information available.

2. DISTRIBUTION

2.1 Total Area

Northern searobins occur from the Gulf of Maine to South Carolina, occasionally straying north to the Bay of Fundy and south to Florida. They can be found from the estuaries to the edge of the continental shelf and they prefer a sandy bottom.

2.2 Differential Distribution (size)

2.2.1 Spawn, Larvae and Juveniles

Eggs and larvae - Studies of the identification and distribution of northern searobin larvae at the NMFS Sandy Hook Laboratory, Highlands, New Jersey show that the larvae are found over the entire width of the continental shelf from New York to Cape Hatteras, North Carolina (unpublished data). The eggs and larvae are also reported in estuaries of Rhode Island and Connecticut (Appendix I) however the identification to species is questionable.

Juveniles - Juveniles are regularly mixed with adults in ocean surveys. Few are reported in estuarine surveys with the exception of Richards (1963) who reported 43 juveniles and adults in Long Island Sound (Appendix I).

2.2.2 Adults

Results of surveys conducted by the National Marine Fisheries Service from Cape Canaveral, Florida to Nova Scotia, Canada (Table 1) indicate that adult and juvenile northern searobin north of Cape Hatteras migrate from mid-shelf (15-60 fm) and far-shelf (60-200 fm) waters inshore (0-15 fm) into the Long Island, New York area in April. By May they are found inshore from Block Island, Rhode Island to Cape Hatteras and they remain there until September when a few start migrating to mid-shelf waters again. The last of the searobins are found inshore in December only at the two extremities of distribution, the Montauk Point, New York-Block Island area and off North Carolina.

South of Cape Hatteras northern searobin appear to be scattered over the shelf most of the year although there are no summer data available (Table 1).

TABLE 1. Distribution of northern searobins (juvenile and adult) along the Atlantic coast of the United States as reported in five continental shelf survey programs. ✓ indicates presence; X indicates absence.

		North of Cape Hatteras, North Carolina		
		Inshore 0-15 fm	Mid-Shelf 15-60 fm	Far-Shelf 60-200 fm
Winter	1971 March		✓ (a)	✓ Block Island, RI to Cape Hatteras, NC (a)
	1972 March		✓ Block Island, RI to Cape Hatteras, NC (a)	✓ Block Island, RI to Cape Hatteras, NC (a)
	1973 March	X Only Cape Cod, MA to NJ surveyed (a)	✓ Cape Cod, MA to Cape Hatteras, NC (a)	✓ Cape Cod, MA to Cape Hatteras, NC (a)
	1974 Mar.-Apr.		✓ Block Island, RI to Chesapeake Bay (a)	✓ Block Island, RI to Chesapeake Bay (a)
	1975 March	X Only NY and NJ surveyed (a)	✓ Montauk Pt., NY to Chesapeake Bay (extent of survey area) (a)	✓ Montauk Pt., NY to Chesapeake Bay (extent of survey area) (a)
Spring	1973 May-June	✓ Block Island, RI to Cape Hatteras, NC except in MD-VA area (a)		
	1974 April	✓ Only off NY (a)		
Summer	1970 August	✓ Long Island, NY to VA (b)		
	1971 July-Aug.	✓ Primarily from Long Island, NY to VA (b)	X (b)	
	1975 September	✓ NY to MD (extent of survey area) (a)	✓ NY to MD (extent of survey area) (a)	X (a)
Fall	1971 October		✓ Cape Cod, MA to VA (a)	X (a)
	1972 Sept.-Oct.		✓ Cape Cod, MA to NC (a)	X (a)
	1972 Nov.-Dec.	✓ Around Delaware and Chesapeake Bays (a)		
	1973 Sept.-Oct.		✓ MA to NC (a)	X (a)
	1973 Oct.-Nov.	✓ Block Island, RI to Cape Hatteras, NC (a)		
	1974 Sept.-Oct.	✓ Block Island, RI to Oregon Inlet, NC (a)	✓ Block Island, RI to Oregon Inlet, NC (a)	✓ Block Island, RI to Oregon Inlet, NC (a)
	1975 Oct.-Nov.	✓ Cape Cod, MA to Cape Hatteras, NC (a)	✓ New York Harbor to Chesapeake Bay (a)	✓ MD to VA (a)
	1975 December	✓ Off Montauk Pt., NY, Block Island, RI, and off NC (a)	✓ Block Island, RI to Cape Hatteras, NC (a)	✓ MD to NC (a)

		South of Cape Hatteras, North Carolina		
		Inshore 0-15 fm	Mid-Shelf 15-60 fm	Far-Shelf 60-200 fm
Winter	1960 Dec.-Jan.		✓ Cape Romain, SC to Savannah, GA (c)	✓ Cape Fear, NC to St. Johns River, FL (c)
	1972 March	✓ Ponce de Leon Inlet, FL (b)	✓ Charleston, SC to Ponce de Leon Inlet, FL (b)	✓ Cape Fear, NC (b)
Spring	1972 May	✓ Cape Hatteras, NC to Charleston, SC (b)	✓ Cape Hatteras, NC to Cape Canaveral, FL (b)	✓ Cape Hatteras, NC to Charleston, SC (b)
	1974 April	✓ Cape Hatteras, NC to GA (a)		
Fall	1971 Nov.	✓ Cape Hatteras, NC to Charleston, SC (b)	✓ Cape Hatteras, NC to FL (b)	✓ Cape Hatteras, NC to Charleston, SC (b)
	1972 Oct.-Nov.	X (a)	✓ Cape Hatteras, NC to St. Johns River, FL (a)	X (a)

Description of surveys and data: (a) Grosslein, 1969 (data available through the Northeast Fisheries Center, Resource Surveys Investigation, Woods Hole, Massachusetts)

(b) Wilk and Silverman, 1976

(c) Bullis and Thompson, 1965

Several hundred northern searobin have been reported in both estuarine trawl surveys of the Delaware River and Chesapeake Bay (Appendix I) and salt-water angling surveys of estuaries from Maine to Cape Hatteras (Table 2).

2.3 Determinants of Distribution

Temperature and time of year - Marshall (1946) found searobin species entered New England waters at water temperatures slightly above 4.4 °C and left at temperatures a little below 15.5°C. Abbe (1967) found that the northern searobin in the Delaware River left at higher temperatures: of the 794 caught, only ten were taken after September when the temperature fell below 18°C.

Salinity - Abbe (1967) took no northern searobin taken below 20 o/oo and only a few below 27 o/oo in the Delaware River.

2.4 Hybridization

No information available.

3. BIONOMICS AND LIFE HISTORY

3.1 Reproduction

3.1.1 Sexuality

Heterosexual. Hermaphroditism not reported.

3.1.2 Maturity

Northern searobin reach sexual maturity at an age of 2-3 years and ∿200 mm, corresponding to about 85 g, in the Chesapeake Bight (Wong, 1968). Marshall (1946) found one-year olds (14 cm) from New England waters capable of producing ripe eggs, however the ovaries were small and the numbers of eggs few.

3.1.3 Mating

Moulton (1958) has indirect evidence that searobins produce a staccato call thought to characterize the breeding season as opposed to a grunting sound they usually emit (see 3.5.3, auditory).

3.1.4 Fertilization

External.

3.1.5 Gonads

Immature - no information available.

Developing - Testes opaque white and elongate (approximately 40 x 10 mm in an adult). Eggs not visible to the eye. Ovaries yellow to orange (pers. observ.).

Ripe - Testes opaque white. Ovaries yellow to orange, eggs visible, granular texture, faint to prominent blood vessels, triangular shape. Adult specimen 240 and 265 mm in length and ovaries weighing 10.66 to 9.27 g respectively (pers. observ.).

