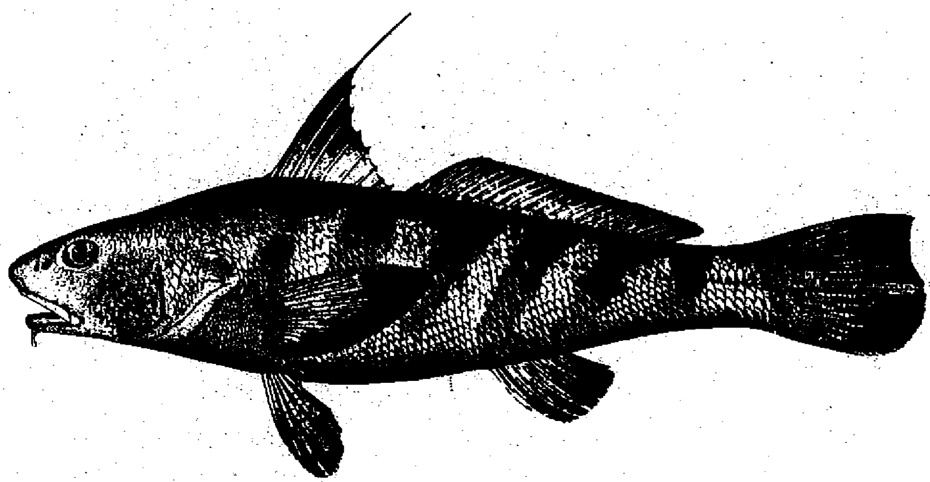

BIOLOGICAL & FISHERIES DATA
ON
NORTHERN KINGFISH, *Menticirrhus saxatilis*
(Bloch and Schneider)

JULY 1982

Biological and Fisheries Data on the Northern Kingfish, *Menticirrhus saxatilis*

by

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1.e IDENTITYe

1.1 Nomenclaturee

1.1.1 Valid Name

Menticirrhus saxatilis (Bloch and Schneider).

1.1.2 Synonymye

Johnius saxatilis Bloch and Schneider 1801.
Menticirrhus saxatilis Jordan 1883.
Umbrina nebulosa Gunther 1860.
Menticirrhus nebulosus Jordan and Gilbert 1883.
Menticirrhus saxatilis Jordan and Eigenmann 1889.

1.2 Taxonomy

1.2.1 Affinities

The classification is that of Berg (1947) and Greenwood et al. (1966).

Phylum: Vertebrata
  Class: Teleostomi
    Superorder: Acanthopterygii
      Order: Perciformes
        Suborder: Percoidei
          Family: Sciaenidae
            Genus: *Menticirrhus*
              Species: *Menticirrhus saxatilis*

A classical description of the genus is given by Jordan and Evermann (1896). "Body comparatively elongate, little compressed; head long, subconic, the bluntish snout considerably projecting beyond the mouth; mouth small, horizontal, both jaws with bands of villiform teeth, the outer teeth in the upper jaw more or less enlarged; chin with a single stoutish barbel; preopercle with its membraneous edge surrulate; gill rakers short and tubercular or obsolete; dorsal spines high, slender, 10 or 11 in number; second dorsal long and low; caudal fin with the lower angle rounded, the upper sharp; anal fin with a single weak spine; no air bladder. Lower pharyngeals separate, the teeth varying from sharp to very obtuse. This genus is one of the most strongly marked in the family. All the species are American, and all bottom fishes. The low, elongate body, the large pectorals, and the obsolete air bladder are all characters related to this peculiarity of habit."

A morphological study of western Atlantic Sciaenidae by Chao (1978) contained the following descriptions:

Menticirrhus group

"Swim bladders atrophy as the fish grow, only a vestige remains in adult. Drumming muscles absent in both sexes. Sagitta oval, elongate, and relatively small, the expanded part of the ostium not reaching to anterior margin. Snout with three upper pores and five marginal pores, rostral fold deeply indented; lower jaw with a short, rigid barbel, knoblike and five pores, the median at tip of barbel. Anal fin with only one weak spine. One genus in this group: Menticirrhus."S

Menticirrhus genus

"Body elongate, rounded, dorsal profile slightly arched, ventral profile nearly flat. Head conical, low and broad, snout projecting. Mouth small and inferior; teeth in villiform bands. Gill rakers short and tubercle Vertebrae 10+15 = 25. Other diagnostic characters as in the group diagnosis. Tropical and temperate eastern Pacific and western Atlantic, nine species. Three species in the western Atlantic: M. americanus, M. littoralis, and M. saxatilis. Inhabits shallow coastal waters with sandy bottoms, juveniles often found in estuaries."

Robins et al. (1980) recognizes four valid species within the genus Menticirrhus. These are:

M.s americanus (Linnaeus), southern kingfish
M.s littoralis (Holbrook), Gulf kingfish
M. saxatilis (Bloch and Schneider), northern kingfish
M. undulatus (Girard), California corbinas

The California corbina (M. undulatus) is a Pacific coast species. The other three species occur along the Atlantic coast.

Chao (1978) provides this key to the Atlantic species of Menticirrhus.

1a. Breast scales not uniform in size, those towards head notably smaller than scales along lateral line; molariform teeth present onpharyngeal plates; pectoral fins short, not reaching beyond tip of pelvic fins; gill rakers in adult usually three or more on the lower limb of first branchial arch; color plain silvery gray. [Young fish (less than 100 mm SL) with only a vestige of swim bladder. D.IX-X+I,19-26; gill rakers short, (3-5)+(0-8)=3-12(sic)] ....M. littoralis (U. S. Atlantic coast, Gulf of Mexico and Caribbean coast to Brazil)

1b. Breast scales uniform in size; about as large as those along lateral line; no molariform teeth on pharyngeal plates; pectoral fin reaching to or beyond tip of pelvic fin; gill rakers in adult tuberculate or absent on the lower limb of first branchial arch; sides with dark oblique bars..2

2a. Anal fin rays usually 7(6-8); depressed spinous portion of dorsal fin seldom extends past base of second soft ray in dorsal fin; longest dorsal spine 16.2-24.1% of SL; young fish (less than 100 mm SL) with only a vestige of swim bladder. [D.IX-X+I,20-26; gill rakers short, (2-3)+(0-7)=2-10]........M. americanus (U. S. Atlantic coast, Gulf of Mexico and Antilles, Caribbean coast to Argentina)

2b. Anal fin rays usually 8(7-9); depressed spinous portion of dorsal fin often extends past base of second soft ray in dorsal fin; longest dorsal spine 24.6-38.9% of SL; young fish (less than 100 mm SL) with well-developed swim bladder. [D.IX-X+I,22-27; gill rakers short, (3-5)+(0-7)=3-12; a longitudinal dark stripe usually present below lateral line posteriorly...................M. saxatilis (U. S. Atlantic coast and Gulf of Mexico coasts to Yucatan, Mexico)

The following key to the Atlantic coast species of Menticirrhus is taken from Jordan and Evermann (1896), and Hildebrand and Schroeder (1928):

a)eGill rakers obsolete, reduced to tubercular prominences,e covered with teeth similar to those on the other gill arches,e more developed in the young; lower pharyngeals narrow, thee teeth villiform or cardiform, all of them acute or conical,e none with rounded heads (molar); teeth in the outer seriese of upper jaw more or less enlarged; mouth comparative large,e the maxillary reaching to below the middle of the eye, 2-3/4 to 3-1/4 in head; scales on breast not reduced and not notably smaller than on sides; pectoral fins reaching to or beyond tips of ventrals; soft dorsal long, its ray I, 23-25; backe and sides usually with oblique dusky bars; lower lobe ofe caudal the longer.e

b)eOuter teeth of upper jaw decidedlyeenlarged; dorsale spines not much elevated, the longest usually not reaching front of soft dorsal, 1-1/2 to 1-2/3 in head; dorsal rays X-I, 24 or 25; snout longer, 3-1/3 in head; maxillarye reaching nearly to middle of eye, 2-4/5 to 3 in head;e eye small, 2 in snout; teeth villiform, in broad bands:e ventrals short 1-1/2 in pectorals; pectorals 1-1/4 in head;e caudal f-shaped, the broad rounded lower lobe longer thane the acute upper; scales all ctenoid, those of the breaste larger and regularly placed. Color grayish silvery, withe obscure darker clouds along the back and sides, these markse forming dusky bars, running obliquely forward and downwarde to considerably below the lateral line, these often obsolete; the bar at the nape saddle-like; lining of gill cavity dusky;e pectoral yellowish, dusky at tip; an obscure dusky streake along the lower parts of sides running into lower lobe ofe caudal...<u>M. americanuse</u>

bb) Outer teeth of upper jaw less enlarged; spinous dorsal elevated, the longest spine reaching past front of soft dorsal, its length 1-1/2 in head; coloration strongly marked, body scarcely silvery, eyes small, 2-1/3 in snout, 2 in interorbital area, about 7 in head; snout long, bluntish, 3-4/5 in head; mouth large; maxillary reaching middle ofe eye, 2-4/5 in head; pectorals 1-1/7 in head. Color dusky gray above, sometimes blackish, the back and sides withe distinct dark oblique cross bands running downward ande forward, the anterior one at the nape extending downward,e meeting the second and thus forming a V-shaped blotch one each side; a dark lateral streak bounding the pale color ofe the belly, most distinct posteriorly, and extending on lowere lobe of caudal; inside of gill cavity scarcely dusky; pectorals dark...<u>M. saxatilise</u>

aa) Gill rakers present, very short and rather slender; lower pharyngeals rather broad; some or most of the teeth molar, that is, enlarged, with thickened rounded heads, the molar teeth covering at least the anterior portion of the bone; teeth in the outer series of upper jaw scarcely larger than the others; scales on breast much reduced, notably smaller than on sides; pectoral fins failing conspicuously to reach tips of ventrals; upper lobe of caudal not longer than lower lobe; scales rather large, 15 to 18 in an oblique series from vent upward and forward to lateral line; axillary scale not 1/4 length of pectoral;

snout distinctly projecting beyond mouth, 3-1/2 in head; gill rakers larger than in other species, the longest about 1/2 length of pupil. Color silvery gray above, with bluish and bronze reflections, immaculate; a dark bronze shade along sides on level of pectorals, extending to tail and along cheeks; belly below this abruptly white; dorsal light brown, spinous dorsal black at tip, the base narrowly white; caudal pale, its tip usually black; inner lining of pectorals and ventrals blackish; gill cavity pale...M. littoralis

1.2.2 Taxonomic Status

The northern kingfish is a morphologically distinct species within the polytypic genus Menticirrhus.

1.2.3 Subspecies

There are no recorded subspecies in the literature.

1.2.4 Common Names

Kingfish, roundhead, sea mullet, sea mink, whiting, king whiting, northern whiting, barb.

