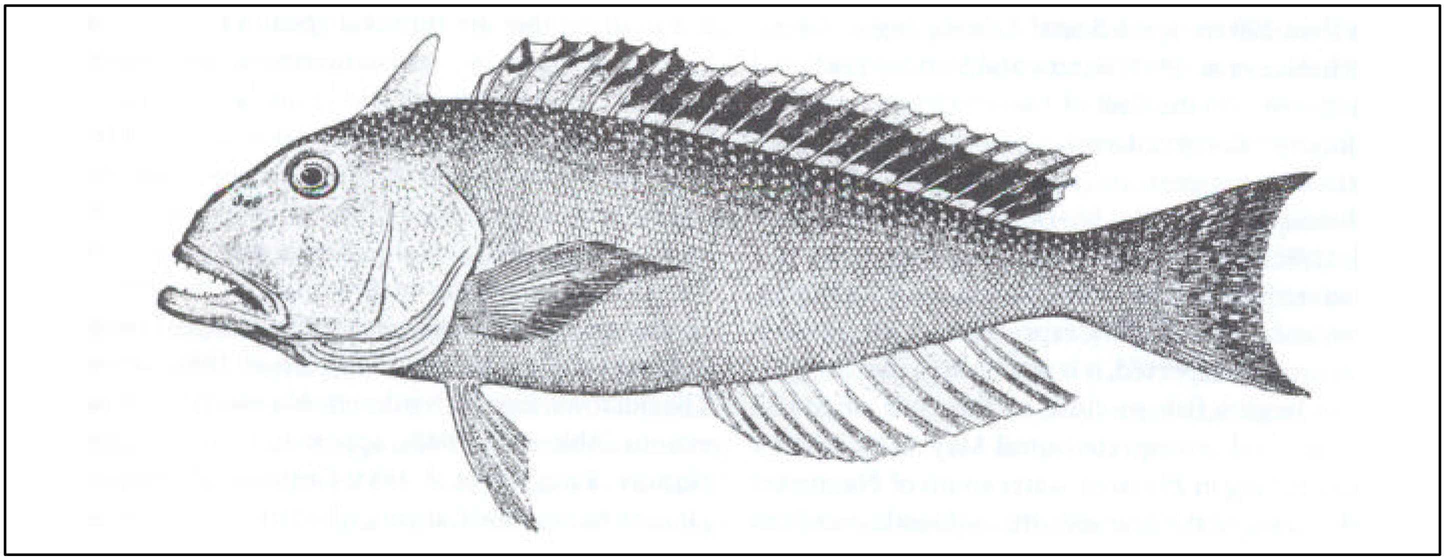
TILEFISH / ***Lopholatilus chamaeleonticeps*** Goode and Bean 1879 / Bigelow and Schroeder 1953:426-430



Description. Body compressed, deep (Fig. 211). Head large, mouth wide, jaws with large conical teeth and inner rows of smaller teeth. Thin, high, fleshy flap on dorsal surface of head just anterior to dorsal fin. Flap absent in small juveniles «80 mm SL), increasing in size with age, most prominent in large males. Distinctive fleshly flap or barbel on posterior margin of lower jaw. Spinous- and soft-ray portions of dorsal fin continuous. Both dorsal and anal fins with longest rays in posterior portion of fin. Pectoral fins elongate, inserted high on sides of body. Pelvic fins originate directly below pectorals. Caudal fin shallowly lunate and broad. Prominent scales present on lateral surfaces of head and operculum. General body proportions are given by Dooley (1978).

Meristics. Dorsal fin rays VII or VIII, 14 or 15; anal fin rays I, 13 or 14; pectoral fin rays 16-18; total gill rakers 22-26; pored lateral line scales 66-75; vertebrae 10 precaudal + 14 caudal.
Color. One of the most colorful fishes along the east coast of the United States. Upper body steely blue fading to milky white below midline and covered with yellow spots. Smaller yellow spots on head to interorbital and on cheek to operculum. Lower jaw and branchiostegal membrane milky white. Distal and proximal margin of dorsal and anal fin light near body; darker in the center of the fin. Yellow prominent on dorsal fin membranes. Caudal fin with yellow spots; light blue on margin. Adipose flap yellow with dark edge, the latter more prominent in juveniles.