Marshall (1946) reports "variability" of egg size and development is conspicious throughout. The largest eggs, whether ripe or partially so, are not grouped but are scattered amongst less developed eggs of diverse sizes. Correlated with this is the fact that few eggs are ripe at any one time and the breeding season is somewhat prolonged."

The diameter of the largest eggs taken from several ripe ovaries averaged 0.2 mm to 1.0 mm (Marshall, 1946).

3.1.6 Spawning

Wong (1968) in his study of northern searobin from the continental shelf of the Chesapeake Bight reports that "gonads of sexually mature fish began to increase in size in March. By May, some fish were gravid, and in July the running ripe condition was observed. Running ripe fish were prevalent in August and early September. Most fish were spent by November, except for a few males. The gonads of fish caught in February appeared little different from those found in November. The incomplete data indicated that the spawning season in 1966 in the Chesapeake Bight was July, August and at least part of September." Kuntz and Radcliffe (1918) reported spawning occurred earlier at Woods Hole in June, July and early August.

No information available pertaining to the act of spawning.

3.1.7 Spawn

"The eggs are spherical in form at 1 to 1.15 mm in diameter. They are slightly yellowish in color, but highly transparent. The yolk sphere contains a variable number (10 to 25) of oil

TABLE 2. Number of searobins caught by anglers in the estuaries and ocean north of Cape Hatteras, North Carolina in 1965 and 1970 (Deuel and Clark, 1968; Deuel, 1973).

	Number caught (in thousands)			
	Cape Hatteras-New Jersey		New York-Maine	
	Estuaries	Ocean	Estuaries	Ocean
1965	1,004	720	1,783	508
1970	1,433	4,398	1,810	1,010

globules of unequal size scattered over the surface. As development advances, some of these globules may become aggregated. Usually, however, they remain distributed more or less uniformly over the surface of the yolk. The egg membrane is thin and horny." (Kuntz and Radcliffe, 1918).

See section 3.2.1 for egg development and illustrations.

3.2 Pre-Adult Phase (to sexual maturity)

3.2.1 Embryonic Phase

The following is from Kuntz and Radcliffe (1918) who described and illustrated artificially fertilized northern searobin eggs.

"...eggs develop in a manner typical of pelagic teleostean eggs. They are somewhat larger than the eggs of Tautoga onitis, and therefore development advances somewhat less rapidly. The volume of protoplasm in proportion to the volume of yolk is relatively small, yet the blastodisc is relatively thick; consequently, during the early stages of cleavage [Figure 2b] the blastoderm covers a relatively small area of the surface of the yolk sphere.

"The first act of cleavage occurs within 1.5 hours after fertilization. The successive acts of cleavage follow each other very regularly. The early blastoderms are usually more nearly symmetrical than are those of Tautoga onitis or either of the other species described. A blastoderm of 16 cells in which symmetry is somewhat disturbed is illustrated in Figure [2c].

"Within 20 hours after fertilization [Figure 2e] the embryo is well differentiated and extends halfway around the circumference of the yolk sphere. The blastopore is not yet closed. The embryo shows 10 to 12 somites and pigmentation has already begun. Numerous yellow and black pigment cells are present over the entire surface of the embryo and in the adjacent areas of the extra-embryonic blastoderm. Pigment cells arise earliest in the embryo and gradually become apparent in the remoter parts of the blastoderm. Yellow pigment arises somewhat earlier than black pigment in these embryos.

"At 42 hours after fertilization [Figure 2f] both black and yellow chromatophores are larger and fewer in number than during the earlier stages. They are now sparsely distributed over the surface of the embryo and throughout the extra-embryonic blastoderm."

See section 3.1.1 for external morphology.

3.2.2 Larval Phase

Kuntz and Radcliffe's (1918) following description and illustrations of larvae through 3.4 mm are of reared material. Larvae 4-10 mm are presumably described and illustrated from planktonic material. The illustration of the 9 mm larva is now typical of a northern searobin larva (i.e., caudal peduncle too deep), however it is included for completeness.

"...incubation in water at a temperature about 22°C occupied approximately 60 hours. The newly hatched larvae [Figure 3a] are approximately 2.8 mm in length. The yolk sac is relatively small and still contains oil globules. The head is not markedly deflected. The vent is located just posterior to the yolk sac. The pectoral fins are prominent (the depth of either dorsal or ventral fin fold is greater than the depth of the body posterior to the vent). Black and yellow chromatophores are sparsely scattered over the head, the anterior region of the trunk, and the dorso-lateral and ventrolateral aspects of the trunk farther posteriorly. The body is marked further by two transverse yellow bands, one just posterior to the pectoral fins, the other approximately halfway from the vent to the posterior end of the body. These bands of pigment extend onto the fin folds. The general color of the head and pectoral fins is yellowish. In Figures [3a] and [3b] black pigment is indicated by solid color, while yellow pigment is indicated by short lines.

"As development advances a material reduction of the yellow pigment becomes apparent. Five days after hatching [Figure 3b] the yellow markings characteristic of the newly hatched larvae are no longer apparent. The head and the pectoral fins still show yellow pigment. Some yellow chromatophores also remain at the vent and at the former location of the posterior transverse band. Black chromatophores are sparsely scattered over the body and a few appear also in the dorsal and ventral fin folds. The posterior caudal region remains practically free from pigment.