1.3 Morphology

1.3.1 External Morphology

The following description of the adult northern kingfish is from Jordan and Evermann (1896), Hildebrand and Schroeder (1928), and Miller and Jorgensen (1973).

Head 3.05 to 4.10; depth 3.65 to 4.30; D. X-I, 24 to 27; A.eI, 8 (sometimes 9); scales 91 to 96 (counting verticale series between enlarged scale at upper angle of opercIee and base of caudal). Body elongate, compressed; backe elevated; ventral outline nearly straight; head low; profile slightly depressed above the eyes; eye small;e snout conical, projecting beyond mouth; mouth horizontal,e inferior; chin with a single short, thickish barbel; maxillary reaching opposite middle of eye, 1.35 to 2.85e in head; teeth in jaws in bands, outer teeth in upper jawe somewhat enlarged; preopercle serrate; gill rakers very short, about six more or less developed on lower limb ofe first arch; scales small, firm, strongly ctenoid, note reduced in size on the breast; dorsal fins contiguous, the first with slender, flexible spines, the third spine produced in the adult, reaching far beyond the anteriore soft rays when deflexed; soft dorsal rather long and low; caudal fin with concave upper lobe and somewhat produced lower lobe, proportionately longer in young than in adult; anal fin moderate, with a single slender spine; ventrale fins rather short, inserted about a half an eye's diametere behind base of pectorals; pectoral fins reaching to or a little beyond tips of ventrals, 1.0 to 1.45 in head.

Color dusky above, silvery underneath; some specimens much darker than others; back and sides with distinct dark oblique cross bands running downward and forward, the anterior one at the nape extending downward, meeting the second and thus forming a V-shaped blotch on each side; a dark lateral streak bounding the pale color of the belly, most distinct posteriorly; and extending on lower lobe of caudal; inside of gill cavity scarcely dusky; pectorals and spinous dorsal mostly black; other fins plain to dusky, varying among individuals(Figure 1).

1.3.2 Cytomorphology

No data available.

1.3.3 Protein Specificity

No data available.

2.a DISTRIBUTIONa

2.1 Total Areaa

The general range of the northern kingfish has been reported by Bigelow and Schroeder (1953) as extending along the Atlantic coast of the United States from Florida northward to Cape Cod, with the species most abundant from Chesapeake Bay to New York. It is known as far north as Casco Bay, Maine, as a stray. Beebe and Tee-Van (1933) have noted introduction of the species into island waters of Bermuda. Chao (1978) reported the range south through the Gulf of Mexico to Yucatan.

2.2 Differential Distribution

Northern kingfish inhabit the coastal waters from Chesapeake Bay to New York during the summer months of the year. They first appear in late April or early May and remain until late autumn (usually through October), at which time they migrate to wintering grounds. The wintering grounds of the species are unknown, but presumed to be offshore and to the south in deeper water (Schaefer, 1965a).

During the summer residence period, the fish are confined to the immediate vicinity of the coast, where they occur on sandy bottoms just outside the surf, and in sandy channels in the vicinity of inlets. They occupy enclosed as well as open waters, even entering river mouths (Bigelow and Schroeder, 1953; Schaefer, 1965a).

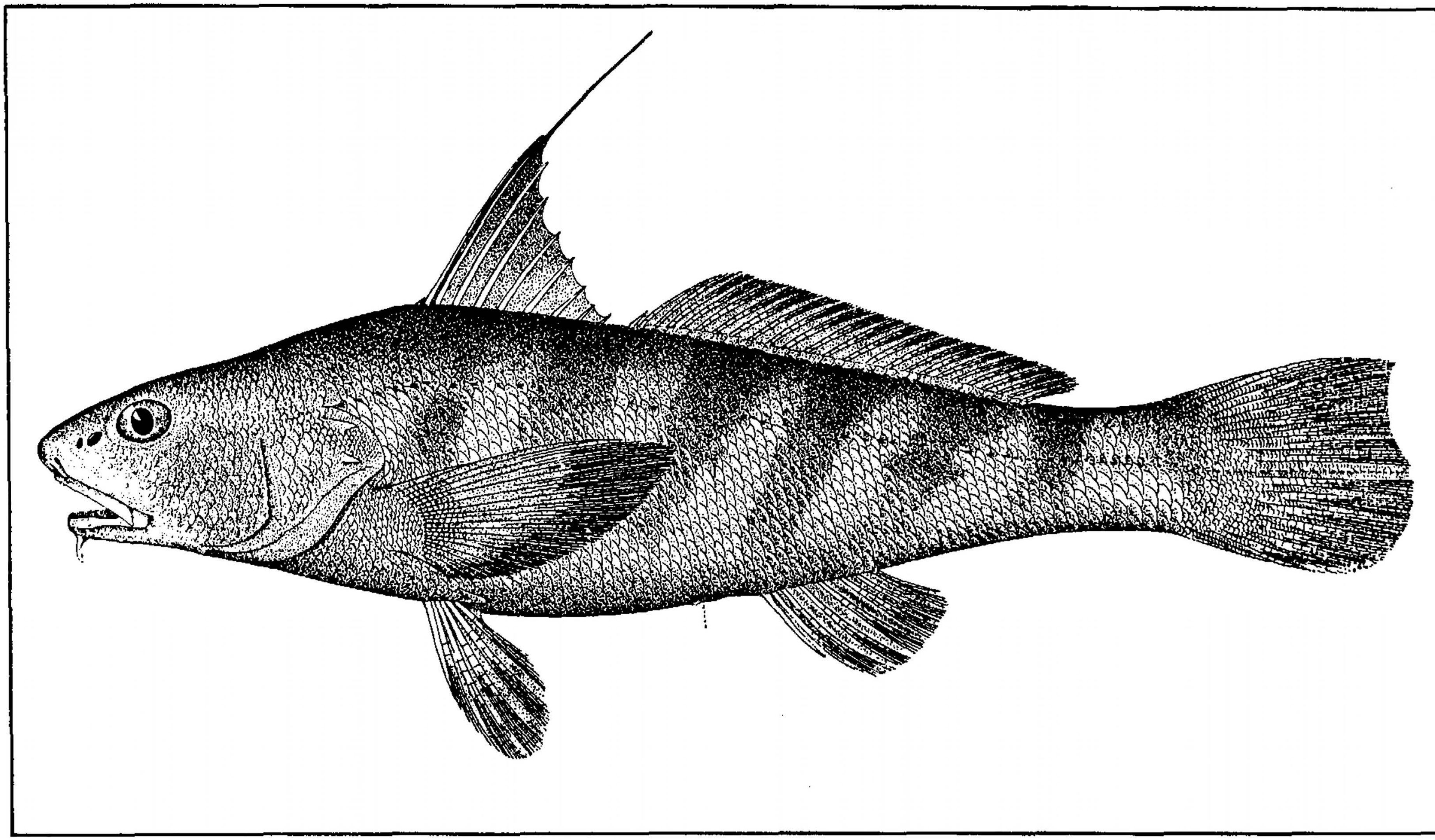

Figure 1. Adult northern kingfish, <u>Menticirrhus saxatilis</u> (drawing by H. L. Todd in Bull. U. S. Bureau Fish., 1886).

2.3 Determinants of Distribution

The summer distribution pattern of the northern kingfish depends on several interacting environmental factors. These include bottom temperature, salinity, depth, bottom type, and surf action.

Abbe (1967) found the distribution of northern kingfish in the Delaware Bay estuary to be a result of the influences of bottom temperature, salinity, depth, time of year, and possibly substratum. The greatest concentration of fish were taken in waters of 24-26°C; none were caught below 16.4°C. Distribution by depth indicated a preference for shallow water in general and a separation by size, with small fish in shallower water than large fish. Movement out of the bay area occurred in autumn, and by October northern kingfish were not caught in the bay. Salinity also produced a size stratification, with smaller fish in the waters of lower salinity. Larger fish were associated with the higher salinity in the offing of the bay.

Wilk and Silverman (1976b) found temperature, salinity, and depth preferences for northern kingfish summering in Sandy Hook Bay, New Jersey consistent with Abbe (1967).

Struhsaker (1969) described their coastal habitat as that section of the shelf extending from the estuaries to depths of 10 fathoms, with the bottom typically smooth, sandy mud. Bigelow and Schroeder (1953), among others, have noted the preference in the northern kingfish for hard or sandy bottom.

2.4 Hybridization

There is, at present, no record of either natural or induced hybridization in northern kingfish, or within the genus *Menticirrhus* (Schwartz, 1981).

3.e BIONOMICS AND LIFE HISTORYe

3.1 Reproductione

3.1.1 Sexuality

Northern kingfish are heterosexual, and there is no record of external sexual dimorphism.

3.1.2 Maturity (see also 4.1.3)

Welsh and Breder (1923) reported that the northern kingfish reaches maturity during the third or fourth summer of life, i.e., at the age of 2 or 3 years. They stated that malese appear to mature earlier (at age 2) than the females, whiche they suggested do not spawn until age 3. Bigelow and Schroeder (1953) have stated simply, "Many males ripen when 2 years old, but few females until 3 years old." Data from Schaefer (1965a) indicate that many fish of both sexes as young as 1 year are sexually mature. More than half of all 1- and 2-year old males examined were classified running ripe, while a larger percentage of the females from the same age groups were at or approaching spawning condition.

3.1.3 Mating

Mating, in terms of paired individuals, is not known to occur.

3.1.4 Fertilization

Fertilization is external.

3.1.5 Gonads

No estimates of fecundity are available.

3.1.6 Spawning

Northern kingfish spawn annually in bays and sounds. Spawning has also been reported to occur outside of estuaries (Jannke, 1971; Thomas, 1971). Spawning occurs on the bottom.

The following summary of recorded spawning times for northern kingfish is based on Schaefer (1965a). Some early researchers noted the common occurrence of ripe fish during June at both Woods Hole, Massachusetts and Narragansett Bay, Rhode Island. Bigelow and Schroeder (1953) reported the spawning period as June until August, but noted, "It is not likely that any young that might be hatched in the Gulf of Maine from eggs laid by the occasional visitors would survive its low temperature." Warfel and Merriman (1944) presented data collected in Connecticut waters that suggested spawning from June to August. For Long Island, Perlmutter (1939) reported collecting eggs only during June, but found postlarvae from June through early July. More recent data from New York waters by Schaefer (1965a) indicated an extended spawning interval, with a maximum reached during June and continuing to a lesser extent some years through August and into September. Welsh and Breder (1923), from Atlantic City, New Jersey, placed the spawning period from June through August with a maximum reached in late June or early July. deSylva et al. (1962) suggested a lengthy protraction of the spawning season in Delaware Bay. Hildebrand and Cable (1934) suggested spawning began no later than April and continued through May and probably later at Beaufort, North Carolina.

From this, it can be seen that spawning in northern kingfish generally follows a spring spawning pattern, with advancement from south to north throughout the range of the species in response to increasing bottom temperature. Data by Schaefer (1965a) indicate that older groups in the population spawn first.