Size. Maximum size of females 95 cm FL; males 112 cm FL (Thrner et al. 1983). The all-tackle game fish record is a 9.18-kg fish caught at Murrell's Inlet, S.C., in April 2000 (IGFA 2001).
Distinctions. Tilefish can be distinguished from all other Gulf of Maine fishes by the prominent adipose flap anterior to the dorsal fin, the barbels at the posterior margin of the jaw, and the unique color pattern, characters that also differentiate this species from all other tilefishes (Dooley 1978).

Habits. In the northern part of its range, tilefish occur as shallow as 80 m, but extend to 305 m, whereas they are generally found deeper than 200 m in the South Atlantic Bight (Grossman et al. 1985; Able et al. 1993; Barans and Stender 1993) and in depths of 162-450 m in the Gulf of Mexico (Nelson and Carpenter 1968; Jones et al. 1989). Depth preference appears to be largely a function of temperature, with most populations occupying a rather narrow range of 9°-14°C along the east coast (Grimes et al. 1986; Barans and Stender 1993). The population dynamics of tilefish appear to be heavily influenced by environmental factors, especially temperature. As Bigelow and Schroeder reported, it is astonishing that the very existence of so large a fish so close to the Gulf of Maine should have remained unsuspected until May 1879, when a Capt. Kirby, cod fishing in 274 m of water south of Nantucket Shoals Lightship, caught the first specimens (Goode and Bean 1880b). Others were caught at 159 m nearby during the following July. Trips by the U.S. Fish Commission during the next two summers proved that tilefish were plentiful enough to support an important new fishery. These early and subsequent investigations (Twitchell et al. 1985; Grimes et al. 1986) proved that tilefish occupy a very definite environment, along theupper part of the continental slope and on the outer edge of the shelf, where a narrow band of seafloor is bathed with a belt of warm water (about 9°-14°C), varying by only a couple of degrees from season to season. Within 3 years (1882) of its discovery, a massive mortality occurred (Collins 1884; Marsh et al. 1999). Numerous vessels reported multitudes of dead tilefish floating on the surface from the Great South Channel to north of Delaware Bay. It has been estimated that at least 1.5 billion dead tilefish were sighted (Collins 1884).
It is generally believed that this destruction was caused by a temporary flooding of the bottom along the warm zone by abnormally cold water. Consonant with this explanation is the fact that other species of fishes suffered as well, and dredgings carried out during the following autumn proved that the peculiar invertebrate fauna that had been found in abundance along this warm zone in previous summers had likewise been exterminated ~errill1882).
This mortality of tilefish was so devastating that fishing trials carried out off southern New England by the Fish Commission later in 1882, in 1883, 1884 (when a particularly careful search was made), 1885, 1886, and 1887 did not yield a single fish (Bigelow and Schroeder). But the species was not quite extinct, as eight of them were taken off

Martha's Vineyard in 1892 and 53 were caught in 1893; they were more numerous in 1898 (Bumpus 1899).

The northern stock is known to occupy a variety of habitats, including scour basins around rocks and boulders and "pueblo habitats" (Warme et al. 1977; Valentine et al. 1980; Able et al. 1982; Grimes et al. 1986). The dominant habitat type, at least in U.S. waters, is a vertical burrow in the substrate (Able et al. 1982, Grimes et al. 1986). Based on numerous observations from submersibles, size and shape of burrows vary considerably: the smallest juveniles observed (10-20 cm TL) occupy simple vertical shafts in the substrate, and larger fish occupy much larger burrows (up to 4-5 m in diameter and 2-3 m deep) that are funnel-shaped in cross section. The upper margins usually contain numerous small secondary burrows of associated fishes and crabs. The increase in burrow size with fish size suggests a regular sequence of burrow construction by tilefish and their burrow associates. Several associates, such as galatheid crabs *(Munida),* lobsters *(Homarus americanus),* and *Chacellus filiformis,* may help in burrow construction by removing sediments from the upper margin of the burrow. Others such as conger eels appear to be consistent residents of these burrows (Hood et al. 1988; Levy et al. 1988). The burrows, based on submersible and sidescan sonar observations (Able et al. 1987), appear to occur in aggregations or clusters (Twitchell et al. 1985; Grimes et al. 1986) at least near Hudson Submarine Canyon, where they are abundant (average density in 1982 was 2,500 km-2).