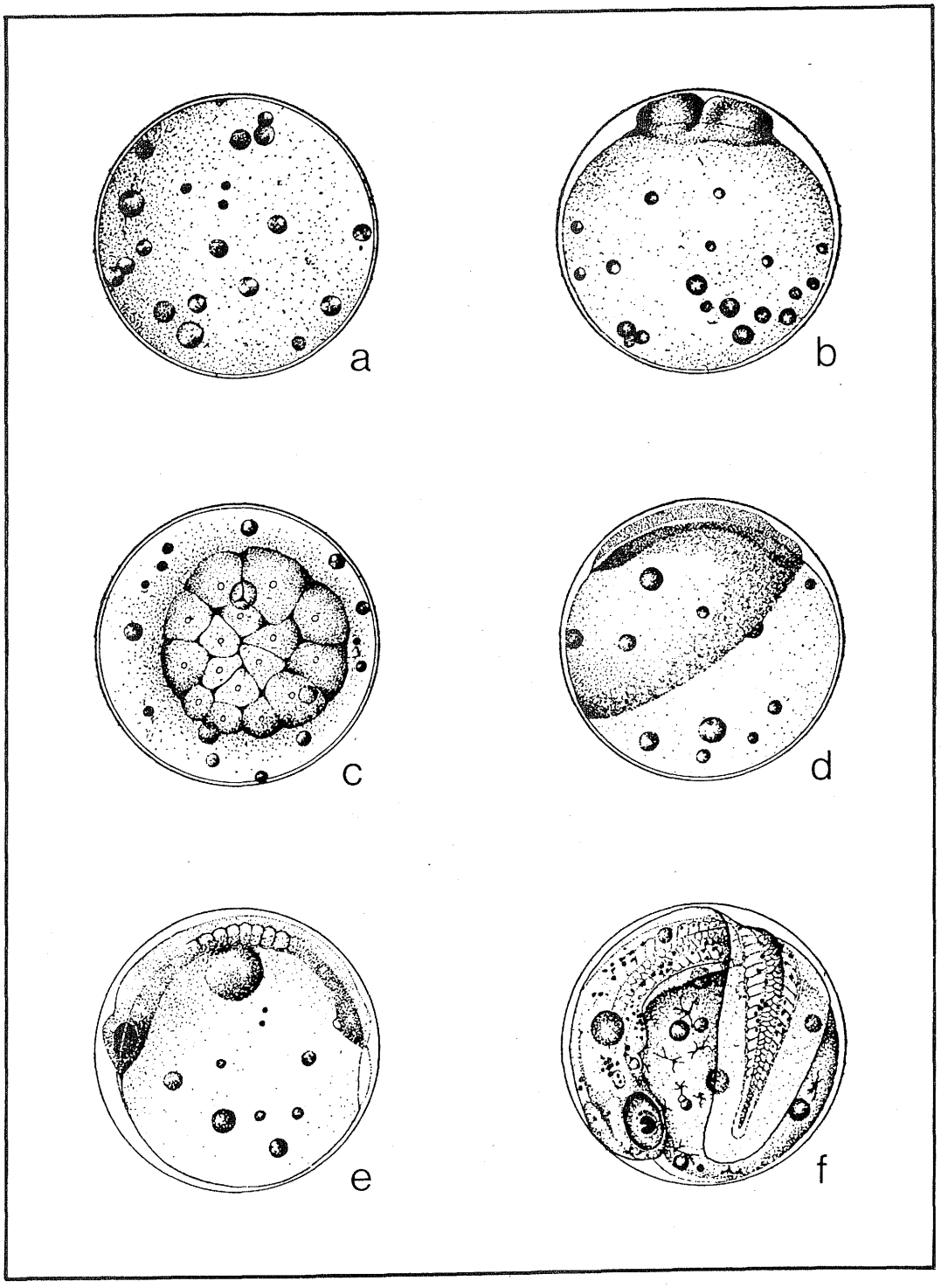

Figure 2. Egg development of the northern searobin from Kuntz and Radcliffe (1918).

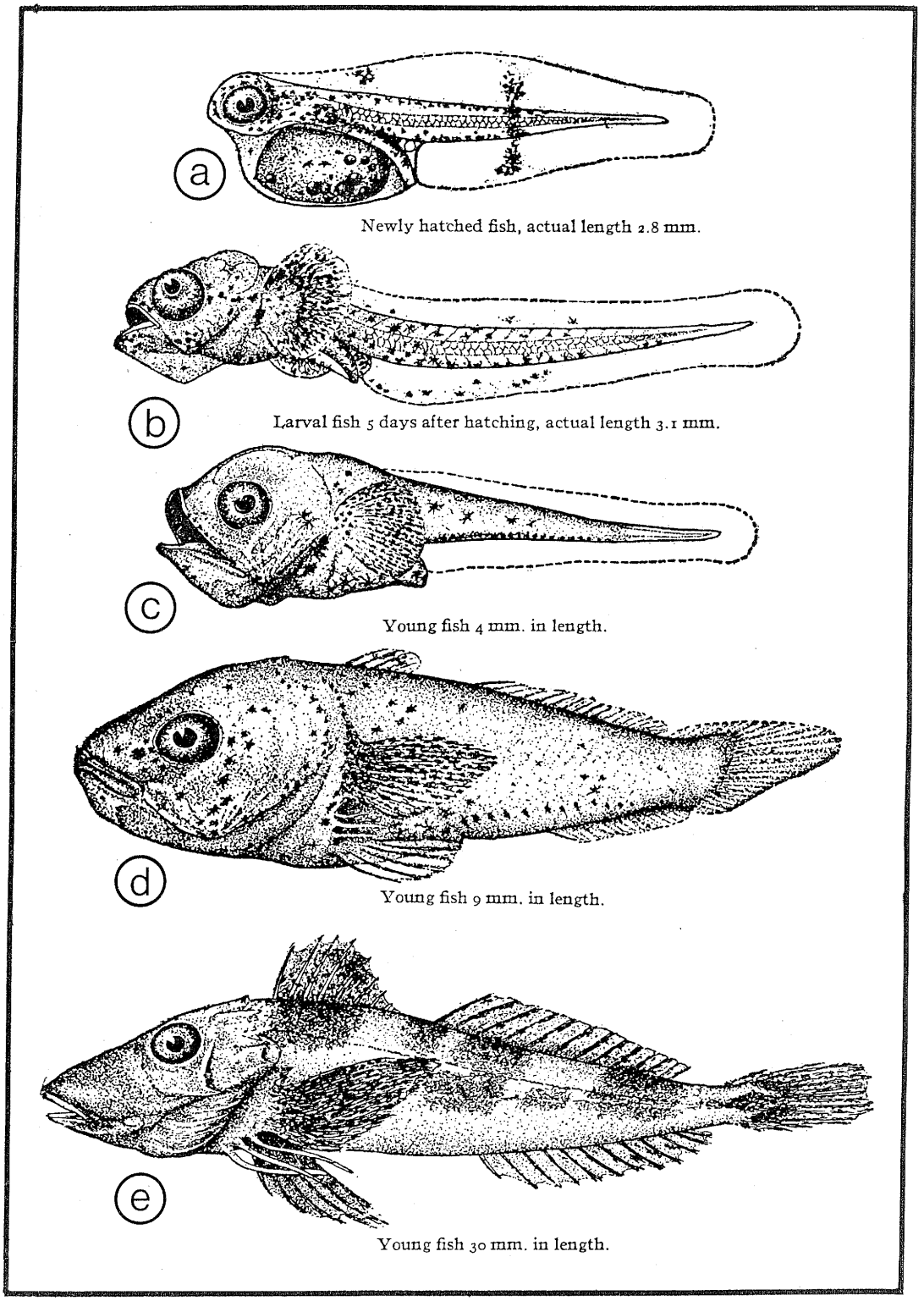

Figure 3. Larval development of the northern searobin from Kuntz and Radcliffe (1918).

"Larval fish five days old have grown to a length of 3.1 to 3.4 mm. The head is relatively large. The pectoral fins are large and prominent. The critical period for this species is reached during the fifth or sixth day after hatching; when kept in dishes of sea water, few survived until the seventh day.

"Young fish 4 mm in length [Figure 3c] are characterized by a very large head and relatively great depth of the body in the anterior region of the trunk. The ground color of the body remains yellowish. Black chromatophores occur sparsely scattered over the dorsal and lateral aspects of the body and in a series along the ventrolateral aspect of the body near the base of the ventral-fin fold.

"In young fish 8 to 10 mm in length [Figure 3d] the dorsal, anal, and caudal fins are becoming well differentiated, and the free rays of the pectoral fins characteristic of the species are already present. The general color of the body and the distribution of black chromatophores remain essentially as in the preceding stage."

3.2.3 Adolescent Phase

The following description is from Kuntz and Radcliffe (1918).

"In young fish 25 to 30 mm in length [Figure 3e] the general color of the body has become darker, and the trunk is marked by heavily pigmented areas that give it a transversely banded appearance. The fins are well differentiated. The head is long and somewhat pointed and shows the bony structure characteristic of the adult. The young fish are gradually assuming the appearance of the adults and already show many of the diagnostic characters of the species."

3.3 Adult Phase

3.3.1 Longevity

From a study of otoliths, Wong (1968) determined the oldest fish in his Chesapeake Bight samples to be eleven years (298 mm, 326 g). He did not report abundance of each age group.

3.3.2 Hardiness

Northern searobin can tolerate a temperature difference of 13°C (28°F). Temperatures range from 19°C (68°F) inshore in the summer to 6°C (40°F) offshore in the winter (Bigelow and Schroeder, 1953).

3.3.3 Competitors

No information available.

3.3.4 Predators

Dusky shark, sand bar shark (Casey, 1964), man.

3.3.5 Parasites, Diseases, Injuries and Abnormalities

Parasites of northern searobin listed by Linton (1901) from Woods Hole specimens are:

Nematodes -

Ascarids - immature; encapsuled in peritoneum.

Cestodes -

Rhynchobothrium - encysted on viscera.
Tetrarhynchus bisulcatus Linton - encysted in stomach and intestine.

Trematodes -

Distomum appendiculatum Rudolphi - intestine.
Distomum sp. - intestine.
Diplostomum sp. - intestine.

No information is available as to diseases, injuries and abnormalities.