3.1.7 Spawn

The following egg description is from Welsh and Breder (1923) (Figure 2):

Fertilized eggs of the northern kingfish are immediately buoyant. The eggs are spherical, 0.76 to 0.92 mm in diameter, averaging about 0.80 to 0.85 mm. They are almost colorless, some however, show a faint yellowish tinge. The yolk contains one or more refractive oil globules, the number varying greatly in the eggs of different individual fish. Eggs from some fish contain from 1 to 6 globules, and average 3 to 4, while in others the number may be from 9 to 18, and average 13 or 14. When only one oil globule is present, its diameter is from 0.19 to 0.26 mm. When many are present, they are irregular in size, and range from 0.14 to 0.20 mm in diameter. As development proceeds, these globules become amalgamated until at the time of hatching only one is present.

3.2 Pre-Adult Phase

3.2.1 Embryonic Phase

The following description of the embryo is from Welsh and Breder (1923):

In still water, at a temperature of 20.0-21.0°C, the incubation period is 46-50 hours. Segmentation and development proceed in the sequence described by Kuntz (1914). Approximately 18 hours after fertilization grayish chromatophores become distributed over the dorso-lateral aspects of the embryo and on the surface of the oil globule. At 24 hours the chromatophores on the globule have become black and stellate and the embryo is dotted with black punctulations. A number of scattered small black chromatophores also appear on the dorsal surface of the yolk sac (Figure 3).

3.2.2 Larval Phase

Welsh and Breder (1923) give the following description of development from hatching through seven days:

At the time of hatching, the northern kingfish larva is from 2.0 to 2.5 mm in length. The head is slightly deflected and the oil globule lies in the posterior portion of the yolk

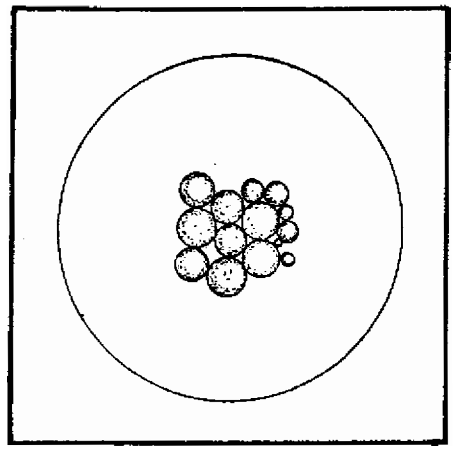

Figure 2. Northern kingfish egg (from Welsh and Breder, 1923)

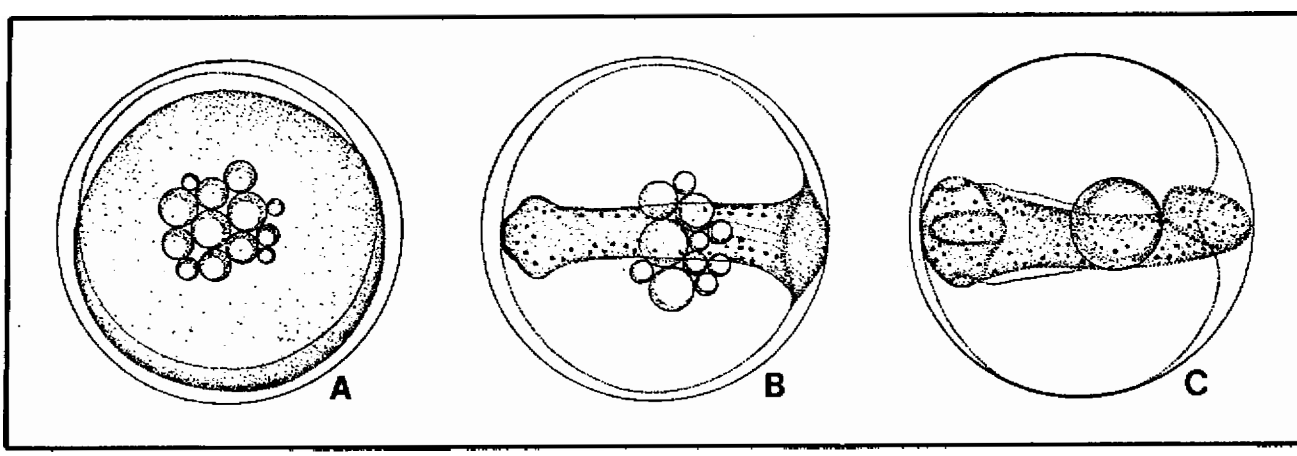

Figure 3. Embryological development in the northern kingfish: A-blastodermal differentiation; B-early embryo; C-late embryo (from Welsh and Breder, 1923)

sac. Pigmentation consists of three vertical bands of black and dull gold chromatophores, one above the anus and two posterior to it. These bands divide the caudal region into three nearly equal sections. A patch of black and dull gold pigment lies in the dorsal finfold anteriorly, and similar chromatophores are scattered over the yolk sac. The larva floats in an inverted position with the tail inclined upward, and sporadically makes short wriggling dashes which bring it momentarily into what is to be its normal position after the yolk sac is absorbed.

On the second day after hatching, the posterior caudal band loses its gold pigment and all the markings are less conspicious. The yolk sac is considerably reduced, but little growth in length occurs. The pectorals are faintly visible.

On the third day, the yolk sac is still further reduced and the bands of pigmentation, especially the anterior ones, are becoming faint.

On the fourth day, only traces of the caudal bands are visible. A row of black chromatophores appear along the ventral surface posterior to the vent, and extends to the location of the middle band. The blotch in the dorsal finfold is still conspicuous. The eye is pigmented. The pectorals are pigmented with black and gold chromatophores, and the abdomen has a golden tinge. The mouth is open and functioning; the yolk sac is almost completely absorbed.

On the fifth day, the normal resting position is floating head downward, but the fry are very quick in action when disturbed. Growth in length up to this time is negligible.

On the sixth day, the eye shows a steel-blue luster. No trace of rudimentary fins is visible. By the seventh day, a few fry attain the length of 2.8 mm. (No larvae survived to the eighth day.) Figure 4 illustrates early development stages.

Narrative description of the larvae from 2.9 to 10.0 mm in length is lacking. The following description of development in larvae from 10 mm is by Hildebrand and Cable (1934).

At a 10 mm size, the body is rather deep, compressed, with the greatest depth being contained about 2.8 to 2.9 in length to the base of the caudal fin. The head is quite narrow and compressed; its length is equal to or slightly longer than the greatest depth of the body. The interorbital

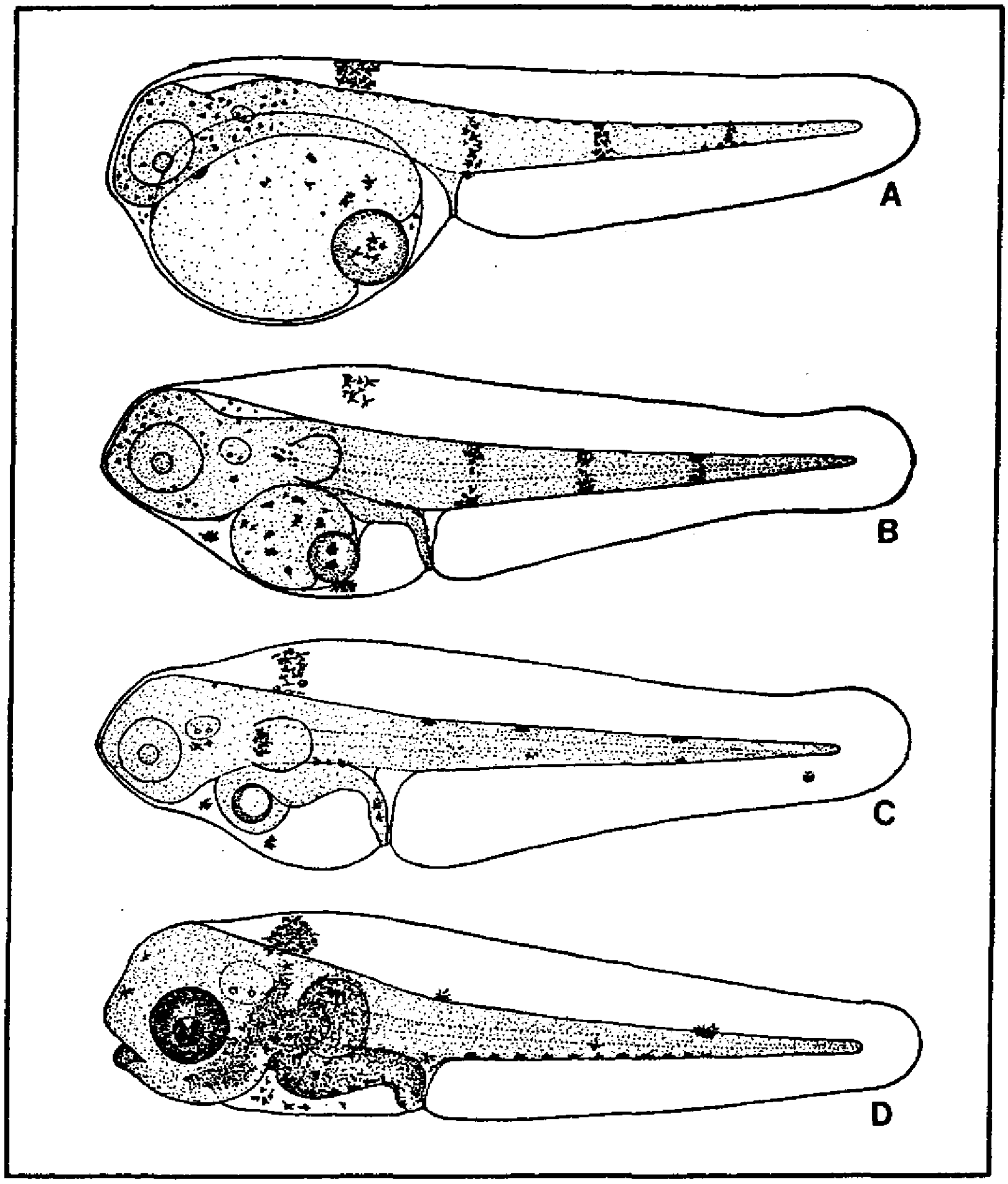

Figure 4. Early development of northern kingfish larvae: A-2.3 mm TL; B-2.5 mm TL; C-2.65 mm TL; D-2.7 mm TL (from Welsh and Breder, 1923)

is convex. The eye is longer than the snout. It has a very small, and slightly vertical pupil. The mouth is moderately oblique, the upper lip anteriorly being nearly on a level with the lower margin of the pupil. The maxillary reaches slightly past the middle of the eye, and the upper jaw projects beyond the lower one. The fins are well developed. The longest spines in the first dorsal reach past the origin of the second dorsal when deflexed. The caudal fin is asymmetrically rounded, with the rays in the lower half of the fin the longest. The ventral and pectoral fins are rather long and coterminal, not quite reaching the vent. The body is almost everywhere dotted with prominent black chromatophores. An indefinite brownish band is present on the back below the base of the dorsal fins, and another one extends along the lateral ventral edge from the origin of the anal to the base of the lower rays of the caudal. The spinous dorsal fin is nearly all black, while the second is colorless, except for an indefinite elongate dark band on the base of about the middle third of the fin. The caudal fin is colorless, with a white base, and sometimes with one or a few large black chromatophores. The anal fin is colorless except for dark dots on its base. The ventral fins are entirely black, while the pectorals are plain translucent.