3.4 Nutrition and Growth

3.4.1 Feeding

The digging and "feeling" movement exhibited by the modified pectorals of searobins has been connected with the search for food. In 1884, Goode observed searobins using their modified pectorals to stir up the weeds and sand to rout out the small animals on which they fed. Bardach and Case (1965) supported the

observation with their findings that blinded anosmic searobins responded by digging when food extracts were placed in the water proximal to their modified pectorals (see 3.5.3, chemical).

Although research indicates that the modified pectorals are involved with the detection of food, the findings of Marshall (1946) indicate that searobins most likely feed on organisms on or just above the bottom rather than burrowed in the bottom. This conclusion was reached when he compared the stomach contents of searobins with the most abundant organisms listed by Lee (1944) in his bottom samples of the same area and found little correlation.

3.4.2 Food

A typical description of northern searobin stomach content from the Woods Hole region was made by Linton (1901) as follows:

"Stomachs and intestines of this species have yielded a variety of material. In one specimen were found a young herring, several young clams (Mya), two shrimp (Palaemonetes), and a pebble. Small specimens have yielded shrimps in large numbers, amphipods and other small crustaceans, squid and lamellibranch mollusks, annelids, and seaweed. One small specimen had four young winter flounder in its stomach."

Bigelow and Schroeder (1953) gave the following general listing: shrimps, crabs, amphipods, squids, bivalve mollusks, annelid worms, small fish (i.e. herring, menhaden, winter flounder), seaweed, any bait.

A more detailed analysis of stomach content is given in Marshall (1946) who found that while copepods were eaten in large quantities by young-of-the-year northern searobin from the Woods Hole, Massachusetts area they were not consumed by older fish. The major diet items of the older fish were Mysis americana (Mysidacea), Gammarus locusta (Amphipoda) and/or various other amphipods, depending on location. Crago septemspinosus (Decapoda), various annelids, cumacean, gastropods, pelecypods, fish and eggs along with sand and seaweed were consumed in small amounts.

Further analysis is given in Richards (1963) who notes that a significantly greater food diversity is found in younger specimens of northern searobin.

3.4.3 Growth Rate

The following statistics from Wong (1968) are based on otolith readings taken from northern searobin in the Chesapeake Bight:

Age	Length (mm)	Weight (g)	Average Length (mm)	Average Weight (g)
I	72-213	10-105	155	41
II	168-232	37-148	200	85
III	193-255	80-170	221	117
IV	222-274	115-260	242	157
V	204-305	125-265	250	181
VI	236-290	135-267	259	204
VII	240-287	172-297	265	221
XI			289	326

Although the longest searobin reported by Wong was 305 mm, Bigelow and Schroeder (1953) states that northern searobin in New England waters reach a maximum of 381-406 mm (15-16 inches) with fish less than 305 mm (12 inches) common.

Wilk, et al. (in press) found a statistically significant difference in the weight of male and female northern searobin of the same length from the New York Bight. While length-weight slopes for the two sexes did not differ significantly ($P>0.05$), the intercepts did ($P<0.01$). Calculated weights of females 200 mm long were found to be 4% heavier than males of the same length.

Length-weight equations and sample size (n) for northern searobin from trawl surveys in the New York Bight from June 1974-June 1975 were:

$$\log_{10} W = -4.9951 + 2.9935 (\log_{10} L),\ n = 257 \text{ males}$$

$$\log_{10} W = -5.0242 + 3.0135 (\log_{10} L),\ n = 248 \text{ females}$$

W = weight (g)
L = fork length (mm)

3.4.4 Metabolism

No information available.

3.5 Behavior

3.5.1 Migration

A seasonal migration occurs north of Cape Hatteras; inshore during spring months and offshore in late fall (see 2.2.2). Not enough data is available to determine if there is inshore-offshore migration south of Cape Hatteras or the extent of a north-south migration, if any.

3.5.2 Schooling

There is no evidence of schooling although occasional large catches of fish are reported in the results of the National Marine Fisheries Service spring and fall groundfish surveys offshore near the 100 fathom line. These catches range from 300 to several thousand fish with one catch of 39,280 reported off Maryland in the 1973 spring groundfish survey. In general, searobins are taken regularly, with the numbers varying with the time of year and distance from shore.

3.5.3 Response to Stimuli

Auditory - Moulton (1955, 1958) discusses possibility of eliciting a staccato call from searobins, thought to characterize the breeding season, by playing imitations and recordings of the call into the water. Parker (1912) found that in a controlled study of response to sound made by an iron ball hitting the side of a wooden tank that "P. carolinus...exhibited unmistakable tendencies to gather near the sound center."

Optical - Roberts (1968) reported that as a result of visual disturbances, the searobin exhibited ventilatory pauses, and changes both in rate and amplitude and an associated transitory bradycardia (of the heart).

Chemical - Bardach and Case (1965) found blinded anosmic searobins showed a strong digging response when extracts of rotted clams, worms or squid were applied to the water near their modified pectoral fins. The responses to fresh extracts was weaker. The fish had a positive response to milk. The digging response was elicited also by application of several amino acids. When the lips or mouth were stimulated, the animals responded by swallowing or gulping instead of digging.

4. POPULATION

4.1 Structure

4.1.1 Sex Ratio

Wong (1968) found the sex ratio approximately 1:1 for northern searobin in the Chesapeake Bight. Wilk, et al. (1975) found the same ratio in the New York Bight.

4.1.2 and 4.1.3 Size and Age Composition

From interpretation of a length-frequency graph given in Wong (1968), 180-300 mm in length fish is present in the Chesapeake Bight year-round. This size class includes fish from I-VIII years in age. A second length-frequency group, less than 180 mm, was also present year-round. These fish are age groups 0 or I and the progression of their modal length depends on the season.

4.2 Abundance and Density

Relative abundance - Marshall (1946) reported northern and striped searobin to be in the ratio of 2.5:1 from June to September in Buzzards Bay and Vineyard Sound, Massachusetts. A similar ratio was obtained in the New York Bight (Wilk et al., 1977).

Results of National Marine Fisheries Service sport fishing surveys in the northeastern United States from June 1973 to June 1974 rank searobins tenth in weight of "other finfish"[8] falling behind bluefish, striped bass, weakfish, tautog, scup, dogfish, other (miscellaneous species), spot and black sea bass in descending order. They ranked higher than croakers, cunner, cusk, black drum, red drum, kingfishes, Spanish mackerel, puffers, shad, skates, smelt, tilefish and toadfish (U. S. Department of Commerce, National Marine Fisheries Service, 1976).

Of the 21 groups of "other finfish" mentioned above, ICNAF commercial landings record searobins varying usually from 9th to 18th in weight over a 12 year period with a single high rank of third in 1968. They were generally greater than the angler, tilefish, wolffishes, bluefish, croaker, black sea bass, spot and squeateague (U. S. Department of Commerce, National Marine Fisheries Service, 1976).

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[8]"other finfish" - defined by the International Commission for the Northwest Atlantic Fisheries (ICNAF) as all species except cod, haddock, redfish, silver hake, red hake, pollock, sea herring, mackerel, flounders, large pelagic fish (like tuna, swordfish and sharks other than dogfish), billfishes and menhaden.

A summary of mean catch per tow data from fall bottom trawl surveys of the National Marine Fisheries Service, 1963-74 (Table 3) gives an idea of fluctuations in abundance. Searobins in the southern New England area (ICNAF 6A and 5ZW) remained at a fairly constant low level, increasing slightly in 1972. In the middle Atlantic area (ICNAF 6B and 6C) searobins were far more abundant in 1967. In 1968 they decreased abruptly, continuing downward to a low level in 1974.

Actual abundance - No information available.

4.3 Natality and Recruitment

No information available.

4.4 Mortality and Morbidity

No information available.

4.5 Dynamics of Population (as a whole)

No information available.

4.6 The Population in the Community and the Ecosystem

See 3.5.2.

5. EXPLOITATION

Sport fishery - Searobins are good fighters and they are comparable in quality to a kingfish or whiting as food (Goode, 1884). Despite this, they are generally considered a nuisance to most fishermen as they are spiny to handle and there is relatively little of them that can be eaten.

Commercial fishery - Searobins are considered trash fish and are taken incidently with the food fish catch or with the trash fish catch. I know of no special fishery for searobins.

5.1 Fishing Equipment

Sport - Searobins bite at any type of fresh bait. Results of salt water angling surveys (Table 4) indicate that the majority of searobins are caught from stationary boats. Many searobins are caught from shore with still bait. Off New England, searobins are caught principally around bridges, piers and jettys, whereas south of New York Harbor, more are caught from beaches and banks.

TABLE 3. Mean catch per tow (kilograms) of searobins in NMFS strata, with approximately corresponding ICNAF Divisions (Figure 2), from Albatross IV autumn bottom trawl survey data, 1967-74 (Clark and Brown, 1977).

NMFS Strata	ICNAF Division or Subdivision	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
61-76	6B, 6C					130.1	13.8	5.4	6.9	3.1	1.7	1.9	1.9
1-12	6A, 5Zw	1.0	0.8	0.5	0.7	0.8	0.3	0.5	0.2	0.3	4.7	0.3	0.1

TABLE 4. Number of searobins reported in 1960, 1965 and 1970 salt-water angling surveys by region and method of fishing (Clark, 1963; Deuel and Clark, 1968; Deuel, 1973).

Year	Region	No. of Anglers (thousands)	No. of Searobins Reported (thousands)				
			Boat		Shore		
			Still	Moving	Still	Moving	Total
1960	North Atlantic	24	287	3	-	3	293
	Middle Atlantic	44	2,747	-	236	-	2,983
	South Atlantic	3	-	-	3	-	3

Year	Region	No. of Anglers (thousands)	Boat	Bridge Pier Jetty	Beach Bank	Total
1965	North Atlantic	134	2,079	149	63	2,391
	Middle Atlantic	95	1,327	8	389	1,724
	South Atlantic	-	-	-	-	-

Year	Region	No. of Anglers (thousands)	Boat	Bridge Pier Jetty	Beach Bank	Total
1970	North Atlantic	263	2,556	177	87	2,820
	Middle Atlantic	367	5,194	188	449	5,831
	South Atlantic	4	-	-	4	4

Commercial - Snow (1950) reported that the boats used by the trash fishery at New Bedford, Massachusetts were small draggers with an average length of 51 feet and an average of 26 tons. The gear was the same used for otter trawling operations except that a liner of 1½ or 2-inch mesh was inserted in the cod end of the net to support the heavy weight of a haul of trash fish.

Most ports taking searobins do not have a specific trash fishery but take searobins incidently with their regular food fish catch. Searobins are mostly taken with the otter trawl, pound net and floating traps (Table 5). A few are reported in fyke net, hoop net, haul seine and purse seine catches.

5.2 Fishing Areas

The greatest catches of northern searobin are made from Cape Fear, North Carolina to Block Island, Rhode Island although they are common from South Carolina to the Gulf of Maine. They are usually found on sandy bottoms. They tend to keep to the bottom but swim actively and are sometimes caught close to the surface.

5.3 Fishing Seasons

Inshore - May through October.

5.4 Fishing Operations and Results

Sport - See Table 6.

Commercial - Commercial catch records are influenced by the fact that 1) many states do not have scrap fisheries and thus many fish are thrown overboard; 2) some states (Delaware and North Carolina) have not reported searobins; and 3) fishing areas for individual states overlap and may vary from year to year. Therefore, reported numbers are of limited value for searobins (Table 7), except for evaluating general trends.

Nominal catches of Atlantic shelf searobins by ICNAF countries from 1964-1973 are given in Table 8. ICNAF fishing areas are shown in Figure 4.

TABLE 5. Commercial landings of searobins, by gear. Numbers in pounds. (U. S. Dept. Commer. B. F. 1930-1940; U. S. Dept. Int. F.W.S. 1942-1969; U. S. Dept. Commer. NMFS 1971-1976).

	Massachusetts		Rhode Island			Connecticut				New York					New Jersey			Maryland		Virginia		
	Pound Net	Otter Trawl	Floating Trap	Otter Trawl	Pound Net	Otter Trawl	Hand Line	Gill Net	Pound Net	Otter Trawl	Pound Net	Fyke; Hoop Net	Floating Trap	Gill Net	Otter Trawl	Pound Net	Purse Seine	Otter Trawl	Pound Net	Otter Trawl	Pound Net	Haul Seine
1930	87,450	-	101,978	4,500	-	40,556	-	-	500	-	11,139	-	3,115	400	-	117,747	-	600	-	-	-	-
1935	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	600	-	-
1940	700	19,500	112,400	2,400	400	6,500	100	200	-	23,700	34,300	-	-	-	7,100	97,000	-	-	-	8,200	2,000	-
1945	-	2,500	9,700	-	-	18,500	300	-	-	3,400	3,400	-	-	-	3,600	300	-	-	-	10,200	-	-
1950	-	-	68,100	2,800	-	-	-	-	-	36,900	-	-	-	-	2,300	52,100	-	-	-	30,800	-	-
1955	-	16,500	6,200	5,200	-	14,500	-	-	-	11,500	-	-	-	-	400	1,500	-	-	-	2,400	-	-
1960	-	-	205,200	4,200	-	5,000	-	-	-	2,700	3,500	-	-	-	-	17,800	-	-	-	500	-	-
1961	-	-	187,800	3,000	-	22,100	-	-	-	100	5,500	-	-	-	-	2,600	-	-	-	-	-	-
1962	-	-	98,700	-	-	11,600	-	-	-	-	-	-	-	-	1,000	-	-	-	-	3,000	-	-
1963	-	-	130,000	1,400	-	3,400	-	-	-	1,100	9,800	-	-	-	-	19,700	-	72,100	-	3,100	-	-
1964	-	-	88,200	-	-	7,400	-	-	-	-	25,000	-	-	-	-	43,500	-	525,400	-	6,300	-	-
1965	-	-	252,000	-	-	10,500	100	-	-	6,500	66,300	-	-	-	174,000	-	-	-	-	7,800	-	-
1966	200	-	207,100	-	-	30,800	200	-	-	1,900	38,700	-	-	-	-	190,100	-	455,500	-	-	13,000	-
1967	-	-	125,700	100	-	28,500	300	-	-	17,600	46,800	-	-	-	-	-	-	321,000	-	2,700	14,200	-
1968	-	-	224,400	-	-	100,000	-	-	-	50,400	5,600	-	-	-	300	5,800	-	26,800	-	-	67,200	7,000
1969	600	-	71,700	-	-	600	200	-	-	29,400	35,800	-	-	-	-	2,500	-	85,900	-	-	1,000	-
1970	-	-	128,500	-	-	9,400	-	-	-	39,400	35,800	-	-	-	-	-	-	39,900	-	-	-	-
1971	-	-	70,100	-	-	90,100	-	-	-	111,600	30,400	-	-	-	13,500	600	-	-	-	-	-	-
1972	-	-	139,700	-	-	31,100	-	-	-	42,100	2,200	300	-	-	-	600	700	-	-	-	-	-
1973	-	-	151,500	-	-	600	-	-	-	-	11,700	40,500	-	-	6,900	400	-	-	-	-	600	-

- no record

TABLE 6. Number of searobins caught per angler in 1960, 1965 and 1970 (Clark, 1963; Deuel and Clark, 1968; Deuel, 1973).