By 20 mm in length, the body has become somewhat more slender than that for the 10 mm size, and remains rather strongly compressed, with the greatest depth contained in the length to the base of the caudal about 3.25 to 3.4 times. The head has become broader, but remains much deeper than broad. The mouth is slightly oblique and nearly terminal. The snout scarcely projects beyond the upper jaw. A slight knob, which is the beginning of the characteristically adult barbel, is evident at the symphysis of the lower jaw. Scalation is nearly complete, and the lateral line is developed anteriorly to about the middle of the base of the second dorsal. The caudal fin is rather broadly pointed, with the rays in the lower half still the longest. The general color is an almost uniform dark brown, with a slight indication of a broad vertical bar, darker than the body color, on the side under the spinous dorsal, and another one under the middle of the base of the second dorsal. The spinous dorsal and the ventral fins are black. The pectoral fins are colorless, as is the caudal, except for a black blotch on its base. The second dorsal and anal fins have at least a partly black base; otherwise they are colorless.

At the length of 30-35 mm, the body has continued to become more elongate and less strongly compressed. The depth remains proportionately a little greater than in the adult, it being contained in the length to the base of the caudal 3.50 to 3.65 times. The mouth is nearly horizontal, inferior, and the snout projects moderately beyond it. The mandibular barbel is short and plainly evident. Scalation is complete. The dorsal spines are not produced, the longest reaching no further than opposite the base of the first or second ray of the second dorsal when deflexed. The caudal fin is slightly angular, and the longest rays, which are in the lower half of the fin, are notably shorter than the head. The pectoral fins scarcely reach the tips of the ventrals, and the ventrals do not quite reach the vent. The body is quite fully pigmented. The ground color is silvery, and brightest on the lower parts of the body. Dark brown dots are almost everywhere on the body. Dark bars are usually evident; the first is on the posterior part of the head and runs obliquely downward and backward on the opercle, the second crosses the nape and parallels the first, and the third lies under the spinous dorsal and bends forward slightly to nearly, or quite, join the second on the middle of the side. The two together form a V, which is a recognition mark in the adult. Posterior to the described bars are dark blotches which suggest bars. The spinous dorsal and the ventrals remain almost wholly black. The second dorsal and the anal fins are black at the base or at least are dotted with black. The caudal fin bears two irregular dark spots on its base and is plain translucent elsewhere. The pectoral fins are more or less dotted with black at the base. This series is illustrated in Figure 5. Northern kingfish are included in a general review of the sciaenid larvae of the south Atlantic Bight by Bowles and Stender (1978).

3.2.3 Adolescent Phase

A description from Hildebrand and Cable (1934) follows:

At a size of 50 to 60 mm, the appearance of the juvenile resembles the adult sufficiently to be readily recognized (Figure 6). The body has continued to grow less compressed and somewhat more elongate. The depth is now contained in the length 3.8 to 4.1 times, which is the dominating proportion in the adult. The snout is conical, and projects much more strongly than in the smaller sizes described above. It is somewhat longer than the eye. Although none of the dorsal spines are notably produced, the longest one reaches well past the origin of the second dorsal. The third dorsal spine becomes notably produced when the fish reaches a length of about 85 mm. The caudal fin has a slightly concave margin and the lower lobe remains notably longer and somewhat angulate. The caudal fin does not acquire fully the shape of an adult until the fish attains a length of about 120 mm. The color varies greatly among individuals, some being dark brown while others silvery grey. All, though, have rather definite

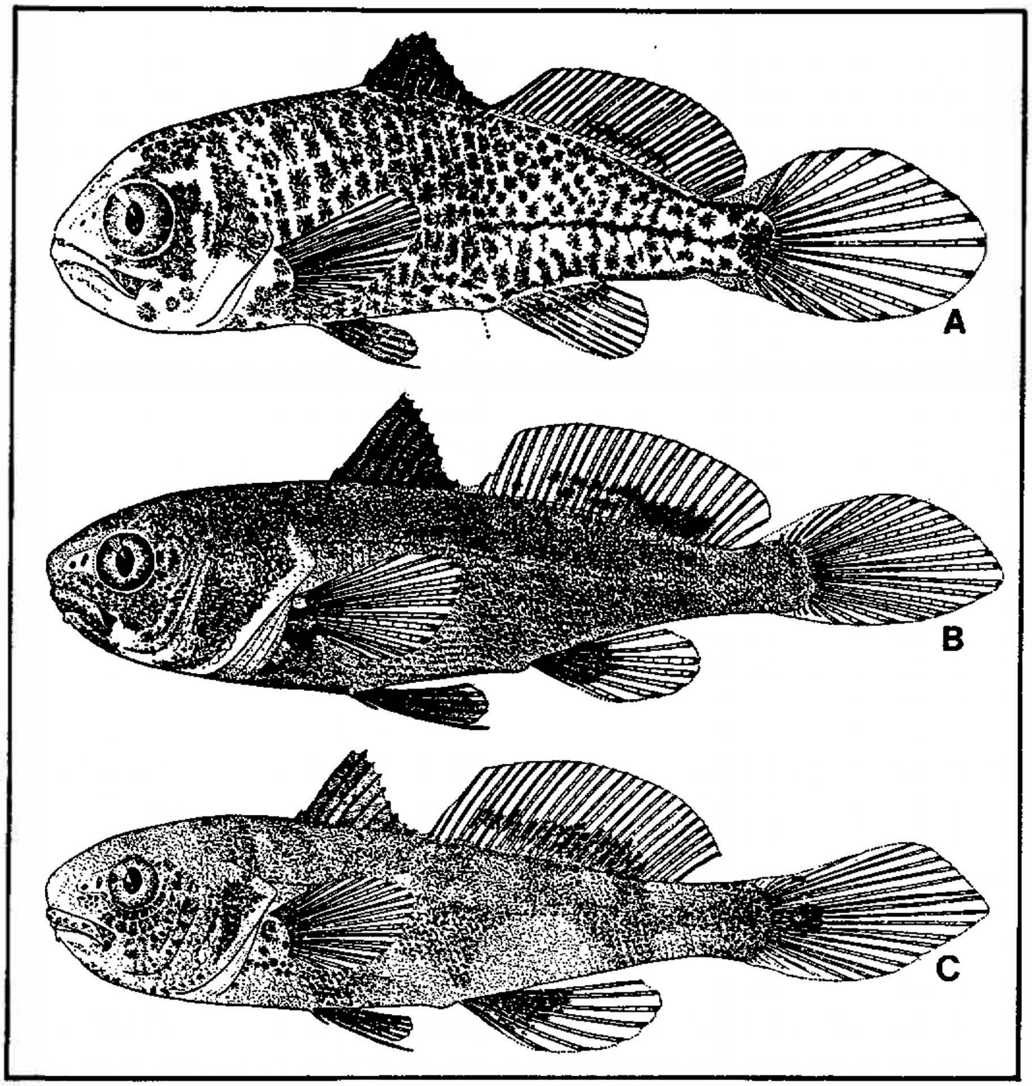

Figure 5. Development of the larvae: A-10 mm TL; B-20 mm TL; C-30 mm TL (from Hildebrand and Cable, 1934)

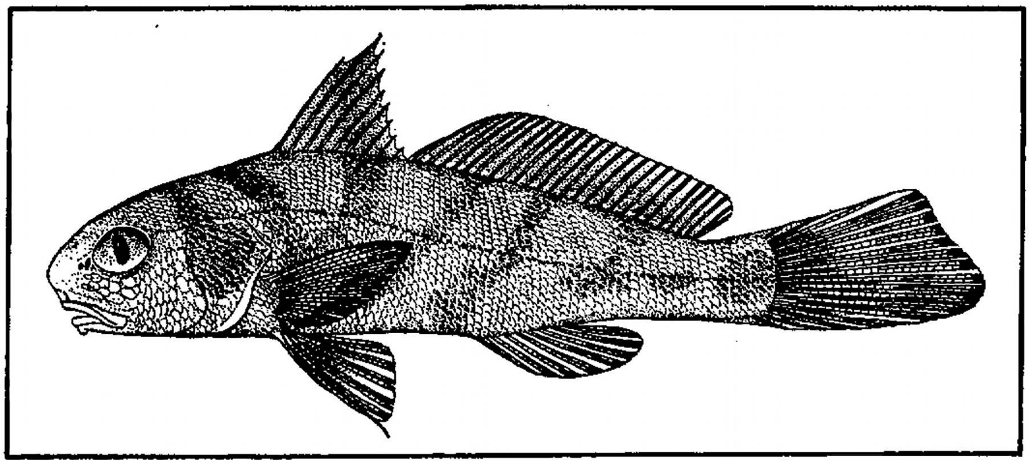

Figure 6. Juvenile northern kingfish, 63 mm TL (from Hildebrand and Cable, 1934)

oblique dark bars on the anterior part of the body and a few blotches posteriorly. The spinous dorsal and the ventrals remain almost wholly black in the darker individuals, but only partly dusky in the lighter ones. The small, vertically elongate, eliptical pupil remains conspicuous, as in the smaller specimens.

3.3 Adult Phase

3.3.1 Longevity

The maximum age reported for northern kingfish from New York by Schaefer (1965a) is 4 years old. The average life expectancy is 2-3 years.

3.3.2 Hardiness

Schaefer (1966) commented as follows: "Visual observations made during the tagging operations suggest that the northern kingfish is an extremely difficult species to maintain in captivity, even for a very brief period. For no apparent reason other than handling, many fish taken in good condition and placed in the holding tank soon entered a stage of rigor (while yet respirating), as if suffering from severe shock. Some died in the tank before they could be tagged. Distress symptoms were also observed in many individuals released to the water following tagging. It is presumed, therefore, that post-tagging mortality was very high." Fish (1954) was unable to maintain five specimens of northern kingfish long enough to acclimate them to laboratory conditions. Schwartz (1964) found the northern kingfish to be among the first of 15 species of marine fishes to succumb while held in captivity and subjected to natural winter water temperatures. Based on his tagging study, Schaefer (1966) proposed several recommendations, including: 1) only young fish should be tagged and preferably those one year old; 2) specimens should be taken from areas other than the turbulent ocean surf environment; and 3) both recovery and holding tanks should be utilized, with tagged fish retained for a period of observation prior to release.