	North Atlantic	Middle Atlantic	South Atlantic
1960	12.2	67.8	1
1965	17.1	18.1	0
1970	10.7	15.9	0

TABLE 7. Commercial fisheries statistics for searobins (in thousands of pounds).

Year	MA	RI	CT	NY	NJ	MD	VA
1928	<1	468	14	30	23	-	50
1929	-	255	30	23	40	1	-
1930	<1	194	41	15	118	1	-
1931	<1	101	29	33	70	1	-
1932	5	81	30	15	17	<1	-
1933	<1	74	3	19	11	1	-
1934	<1	74	3	19	11	-	1
1935	18	219	40	47	45	-	-
1936	18	219	40	47	45	-	1
1937	56	103	22	16	55	-	3
1938	81	289	4	12	73	-	3
1939	52	203	13	37	58	-	38
1940	20	115	7	58	104	-	10
1941	20	115	7	58	104	-	-
1942	-	100	1	63	94	-	3
1943	-	51	29	45	25	-	3
1944	-	32	63	43	4	-	32
1945	3	10	19	7	4	-	10
1946	-	8	43	9	4	-	12
1947	-	15	56	5	5	-	21
1948	-	14	144	5	9	-	30
1949	-	9	120	17	24	-	15
1950	-	71	37	37	54	-	31
1951	-	72	245	5	6	-	103
1952	1	9	68	3	14	-	116
1953	15	68	5	20	12	-	1
1954	-	144	4	22	14	-	4
1955	16	11	14	12	2	-	2
1956	1	7	5	20	263	-	8
1957	-	226	29	83	127	-	14
1958	-	476	5	-	48	-	10
1959	-	220	7	3	273	-	-
1960	-	205	5	6	18	-	1
1961	-	188	22	6	3	-	-
1962	-	99	12	-	1	-	3
1963	-	130	3	11	20	72	3
1964	-	88	7	25	44	525	6
1965	-	252	11	72	174	-	8
1966	1	207	31	40	190	456	13
1967	-	126	29	64	-	321	17
1968	-	224	100	56	6	27	74
1969	1	72	1	65	3	86	1
1970	-	129	9	75	-	40	-
1971	-	70	91	142	14	-	-
1972	-	140	31	45	1	-	-
1973	-	151	1	52	7	-	628
1974	656	230	-	42	1	-	-
1975	-	116	-	45	667	-	-
1976	125	70	-	38	1,210	-	-

- No record

TABLE 8. ICNAF nominal catches of searobins by country in subarea 5, Georges Bank and the Gulf of Maine, and statistical area 6, Middle Atlantic Bight, 1964-73 (metric tons).

Area	GDR		JAP		POL		ROM		USSR		USA		TOTAL	
	5	6	5	6	5	6	5	6	5	6	5	6	5	6
1964	-	-	-	-	-	-	-	-	-	147	14	-	14	147
1965	-	-	-	-	-	-	-	-	-	-	300	-	300	-
1966	-	-	-	-	-	-	-	-	98	1,279	94	-	192	1,279
1967	-	-	-	-	-	-	-	-	124	370	94	196	218	566
1968	-	-	-	-	-	-	-	-	1,130	7,872	102	239	1,232	8,111
1969	-	-	-	-	-	-	-	-	1,758	145	156	1,590	1,914	1,735
1970	-	-	-	41	-	-	-	-	-	258	148	141	148	440
1971	-	-	4	20	-	-	-	-	46	792	50	110	100	922
1972	15	31	-	-	-	-	29	-	283	3,489	47	26	374	3,546
1973	-	1	-	-	962	90	-	-	604	1,172	37	37	1,603	1,300

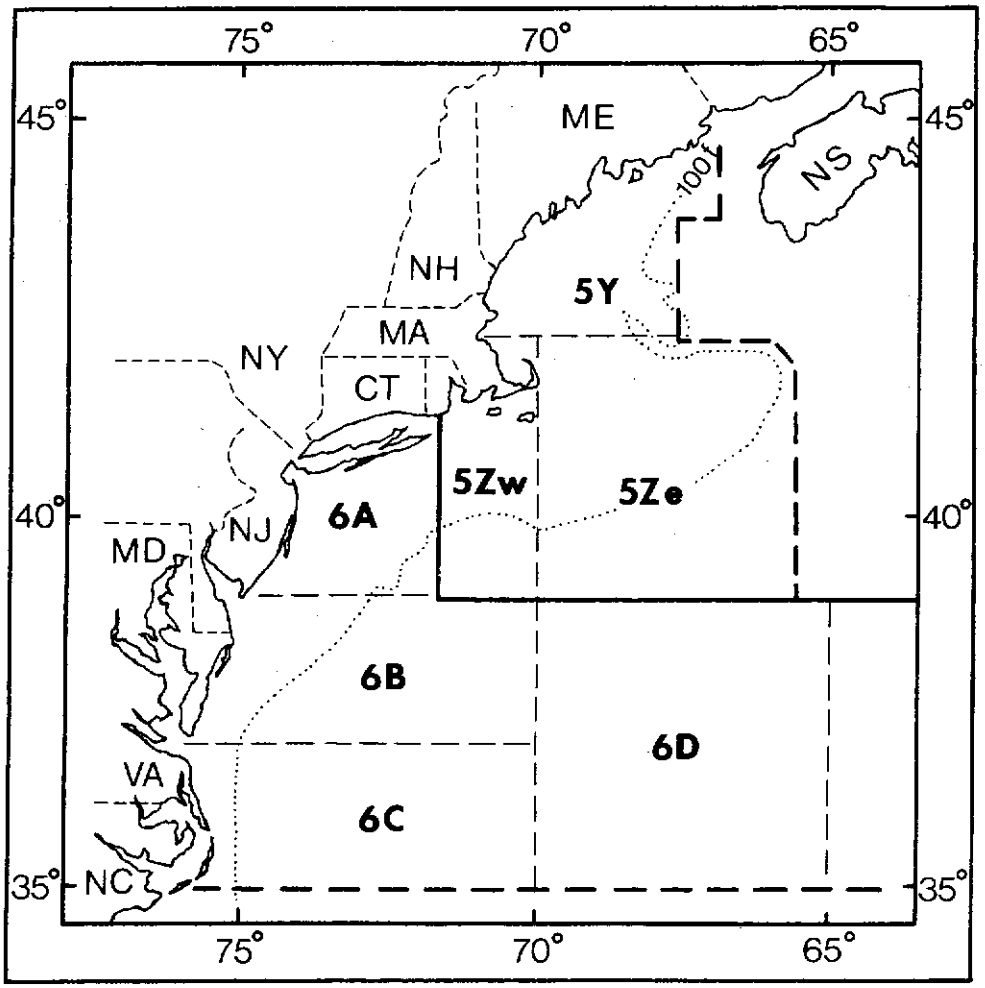

Figure 4. Portion of the Atlantic coast showing locations of ICNAF Subarea 5 and Statistical Area 6.

6. PROTECTION AND MANAGEMENT

6.1 Regulatory Measures

At present searobins fall within the category "other finfish".[8] A total allowable catch (TAC) is set by ICNAF for these fish collectively. The TAC recommended by the NMFS for 1977 was 150,000 tons. On attainment of the quota all fisheries are terminated and subsequently only incidental catches (1% of the total weight of all other fish on board) are allowed (U. S. Department of Commerce, National Marine Fisheries Service, 1976).

6.2 Control or Alteration of Physical Features of the Environment

No information available.

6.3 Control or Alteration of Chemical Features of the Environment

No information available.

6.4 Control or Alteration of Biological Features of the Environment

No information available.

6.5 Artificial Stocking

No information available.

7. AQUACULTURE

No information available.