3.3.3 Competitors

Among the main competitors for food and habitat of the northern kingfish are other benthic members of the sciaenid family, especially in areas of overlapping range. These species would include other members of the genus Menticirrhus; spot, Leiostomus xanthurus; Atlantic croaker, Micropogonias undulatus; red drum, Sciaenops ocellata; black drum, Pogonias cromis.

3.3.4 Predators

Little information exists on the nature or extent of predation upon kingfish. Bearden (1963) believes that existing evidence indicates mortality due to predation is probably low, at least with respect to juveniles. Adults are probably subject, to some extent, to predation by sharks, particularly the sand tiger, *Odontaspis taurus*.

3.3.5 Parasites

The following parasitic trematodes of northern kingfish were recorded by Linton (1940):

Prosorhynchus gracilescens	*Cymbephallus fimbriatus*
Nannoenterum baculum	*Lepocreadium trullaforme*
Stephanostomum tenue	*Homalometron pallidum*
Lebouria truncata	*Brachyphallus crenatus*
Cymbephallus vitellosus	*Sinurus pingus*
	Distoma sp.

Alperin (1966) has reported on the occurrence of the ecto-parasitic copepod, *Livoneca ovalis*, on the northern kingfish.

3.4 Nutrition and Growth

3.4.1 Feeding

Northern kingfish feeding habits are directly related to its morphology and habit preferences. The well-flattened profile, inferior mouth, and mandibular barbel all indicate bottom feeding behavior. The preference for sandy bottoms in warm waters is reflected in the sedentary forms which make up the diet of this rather sluggish fish. Northern kingfish are opportunistic feeders; the diet selection is predominantly a function of food availability.

Chao and Musick (1977) correlated body shape and feeding habitat in six co-occurring juvenile sciaenid species of the York River estuary, Virginia. Juvenile northern kingfish, "...have an elongate, round, and narrow body, and a relatively pointed tail. These features, combined with an inferior mouth with a pored-barbel, and relatively smaller eyes [than the other sciaenids studied], indicate that *M.e saxatilis* is a slow swimmer that feeds in the lower watere column by olfaction and touch." Food items of these young northern kingfish indicate a feeding preference of the epi-fauna.e

3.4.2 Food

Bigelow and Schroeder (1953) described the diet of northern kingfish as consisting of "...various shrimps (perhaps their chief diet), crabs, and other crustaceans, small mollusks, worms, and on young fish." This simplified description is applicable to adult fish, and is consistent with findings by Welsh and Breder (1923).

A report by deSylva et al. (1962) on the stomach contents of juveniles (1-14 cm TL) lists:

INVERTEBRATES

- Nematoda
- Annelida
  - Polychaeta
- Bryozoa
- Platyhelminthes
  - Cestoda
- Arthropoda
  - Crustacea
    - Mysidacea
    - Decapoda
      - Brachyura (adults and larvae)
        - Cragonidae
        - Palemonidae
    - Isopoda
    - Amphipoda
      - *Gammarus*
    - Crustacean eggs
    - Copepoda
  - Insecta
    - Diptera
  - Xiphosura (*Limulus*)

PROTOCHORDATES

- *Balanoglossus*

VERTEBRATES

- Fishes
  - Gobiidae
  - Clupeidae

MISCELLANEOUS

- gravel, sand
- unidentified eggs
- detritus
- plant detritus
- fish scales

This listing, qualitatively, is essentially an expansion of the generalized adult diet cited by Bigelow and Schroeder (1953). Table 1 compares stomach contents of juvenile northern kingfish from three Atlantic coast estuaries (Chao and Musick, 1977).

Quantitative volumetric comparison of stomach contents between juveniles and adults indicates differences in food preference. These differences may be a function of size and improved predatory ability, loss of a functional swim bladder in adults, or simply a reflection of available prey.

3.4.3 Growth Rate

It was stated by earlier authors that the growth of the northern kingfish is exceedingly rapid during the first summer of life. Schaefer (1965a) summarized their data. Based on his study in New York waters, Schaefer concluded that growth during the first summer is more rapid than reported by previous researchers. He states "...it would appear that some fish, probably those hatched in late May or early June, are capable of attaining by October a modal length of nearly 250 millimeters with a maximum length of 300 millimeters". Estimated modal lengths by Welsh and Breder (1923) are more conservative than those by Schaefer (1965a). Based on data of combined sexes, he indicated northern kingfish attain approximate average sizes of 260 mm by the second summer, 325 mm by the second winter, and 335 mm by the third summer, 365 mm by the third winter, and 375 mm by the fourth summer.

Welsh and Breder (1923) have stated that growth falls off in the autumn and practically ceases during the winter, a finding consistent with that of Schaefer (1965a). The major period of annual growth for the northern kingfish is from mid-summer to late fall (Schaefer, 1965a).

3.4.4 Metabolism

No data are available.

3.5 Behaviora

3.5.1 Migrations and Local Movements

In their study of the Sciaenidae of the east coast of the United States, Welsh and Breder (1923) stated, "The entire family as represented in this region, shows well-defined migratory movements, which are evidenced annually by a disappearance of these fishes from inshore waters in winter". Bigelow and Schroeder (1953) classified the northern kingfish as a summer fish which appears on the coast in May and vanishes in October. The wintering grounds are unknown, but presumed to be offshore and to the south in deeper waters (Schaefer, 1965a).

Table 1. Stomach contents of northern kingfish, Menticirrhus saxatilis, from different estuarine areas along U. S. Atlantic coast (from Chao and Musick, 1977).

Author	Chao 1976	Welsh and Breder 1923	
Locality	York River, Va.	Cape May, N.J.	Falmouth, Mass.
Period	Mar. 1972-Dec. 1974	Aug. 1916	Aug. 1892
Source	Original	p.a 194a	p.a 194a
Number of specimens	20	21	17
Empty stomachs	0	0	4
Length of specimens	37-118 mm TLa	1.9-7.2 cm SL	2.4-7.4 cm SL
Quantitative methods	% of occurrence	% of vol.	% of vol.
Macrozooplankton:			
Neomysis americana	35.0		
Isopoda		5.0	
Decapoda (shrimp)		9.0	42.0
Crangon septemspinosa	5.0		
Palaemontes	10.0		
Insecta	5.0		
Others and remains	70.0	9.0	42.0
Microzooplankton:			
Copepoda	5.0		
Calanoid	5.0		
Epibenthos:			
Polychaetes	70.0	19.0	
Glycindae solitaria	10.0		
Spionids	15.0		
Amphipoda	35.0	30.0	
Gammarus sp.	15.0		
Others and remains	40.0		
Unidentified remains and organic matters	50.0	26.0	16.0

3.5.2 Schooling

Schooling in northern kingfish is mentioned by Bigelow and Schroeder (1953) who state, "They run in schools, keep close to the ground, [and] prefer hard or sandy bottom."

3.5.3 Response to Stimuli

Laboratory studies on thermal requirements of five species of estuarine fish, including the northern kingfish, were performed by Gift (1967). Thermal requirements, avoidance temperatures, and upper thermal tolerance levels were determined. For the single experiment conducted on northern kingfish in a gradient tank, individuals of two different sizes were used. The larger fish died first, between 35-36°C, while the smaller fish died between 36-37°C. Avoidance of the warmer end of the tank by smaller fish occurred at 30-30.5°C, while larger fish did not exhibit avoidance behavior until 31.2°C. The experimental data and mortality curve (LD_{50}) are presented in Table 2 and Figure 7.

Males of many sciaenids have a sound-producing apparatus associated with the swim bladder (Breder and Rosen, 1966). It is generally believed that the drumming sound produced is used at the time of spawning (Fish, 1954; Breder and Rosen, 1966). Members of the genus Menticirrhus, however, are assumed mute, as the swim bladder is lacking in adults (c.f. section 1.2).

Schaefer (1965b) noted a well-developed and apparently functional swim bladder present in juvenile (i.e., young-of-the-year) northern kingfish, which atrophies and becomes nonfunctional during the first winter of life. He states, "Whether or not this phenomenon is related to the different environments inhabited by juveniles and adults is unknown, although adaption to environmental change is a possibility. Juvenile northern kingfish are usually found in the relatively quiet waters of estuaries where a swim bladder might be an asset in feeding and in escaping from predators. The adults, however, primarily inhabit the turbulent ocean surf where the absence of a swim bladder might be more advantageous to survival."

Gift (1967) suggests that the presence of a swim bladder in young northern kingfish might influence the sensitivity of young fish to temperature and the thermal tolerance of heated waters.

Table 2. Data compiled during upper thermal tolerance limit and avoidance temperature determination for northern kingfish, Menticirrhus saxatilis (from Gift, 1967).

A.e Avoidance temperature and upper thermal tolerance limits in gradient tank. (8/21 - 8/25/67)

Water Quality

	Initial			Final		
	Sal. o/oo	pH	D.O. mg/le	Sal. o/oo	pH	D.O. mg/le
lehote	21.91	7.9	6.3e	21.61e	7.95	5.16e
18 cold	21.97	7.9	6.3	21.53e	8.0	5.45

Fish - 15 fish in the tank

	length	weight
Size range	4.7 - 13.6 cm	.65 - 19.4 gm
Mean	6.7 cm	3.59 gm

Death Temperature and Percent Mortality

°F	# fish dead	Per cent	Accumulated Per cent
94.5	0	0	0
95.0	2	13.3e	13.3
96.2	1	6.7e	20.0
97.5	2	13.3	33.3
97.8	4	26.7	60.0
98.1	1	6.7	66.7
99.0	5	33.3	100.0e

LD_{50} = 36.5 C (97.65 F)

Avoidance Temperature

Small fish 30-30.5 C (86-87 F)
Large fish 31.2 C (88.5 F)

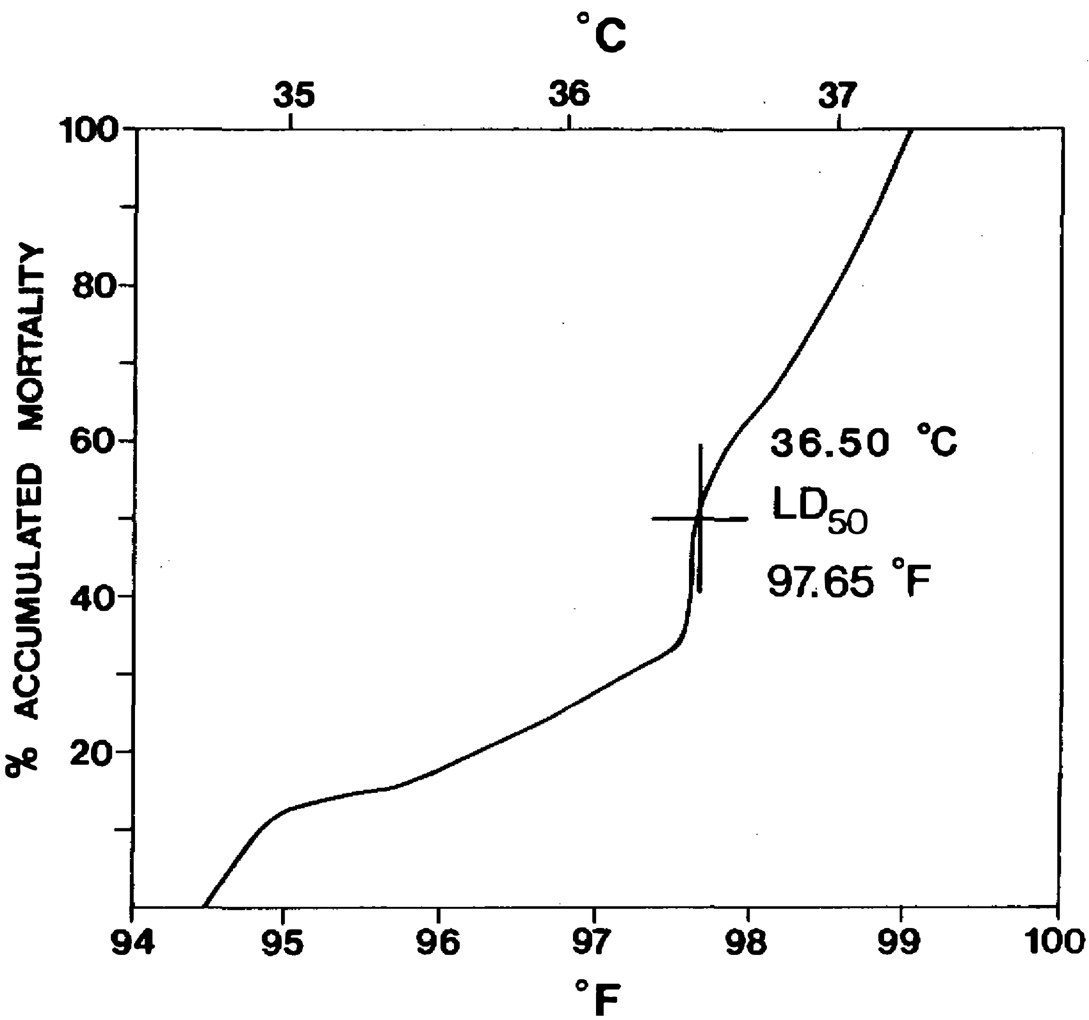

Figure 7. Mortality curve for northern kingfish (from Gift, 1967)

4.e POPULATIONe

4.1 Structuree

4.1.1 Sex Ratio

From unpublished data (SHML) I found the sex ratio (males:females) of northern kingfish did not differ statistically from 1:1. Variations in the ratio related to size, age and seasonality were not examined.

4.d.2 Age Compositione

The population of northern kingfish in Long Island waters is generally comprised of either two or three age groups depending upon the season of the year. In spring and early summer 1- and 2-year old fish are dominant, while from mid-summer to late fall young-of-the-year, 1-year olds and 2-year olds make up the bulk of the catch. Three-year old fish are few in number during all seasons, and 4-year olds (the oldest group collected) are practically non-existent (Schaefer, 1965a).

This seasonal pattern is reflected in the sport fishery catch. From May through July the catch is primarily composed of 1- and 2-year old fish. These two age groups represent approximately 95% of the sport catch. Three-year olds comprise <5%, and young-of-the-year are entirely absent. From August through October, 1- and 2-year old fish represent <70% of the catch, and young-of-the-year, now in the fishery, comprise approximately 30%. Three-year old and older fish remain at <5%.

Schaefer (1965a) believes that this small range in age may, at least partially, account for historical fluctuations in size composition and abundance noted by earlier authors.

c.f. Section 3.1.2 for age at maturity.

4.1.3 Size Composition

Schaefer (1965a) examined the age-length relationship in northern kingfish by sexes with the vonBertalannfy growth-in-length function. The resulting equations are:

males: $L_t = 386.6\ [1-e^{-.7014\ (t_n+.5505)}]$

females: $L_t = 447.5\ [1-e^{-.5558\ (t_n+.6186)}]$

where: L_t is total length at age t, and t_n is the age ofe the fish in the nth age group where t_1=0. These growth rates are graphed in Figure 8. From these equations,

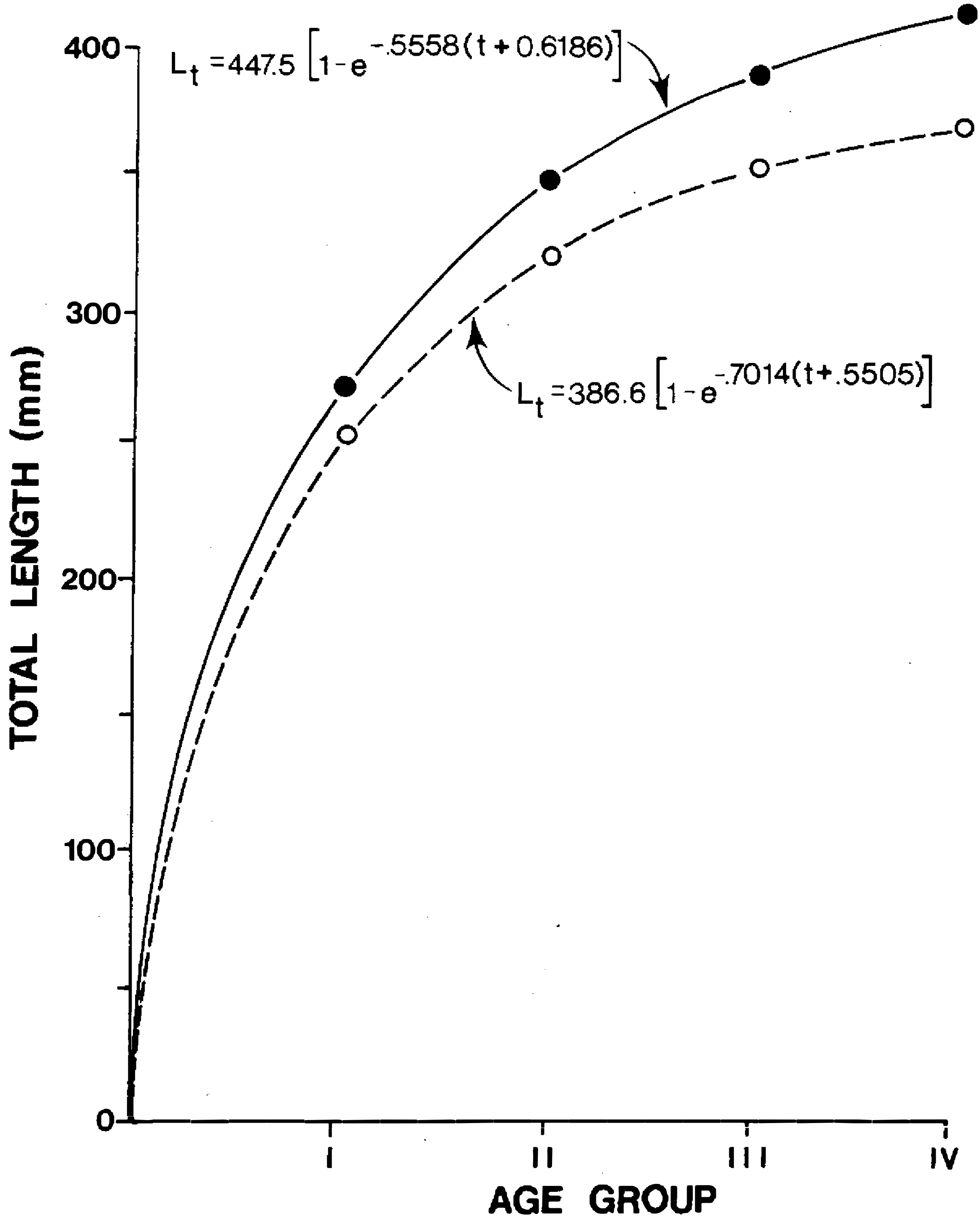

Figure 8. Growth rates of male (broken line) and female (solid line) northern kingfish computed from back-calculated lengths at previous ages (from Schaefer, 1965)

the average size (in mm TL) for males and females are:

	Age			
		II	III	IV
Male	256.3	322.0	354.6	370.7
Female	265.5	343.1a	387.6	413.1a

The expected maximum average sizes are 386.6 mm TL for males and 447.5 for females.

The largest northern kingfish on record is a 550 mm female in its third year, weighting 1500 grams captured in a commercial gill net (Schaefer, 1965a).

Several length-weight relations for northern kingfish have been reported. Schaefer (1965a) found no statistically significant differences between regression equations for males and females. These equations are:

male: $\log W = -5.3905 + 3.1602 \log L$ (n = 216)
female: $\log W = -5.0491 + 3.0261 \log L$ (n = 275)
combined: $\log W = -5.1737 + 3.0747 \log L$ (r = .96)

The combined data are plotted in Figure 9.

Based on a sampling of 110 fish with a size range of 51-410 mm, taken from the New York Bight, Wilk et al.a (1978) determined:a

$$\log W = -5.1995 + 3.1052 \log L, \; r = .99$$

4.2 Abundance and Density

4.2.1 Average Abundance

No data are available.

4.2.2 Changes in Abundance

Schaefer (1965a) stated, "...it is conceivable that the absence of any one or more age group (0, I, or II) from the over-all population could result in a severe reduction in numbers and cause a major change in the length composition of the catch. It seems reasonable to conclude, therefore, that the level of abundance and the size distribution of the northern kingfish population is highly dependent upon the success or failure of individual year classes."