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[8]"other finfish" - defined by the International Commission for the Northwest Atlantic Fisheries (ICNAF) as all species except cod, haddock, redfish, silver hake, red hake, pollock, sea herring, mackerel, flounders, large pelagic fishes (like tuna, swordfish and sharks other than dogfish), billfishes and menhaden.

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APPENDIX I. Summary of estuarine surveys to 1975 along the Atlantic coast of the United States with number of searobins taken.

Estuary	Reference	Frequency and Dates of Survey	Method of Catch	Eggs and Larvae (# caught and dates)	Juveniles and Adults (# caught and dates)
Maine - none					
New Hampshire - none					
Massachusetts					
Merrimack River (9 stations)	Jerome, Chesmore, Anderson and Grice 1965	monthly Jan.-Dec. 1964	minnow seine haul seine trawl		no searobins taken
Parker-River-Plum Island Sound (9 stations)	Jerome, Chesmore and Anderson 1968	monthly Jan.-Dec. 1965	minnow seine haul seine trawl		no searobins taken
Essex Bay (9 stations)	Chesmore, Brown and Anderson 1973	monthly May-Dec. 1969	seine trawl		no searobins taken
Annisquam River-Gloucester Harbor Coastal System (8 stations)	Jerome, Chesmore and Anderson 1969	monthly Apr. 1966-Mar. 1967	minnow seine haul seine shrimp trawl		no searobins taken
Beverly-Salem Harbor (9 stations)	Jerome, Chesmore and Anderson 1967	monthly Jan.-Dec. 1965	minnow seine haul seine trawl		no searobins taken
Lynn-Saugus Harbor (9 stations)	Chesmore, Brown and Anderson 1972	monthly June 1968-June 1969	minnow seine haul seine trawl		no searobins taken
Dorchester Bay (9 stations)	Chesmore, Testaverde and Richards 1971	monthly June 1967-May 1968	haul seine shrimp trawl		no searobins taken
Quincy Bay (9 stations)	Jerome, Chesmore and Anderson 1966	monthly Jan.-Dec. 1964	minnow seine haul seine trawl		no searobins taken
Hingham Bay (13 stations)	Iwanowicz, Anderson and Ketschke 1973	monthly	beach seine haul seine shrimp trawl otter trawl		no searobins taken
North River (6 stations)	Fiske, Watson and Coates 1966	monthly June 1964-June 1965	minnow seine haul seine shrimp trawl		no searobins taken
Wellfleet Harbor (9 stations)	Curley, Lawton, Whittaker and Hickey 1972	monthly Sept. 1968-Aug. 1969 (except Dec.)	beach seine otter trawl		P. carolinus(1) adult, Oct. P. evolans(2) adults, Sept.
Pleasant Bay (6 stations)	Fiske, Watson and Coates 1967	monthly Jan.-Dec. 1965	beach seine haul seine otter trawl		no searobins taken
Waquoit Bay-Bel Pond (7 stations)	Curley, Lawton, Hickey and Fiske 1970	monthly June 1967-May 1968 (except Jan. and Feb.)	shrimp trawl beach seine		P. carolinus(4) adults, Aug.-Sept. P. evolans(1) adult, Aug.
Weweantic River	Lebida 1969	monthly, bimonthly and weekly Jan.-Dec. 1966	plankton nets seine otter trawl fyke nets gill nets		P. carolinus(1-5) present but rare
Westport River (6 stations)	Fiske, Curley and Lawton 1968	monthly May 1965-1966	haul seine shrimp trawl		P. carolinus(5) adults, Sept.-Oct.
Rhode Island					
Narraqansett Bay (4 stations)	Herman 1963	weekly Mar. 1957-Mar. 1958	meter net Clarke-Bumpus sampler	P. carolinus(1,395) eggs, June-Aug. P. evolans(3,488) eggs, June-Aug. P. spp.(285) larvae July-Sept.	
Pettaquamscutt River and Pt. Judith Pond (4 stations)	Mulkana 1966	summer and early fall 1962	shore seine		P. evolans(4) juveniles in river

APPENDIX I (continued)

Estuary	Reference	Frequency and Dates of Survey	Method of Catch	Eggs and Larvae (# caught and dates)	Juveniles and Adults (# caught and dates)
Connecticut					
Block Island Sound	Merriman and Sclar 1952	monthly Aug. 1943-July 1946	trawl plankton net	no searobins reported	no searobins reported
Mystic River	Pearcy and Richards 1962	weekly, biweekly and monthly Feb. 1959-Feb. 1960 eggs and larvae July 1958-Feb. 1960 juveniles and adults	hook and line plankton net small beam trawl otter trawl beach seine trapnet, dipnet	P. carolinus(6) eggs, July-Aug., (2) larvae, June-Aug.	P. carolinus(6) juveniles and adults, Aug.-Oct.
New Haven Harbor	Warfel and Merriman 1944	biweekly July 1942-June 1943	haul seine		P. carolinus(1) juvenile, summer P. evolans(92) juveniles, Aug.-Sept.
Long Island Salt Waters (large # localities)	Greeley 1939	July-Aug.	fine-mesh seine		P. carolinus(1) young adult, Aug. P. tribulus(11) juveniles, July-Aug.
Long Island Salt Waters (56 stations)	Perlmutter 1939	monthly May-Oct. 1938	plankton nets Griek trawl shrimp trawl otter trawl	P. carolinus(285) eggs, May-Aug., (14) larvae, June-Sept. P. evolans(several) eggs, May-July	P. carolinus(19) juveniles P. evolans(21) juveniles, Oct.
Long Island Sound (4-20 stations)	Wheatland 1956	biweekly Mar. 1952-Mar. 1954	Clarke-Bumpus plankton sampler	P. carolinus(22) eggs, June-Aug. P. evolans(25) eggs, June P. spp.(2) larvae, July-Aug.	
Long Island Sound	Richards 1959	35 cruises Apr. 1954-Nov. 1955	Clarke-Bumpus sampler	P. carolinus(35) eggs, June-Aug. P. evolans(11) eggs, June-Aug. P. spp.(7) larvae, July-Aug.	
Long Island Sound (2 stations)	Richards 1963	nearly every two weeks July 1956-July 1957	modified shrimp trawl		P. carolinus(143) juveniles and adults, May-Nov. P. evolans(3) adults, May-Aug.
Long Island Sound	Williams 1968	19 days Apr. 1964-May 1966	Clarke-Bumpus sampler	P. spp.(>100) eggs	
New York					
Lake Montauk (2 stations)	Austin 1973	monthly July 1971-Dec. 1972	plankton nets	P. spp.(11) larvae, July 1972, (1,738) eggs, July 1971, (8,256) eggs, June-Sept. 1972	
Great South Bay (3 stations)	Briggs and O'Connor 1971	random dates May-Oct. 1967 May-Nov. 1968 (no seining June of either year)	seine		P. carolinus(1) juvenile, Sept.
Hudson River (9-12 stations)	Perlmutter, Schmidt and Leff 1967	1-4 times/mo. each sta. June-Aug. 1964 and 1965	seine		all species not reported
Hudson River (9-12 stations)	Perlmutter, Schmidt Heller, Ford and Sininsky 1968	1-4 times/mo. each sta. June-Aug. 1964 and 1965	seine		all species not reported
New Jersey					
Sandy Hook Bay (6 stations)	Croaker 1965	monthly, weekly Oct. 1960-1961	plankton nets	P. spp.(281) eggs, May-June	
Corson and Manasquan Inlets	Murawski 1970	"continuous monitoring" Apr. 1967-Mar. 1969	plankton nets	P. spp.(4,143) eggs, June-Sept., (64) larvae, July-Oct.	