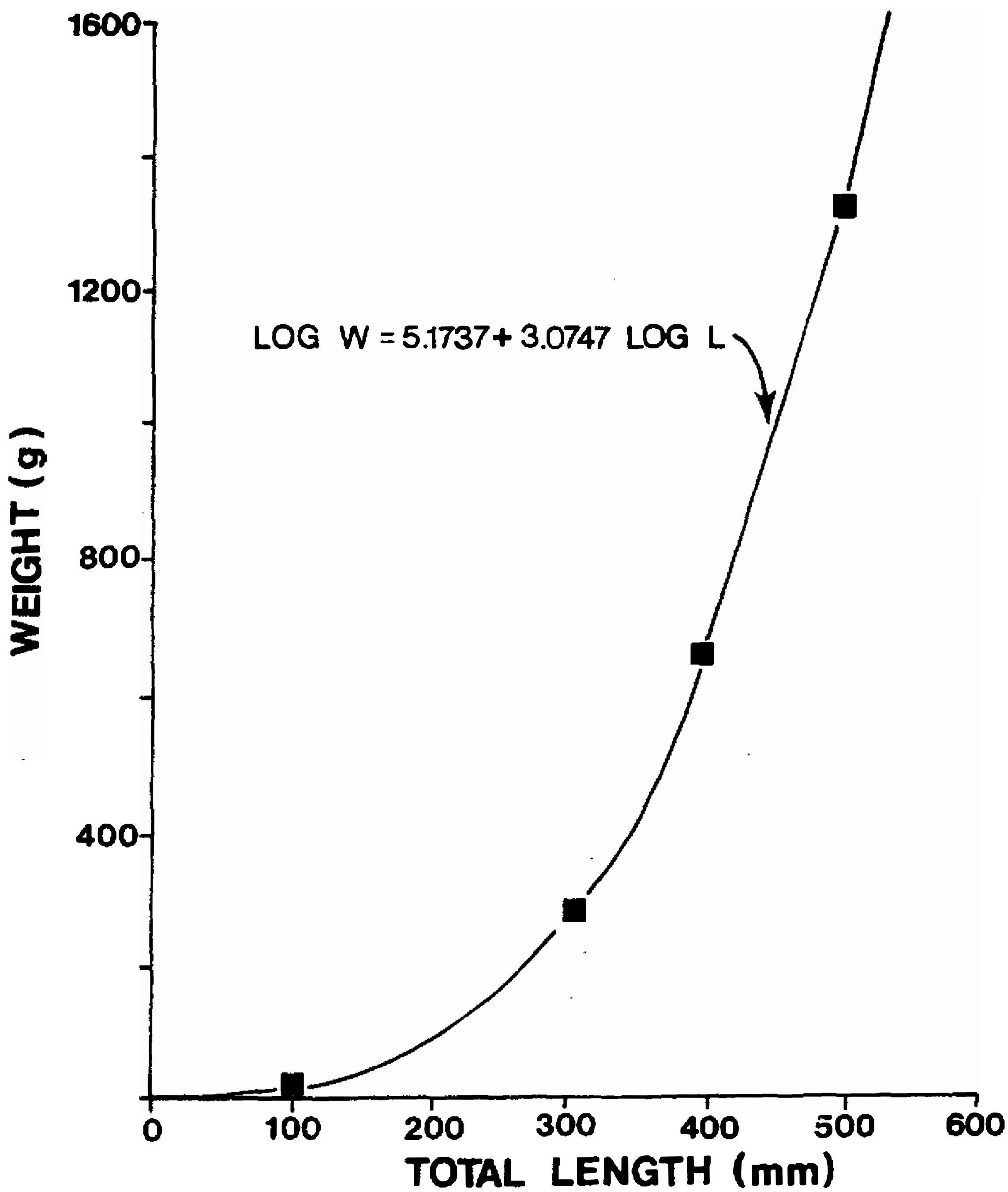

Figure 9. Length-weight relationship for 491 northern kingfish, sexes combined (from Schaefer, 1965)

Variability in local abundance, reflected in the changes in availability to the sport fisheries (especially surf catches) of New York and New Jersey, has been attributed to the seasonal migratory patterns of northern kingfish (McHugh, 1977).

The variability in annual commercial landings of northern kingfish in New York and New Jersey 1908-1975 is shown in Figure 10 (McHugh, 1977). The continuously low landings since the early 1970's are detailed in Table 4 (c.f. also Sec. 5.3.2).

4.2.3 Average Density

No data are available.

4.2.4 Changes in Density

The trawl survey data of Wilk and Silverman (1976a) indicate that the seasonal availability of the northern kingfish, all sizes considered, is greatest during the months of September and October.

4.3 Natality and Recruitment

4.3.1 Reproduction Rates

No data are available.

4.3.2 Factors Affecting Reproduction

Northern kingfish inhabit the ocean surf and associated estuaries, therefore reproductive success is influenced by the quality of the shore waters.

4.3.3 Recruitment

Refer to Sections 3.4.3 on growth rate, 4.1.2 on age composition, and 4.2.2 on changes in abundance.

4.4 Mortality and Morbidity

4.4.1 Mortality Rates

Schaefer (1965a) estimated annual mortality rates from age-frequency data for the years 1962 through 1964. Based on the formula $A = 1-e^{-z}$, where z is the estimate of the instantaneous rate of mortality, the annual mortality rates were:

1962: $A = 1 - e^{-1.413} = 0.76e$
1963: $A = 1 - e^{-1.386} = 0.75e$
1964: $A = 1 - e^{-2.117} = 0.88e$

These estimates suggest a high annual mortality rate.

4.4.2 Factors Causing or Affecting Mortality

Refer to Sections 3.3.2, 3.3.4, 3.4.2, and 4.3.2.

4.4.3 Factors Affecting Morbidity

Refer to Section 3.3.5.

4.4.4 Relation of Morbidity to Mortality Rates

No data are available.

4.5 Dynamics of Population

No models available.

5.a EXPLOITATIONa

5.1 Fishing Equipmenta

5.1.1 Gear

Northern kingfish have been reported in the catches of haul seines, gill nets, pound nets, and inshore otter trawls (June and Reintjes, 1957; ASMFC, 1958; Schaefer, 1965a; Wilk and Silverman, 1976a, b; McHugh, 1977).

Schaefer (1965a) used a modified 1300-foot commercial nylon ocean seine for sampling adult, and some juvenile, northern kingfish from the ocean surf. This sampling gear was constructed of 3-inch stretch mesh in the outer section of the wings, and 1 1/8-inch stretch mesh in the cod end.

Mesh size and dimensions of a commercial gill net may vary depending on the primary species sought. Northern kingfish have been caught in nets with 3 1/4-inch stretch nylon mesh (Schaefer, 1965b).

The pound net is a stationary gear of wooden pilings and netting set in shallow waters along the coast or in bays. The pilings are arranged to hold netting in a pattern that funnels fish inward where they become entrapped.

Inshore otter trawls are of two varieties: a "flatfish" net, and a "roundfish" net. They differ in mesh size, wing length and effective touring speed (June and Reintjes, 1957). Northern kingfish are vulnerable to both types.

Effective methods of sportfishing for northern kingfish include bottom fishing from shore and anchored or drifting boats, chumming from anchored or drifting boats and, south of False Cape, Virginia, jigging (Freeman and Walford, 1974a, b, c; 1976a, b). The most productive baits include: worms, clams, mussels, squid, shrimp, soft or shedder crabs, silversides, cut fish, small jigs, and bucktails.

5.1.2 Boats

Boats used in conjunction with the gear mentioned above range in size from 20 foot dories to trawlers in the 100-foot class.s

Schaefer (1965a) used a 21-foot Lowell Banks dory for ocean haul seining.

Vessels used in the gill net fishery vary from small motor launches to medium size otter trawlers. Most utilize a roller fastened to the stern or gunwale to assist in setting and retrieving the net. Although some of the larger vessels are equipped with a power winch, most of the nets are hand retrieved by the crew of two or three men (June and Reintjes, 1957).

Pound boats are open boats from 30 to 38 feet long used for transporting the catch from the nets to the docks (June and Reintjes, 1957).

Trawlers range from less than 30 feet to over 100 feet. Small and medium-sized vessels (called draggers), up to 50 feet, fish the inshore waters, whereas larger vessels are primarily used offshore. Most are diesel powered. Two or three men normally operate the inshore vessels, while the offshore vessels carry six to eight in the crew (June and Reintjes, 1957).

5.2 Fishing Areas

5.2.1 General Geographic Distribution

Northern kingfish are caught throughout their reported range (refer to Section 2.1); the greatest reported landings occur between New York and Chesapeake Bay.

5.2.2 Depth Ranges (c.f. Sections 2.2 and 2.3)

Table 3 summarizes depths, bottom conditions, and sport-fishing seasons for northern kingfish (Freeman and Walford, 1974a, b, c; 1976a, b).

Table 3. Summary of sportfishing information for northern kingfish (from Freeman and Walford, 1974A, 1974B, 1974C, 1976A, 1976B).

Area:	Nantucket Shoals to Long Island Sound
Depth:	Tide line to 30 feet, on sand or hard bottom
Season:	Late May or June to October
Best:	Variable, June, or September-early October
Area:	Block Island to Cape May, New Jersey
Depth:	Tide line to 30 feet, on sand, shell, or gravel bottom, especially near inlets, sand bars, or along edges of channels.
Season:	Late April or May to early November
Best:	May-early July and, September-mid October
Area:	Delaware Bay to False Cape, Virginia
Depth:	Tide line to 45 feet, on sand, shell or gravel bottom, especially near inlets, sand bars, or along edges of channels.
Season:	Early or mid-April to mid-November
Best:	July to October
Area:	Chesapeake Bay
Depth:	Tide line to 45 feet, on sand, shell, or gravel bottom, especially near sand bars or along edges of channels.
Season:	Late April or May to mid-November
Best:	August to October
Area:	False Cape, Virginia to Altamaha Sound, Georgia
Depth:	Tide line to 40 feet, on sand or sand shell bottom along the beaches and around the mouth of sounds.
Season:	Late March or April to mid-December
Best:	April-May and October-November

5.2.3 Conditions of the Grounds

Refer to Table 3.

5.3 Fishing Seasons

5.3.1 General Pattern of Season

The pattern of the fishing season for any given year is determined by the appearance and duration of summer residence of the species.

5.3.2 Dates of Beginning, Peak, and End of Season

Based on the pattern of monthly landings from the commercial fishery for the 11-year period 1970 through 1980 (Table 4) northern kingfish have been available along New York and New Jersey from April through December. The greatest annual landings have been recorded during May through October. Monthly landings have been decreased dramatically, especially for New Jersey from the 1970-72 levels.

5.3.3 Variation in Date or Duration of Season

Variations in the season for any given year are reflected in the monthly landings for New York and New Jersey (Table 4).

5.4 Fishing Operations and Results

5.4.1 Effort and Intensity

To date, there has been no analysis of the exploitation rate of northern kingfish, although baseline data from research surveys do exist, such as that by Struhsaker (1969) and Wilk and Silverman (1976a).

Clark (1962), Deuel and Clark (1968), and Deuel (1973) have statistically examined the marine sport fisheries of the United States for the years 1960, 1965, and 1970, respectively. Northern kingfish is considered in the species group "kingfishes" which includes the three Atlantic members of the genus Menticirrhus. This same grouping concept has been used for landings reported in Current Fishery Statistics and in ICNAF reports.

Although the abundance centers differ for the three species (see Section 1.2.1), the southern end of the known range for northern kingfish overlaps the northern end of the known range of the southern kingfish. Without differentiation of the species in catch data, accurate values of fishing effort and intensity for the northern kingfish throughout its known entire range cannot be presently determined. In the "kingfishes" 31,000 were estimated to have been caught by recreational anglers in the Middle Atlantic region during 1979 (U. S. Dept. Commer., 1980).

Table 4.1 Northern kingfish commercial fishery landings in pounds for New York and New Jersey by month.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
New York											
January											
February											
March											
April								67			
May	6348	5173	2503			141	391			2460	14713
June	13251	5555	4029		48		100		93	60	
July	1168	13685	1074		25		100				
August	7000	12118	1007	49			210	482			
September	7700	4238	4153	306	300		275	140			
October	9812	2529	2233	261	482		120	248	65	329	180
November	1800	1200	158	54	15		138	201			
December		2600		216							
January											22
February											
March											
April	140	488	21					16			
May	2075	530	396	41	144	78	48				10
June	527	334	45	75		20					
July			10	95	10					86	83
August	515	123	43	209	133	595				136	175
September	1155	1512	584	495	182	1251				39	
October	1217	1488	1621	176	302	715	113			25	
November	2688	1495	521	477	33	602	41			188	
December	148	600	2330	38							

Source: Current Fishery Statistics

5.4.2 Selectivity

Refer to Section 5.1.1.

5.4.3 Catches

Recreational catch statistics for 1960, 1965, and 1970 are summarized in Table 5.

Annual commercial landings for the region Massachusetts-Virginia are presented in Table 6.

In the New York Bight area, and probably throughout its range, the northern kingfish is more important as a recreational than a commercial species (McHugh, 1977; Table 7). Maximum commercial landings in New Jersey were approximately 70 metric tons in 1939, and in New York approximately 35 metric tons in 1940 (McHugh, 1977; Figure 10).

The commercial fishery for northern kingfish, confined to the United States, is incidental, as it is for the entire "kingfish" group. No catches have been reported by foreign fleets. The following nominal catches (in metric tons) of "king whiting" for Subarea 5 and Statistical Area 6 are from ICNAF (see Section 5.4.1). These are the only areas with any reported catches:

Year	Subarea 5	Statistical Area 6
1964	-	109
1965	-	212
1966	-	96
1967	-	59
1968	-	106
1969	-	99
1970	-	166
1971	-	107
1972	19	69
1973	1	43
1974	-	39
1975	-	43
1976	-	30
1977	-	38
1978	1	18

6. PROTECTION AND MANAGEMENT

Any present regulations and/or limitations on either the commercial or recreational fisheries of the northern kingfish are the responsibility of the individual Atlantic coast states.

Table 5. Angler catch statistics of kingfishes in 1960, 1965, and 1970 (all values in thousands) (Clark, 1963; Deuel and Clark, 1968; Deuel, 1973).

Year	Region*	Number of Fish Caught						
		From Boat	From Shore	Ocean	Bay, River or Sound	Total	Estimated Weight	# of Anglers
1960	North Atlantic	13	1126	NA[1a]	NA	1139	800	53
	Middle Atlantic	2743	400	NA	NA	3143	1570	149
1965	North Atlantic	241	51	71	221	292	237	42
	Middle Atlantic	975	166	590	551	1141	1337	64
1970	North Atlantic	1334	1402	1388	1348	2736	3457	226
	Middle Atlantic	1297	614	1347	564	1911	2402	183

*Region - North Atlantic: Atlantic coast from Maine to and including New Yorka
Middle Atlantic: Atlantic coast from New Jersey to Cape Hatteras, North Carolina

[1]NA - not available

Table 6. Annual commercial landings (in thousands of pounds) of "king whiting" by states, 1930-1979.

Year	MA	RI	CT	NY	NJ	DE	MD	VA	NC**	Total
1930	*			14	69	3	2	3	272	363
1931	3		1	87	60	2		36	181	370
1932	65	*		65	113	1	6	27	300	518
1933	38	1	*	735	84		10	64		270
1934							5	102	302	409
1935	4	1		24	46	1	2	56		134
1936							12	131	1216	1359
1937	12	3		735	78		7	136	722	1031
1938	5	25	*	25	103		4	261	1573	1950
1939	5	25	*	745	159		21	193	1464	1918
1940	1	7	1	82	64		9	128	683	975
1941							17	35		52
1942				*	835		9	97		189
1943		5	1	465	1375					189
1944		4	1	62	56		6	75		393
1945		35	*	415	79	1	33	451	1158	1766
1946		1	*	445	NA	NA	42	358	NA	445
1947		15	*	215	124	3	20	544	NA	713
1948		2	5	17	63		14	462	NA	563
1949		86	1	34			5	189	NA	315
1950		*	*	195			5	126	1399	1549
1951		1		145	70		5	102	1122	1314
1952		1		145	29		24	1015	1484	1653
1953		1		1	37	5	9	40	1490	1583
1954		1		45	120	4	20	69	1879	2097
1955		1	25	125	62	4	14	139	1281	1515
1956		25		115	82	33	25	226	1434	1813
1957		1		5	50	*	135	89	1600	1758
1958		*		1	18	1	1	79	1054	1154
1959		1		2	6	1	25	38	780	830
1960		1		2	32	4	16	57	927	1039
1961		1		3	21	3	19	190	1476	1713
1962		2		2	48	4	35	126	1262	1479
1963		1		2	12	7	14	66	1071	1173
1964		*		12	23	5	15	61	1141	1257
1965		1		5	23	3	15	60	1337	1444
1966		2		6	15	2	5	45	766	841
1967		*		9	8		3	24	839	883
1968		1		20	13		4	86	635	759
1969		15	*	135	9		3	36	843	905
1970		2		47	9		11	91	563	723
1971		1		475	7		3	25	479	562
1972		*		155	55	*	25	21	683	726
1973				1	1		15	24	429	456
1974		*		1	15	*	4	18	315	339
1975				*	3		4	18	213	238
1976				1	*		*	10	124	135
1977				1	*	NA	*	1	205	207
1978		2		*		NA	*	2	154	158
1979				35	*	NA	*	14	311	328

NA - not available
* - Less than 500 lbs.
** - Includes a significant proportion of southern kingfish (*M. americanus*) in the "king whiting" classification.

Table 7. Estimated commercial and recreational catches of northern kingfish in the north and middle Atlantic regions of the United States coast 1960-1975. Weights in metric tons (from McHugh, 1977).

	North Atlantic Region			Middle Atlantic Region		
	Commercial		Recreational	Commercial		Recreational
Year	ME-NY incl.	NY only	ME-NY incl.	NJ-NC incl.	NJ only	NJ-NC incl.
1960	1	1	363	470	15	713
1961	2	1		776	10	
1962	2	1		670	22	
1963	1	11		531	5	
1964	5	5		565	10	
1965	3	2	108	653	10	606
1966	4	3		379	7	
1967	4	4		397	4	
1968	10	9		335	6	
1969	6	5		405	4	
1970	22	21	1,568	306	4	1,090
1971	21	21		233	3	
1972	7	7		324	3	
1973	*	*		207	1	
1974	1	*		153	*	
1975	(*)	*		(109)	1	

The national saltwater angling surveys for 1960, 1965, and 1970 did not give data by individual states. New York was included with the New England states and New Jersey with the other middle Atlantic states.

Figures for 1975 in parentheses assume that unavailable landing data from N.H., Conn., and Del. equal the average of recent years.

* Less than 0.5 metric ton.1

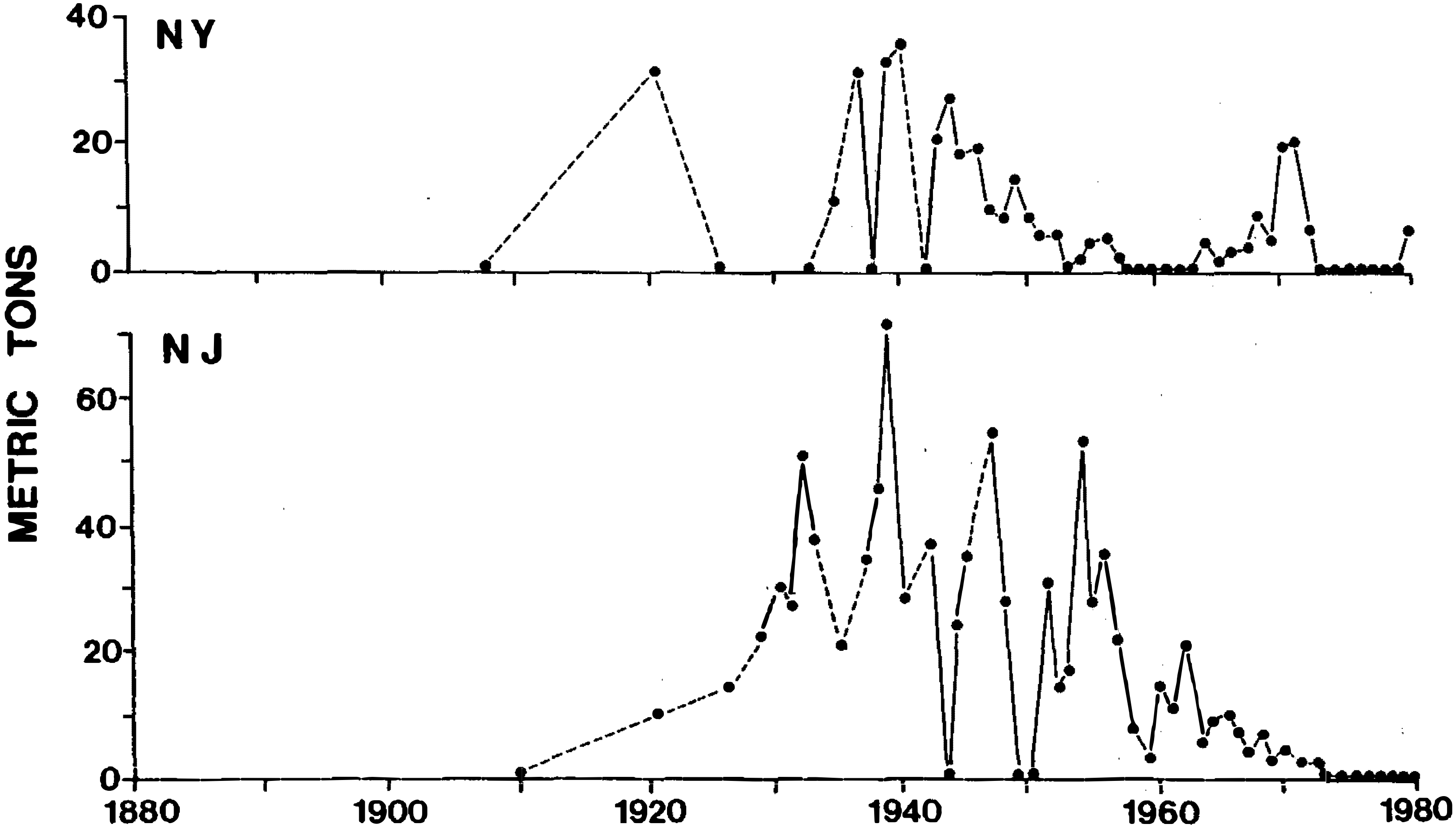

Figure 10. Annual commercial landings of northern kingfish in New York and New Jersey, 1908-1980. (1908-1975 from McHugh, 1977; 1976-1980 from Current Fishery Statistics.)

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