APPENDIX I (continued)

Estuary	Reference	Frequency and Dates of Survey	Method of Catch	Eggs and Larvae (# caught and dates)	Juveniles and Adults (# caught and dates)
Delaware River	deSylva and Kalber 1960	monthly Sept.-Nov. 1958	otter trawl		P. carolinus(150) adults, Sept. P. evolans(13) adults, Sept.-Nov.
Delaware River (20 shore sites)	deSylva and Kalber and Shuster 1962	alternate months and biweekly Aug. 1958-Feb. 1960	haul seine		P. carolinus(1) juvenile, Aug., adults common summer and fall. P. evolans, adults common summer and fall.
Delaware River (12 zones)	Abbe 1967	monthly Aug.-Oct. once Nov.-Jan. Aug. 1966-Jan. 1967	otter trawl		P. carolinus(794) adults, most Aug.-Sept. P. evolans(95) adults, most Aug.-Sept.
Rehoboth and Indian River Bays (18 stations)	Derickson 1970	monthly June 1968-May 1969	seine otter trawl		P. carolinus(5) juveniles, July
Maryland					
Isle of Wight and Assawoman Bays (66 stations)	Schwartz 1964	various dates Mar.-Oct. 1959-63	otter trawl trap nets beach seine oyster trays hook and line		P. carolinus juvenile and adults common May-Sept. P. evolans adults, Aug.-Sept
Chincoteague and Sinepuxent Bays	Schwartz 1961	monthly trawl Mar.-Dec. 1959	beach seine crab potting hook and line oyster test travs otter trawl		P. carolinus adults present May-Sept.
Chincoteague Bay (oyster beds)	Arve 1960	3 times a week Aug.-Nov. 1958 and 59	wire traps		no searobins taken
Patuxent River (96 stations)	Mansueti 1950	1-3 times a year spring, fall and winter	minnow seine bag seine box traps hoop net dipnet		no searobins taken
Virginia					
Chesapeake Bay (22-24 stations)	Massmann and Mansueti 1963)	4 cruises Sept. 1957; Jan., Apr., and July 1958	otter trawl		P. carolinus(4) young adults July, Sept. and Jan.
Rappahannock River (16 stations)	Massmann, Ladd and McCutcheon 1952	22 cruises Mar.28-Nov. 6, 1951	trawl		no searobins taken
Chesapeake Bay, York and Pamunkey Rivers (16 stations)	Massmann 1962	monthly in 1958 most months 1956, 1957, 1959	semi-balloon shrimp trawl		P. carolinus(345) Mar.-Dec. P. evolans(21) May-Nov.
Pamunkey River (9 stations)	Raney and Massmann 1953	weekly seining June 28-Sept. 29, 1949	minnow seine surface trawl roten one bottom trawl plankton net	no searobins taken	no searobins taken
North Carolina					
Beaufort area and Neuse River	Tagatz and Dudley 1961	monthly and biweekly Mar. 1957-Feb. 1960	haul seine	P. carolinus(17) larvae, Sept.	P. carolinus(1) juvenile, Apr. (2) adults, Aug.
Beaufort Inlet area (7 stations)	Pearse, Humm and Wharton 1942	weekly in summer 1939 and 1941; irregularly rest of year	seine otter trawl		P. carolinus common on sandy bottoms P. scitulus present

APPENDIX I (continued)

Estuary	Reference	Frequency and Dates of Survey	Method of Catch	Eggs and Larvae (# caught and dates)	Juveniles and Adults (# caught and dates)
South Carolina					
South Carolina Estuaries (33 stations)	Shealy, Miglarese and Joseph 1974	central estuaries monthly, others quarterly Feb. 1973-Jan. 1974	bottom trawl		P. carolinus(3) P. evolans(1) P. tribulus(24) juveniles
Georgia					
Sapelo and St. Catherine Sounds (14 stations)	Dahlberg and Odum 1970	3-week intervals Jan. 1967-Feb. 1968	otter trawl		P. pectoralis(1) Jan. P. evolans(147) most months P. scitulus(87) most months
Ossbaw and Wassaw Sounds	Mahood, Harris, Music and Palmer 1974	monthly Oct. 1972-Sept. 1973	otter or shrimp trawl gill net seine		Triglidae 21.4 lb. trawled all year; none seined
Doby and Sapelo Sounds	Mahood, Harris, Music and Palmer 1974	monthly Oct. 1971-Sept. 1972	otter or shrimp trawl gill net seine		Triglidae 34.3 lb. trawled all year; none seined
St. Andrews and St. Simons Sounds	Mahood, Harris, Music and Palmer 1974	monthly Oct. 1970-Sept. 1971	otter or shrimp trawl gill net seine		Triglidae 77.7 lb. trawled all months; none seined
Florida					
St. Johns River (12 stations)	Tagatz 1968	several to many times yearly Apr. 1961-Nov. 1963	seine trawl		P. scitulus(25) juveniles, June-Oct. P. tribulus(28) juveniles, most months
St. Lucie River (13 stations)	Gunter 1963	5 scattered months each year Jan. 1957-Jan. 1959	seine otter trawl		P. tribulus(4) juveniles, Jan.
St. Lucie and Indian Rivers	Springer 1960	3 surveys Sept. 1957, Mar. 1958, and Mar. 1959	trawl		no searobins taken

NORTHEAST FISHERIES CENTER
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TECHNICAL SERIES REPORTS

NUMBER	TITLE AND AUTHOR	DATE
1	Proceedings of a workshop on egg, larval and juvenile stages of fish in Atlantic coast estuaries, by Anthony L. Pacheco (editor).	August 1973
2	Diagnosis and control of mariculture diseases in the United States, by Carl J. Sindermann (editor).	December 1974 (out of print)
3	Oxygen depletion and associated environmental disturbances in the Middle Atlantic Bight in 1976 (composite authorship).	February 1977 (out of print)
4	Biological and fisheries data on striped bass, Morone saxatilis (Walbaum), by W. G. Smith and A. Wells.	May 1977 (out of print)
5	Biological and fisheries data on tilefish, Lopholatilus chamaeleonticeps Goode and Bean, by Bruce L. Freeman and Stephen C. Turner.	May 1977
6	Biological and fisheries data on butterfish, Peprilus triacanthus (Peck), by Steven A. Murawski, Donald G. Frank, and Sukwoo Chang.	March 1978
7	Biological and fisheries data on black sea bass, Centropristis striata (Linnaeus), by Arthur W. Kendall.	May 1977
8	Biological and fisheries data on king mackerel, Scomberomorus cavalla (Cuvier), by Peter Berrien and Doris Finan.	November 1977
9	Biological and fisheries data on Spanish mackerel, Scomberomorus maculatus (Mitchill), by Peter Berrien and Doris Finan.	November 1977
10	Biological and fisheries data on Atlantic sturgeon, Acipenser oxyrhynchus (Mitchill), by Steven A. Murawski and Anthony L. Pacheco.	August 1977
11	Biological and fisheries data on bluefish, Pomatomus saltatrix (Linnaeus), by Stuart J. Wilk.	August 1977 (out of print)

NUMBER	TITLE AND AUTHOR	DATE
12	Biological and fisheries data on scup, Stenotomus chrysops (Linnaeus), by Wallace W. Morse.	January 1978
13	Biological and fisheries data on northern searobin, Prionotus carolinus (Linnaeus), by Susan C. Roberts.	June 1978
14	A guide for the recognition of some disease conditions and abnormalities in marine fish, by Carl J. Sindermann, John J. Ziskowski, and Valentine T. Anderson.	March 1978
15	Ichthyoplankton from the RV Dolphin survey of continental shelf waters between Martha's Vineyard, Massachusetts and Cape Lookout, North Carolina, 1965-66, by P. L. Berrien, M. P. Fahay, A. W. Kendall, Jr., and W. G. Smith.	March 1978
16	The seasonal maxima of Ceratium tripos with particular reference to a major New York Bight bloom, by John B. Mahoney.	June 1978