Substrate type apparently plays a role in tilefish distribution as well. In most areas where the northern stock has been studied, particularly Hudson Submarine Canyon, burrows are found in semi-lithified, silty clay but not in sand substrates. When a large fish with a correspondingly large burrow is removed through natural or fishing mortality from the longline fishery (Grimes et al. 1980, 1982), the burrow fills with sediment over several months and is abandoned by the associates (Grimes et al. 1986; Able et al. 1993). These abandoned burrows became much more common in tilefish grounds off New York, New Jersey; and Florida after intensive fishing in the 1980s.

The behavior of tilefish is intimately tied to their burrows (Able et al. 1982; Grimes et al. 1986). Burrow construction probably occurs through a combination of oral excavation of chunks of sediment, secondary bioerosion by associated species, and tilefish swimming motions to flush finer sediments from the burrow. Observations from submersibles strongly suggest that there is one fish per burrow although a single 24-h time lapse series indicated that pairing may occur. The fish appear to be away from their burrows foraging during the day and around or in them at night. Tilefish always enter a burrow head first and exit tail first, usually with slow deliberate movements of the caudal fin. The burrow may be a means of predator avoidance.

Food. The food of tilefish is varied and includes numerous invertebrates such as shrimps, crabs, mollusks, polychaetes, sea cucumbers, brittlestars, urchins, anemones, and tunicates and occasional fishes (Bigelow and Schroeder; Collins 1884; Linton 1901a,b; Bowman et al. 2000). Of these, galatheids *(Munida* spp.), spider crabs *(Euprognatha),* and ophiuroids appear to be the most important. The diet appears to change with age, with mollusks and echinoderms found mostly in the stomachs of smaller tilefish (Freeman and Turner 1977b).

Predators. Small tilefish are sometimes preyed upon by spiny dogfish and conger eel and have been found in stomachs of larger tilefish (Freeman and Turner 1977b). There is one record from the stomach of a goosefish over 90 cm TL (Rountree 1999; Bowman et al. 2000). Large sharks may prey upon free-swimming tilefish as sharks often attack tilefish caught on longlines (Bigelow and Schroeder; Freeman and Turner 1977b; Grimes et al. 1982).

Parasites. Tilefish parasites include cestodes, trematodes, nematodes, and acanthocephalans (Linton 1901a,b). Tilefish are also attacked by sea lamprey (Freeman and Turner 1977b).

Reproduction and Early Life History. Size and age at maturation vary with sex (Harris and Grossman 1985; Erickson and Grossman 1986; Grimes et al. 1988). Maturation of females in the northern part of the range may begin at approximately 50 cm FL and 5 years of age; by 60-65 cm FL and 8-9 years all fish are sexually mature. Comparisons of visual and histological staging techniques for males suggest that males produce sperm at 65-70 cm TL and 7-8 years. They do not develop a large testicular mass until 80-85 cm FL and an age of 10-11 years. There is some evidence that the rapidly expanding fishery during 1978-1982 reduced population density by one-half to two-thirds (Turner 1986) and may have altered the breeding system by causing males to spawn at smaller sizes and younger ages in 1982 relative to 1978 (Grimes et al. 1988).

Sex ratios are skewed in favor of males at larger sizes; however, both sexes are equally abundant at most ages (Grimes et al. 1988). The predorsal adipose flap is a striking sexually dimorphic character, so much so that it can easily be used to determine sex in individuals larger than about 70 cm FL. The flap is typically larger in males than in females but its size decreases for both sexes in more southern populations (Katz et al. 1983).

Tilefish in the Mid-Atlantic-southern New England area appear to spawn from March to November, with a peak in activity between May and September. Eggs have been taken by the NEFSC MARMAP ichthyoplankton surveys in each of these 9 months along the shelf break from Georges Bank to Cape Hatteras (Berrien and Sibunka 1999), but not from the Gulf of Maine. Females release small batches of eggs; that is, they are fractional spawners. Estimates of fecundity, made early in the season before spawning occurred, ranged from approximately 195,000 for a 53-cm FL female to 10 million for a 91-cm FL individual, with a mean of 2.28 million (Grimes et al. 1988).

Eggs that were artificially fertilized and raised to hatching (Fahay and Berrien 1981) were 1.16-1.25 mm in diameter with a thin, colorless chorion with reticulations. The yolks were amber with a single oil globule 0.18--{).20 mm in diameter. Incubation at 22.0°-24.6°C was 40 h. Size at hatching was 2.6 mm NL. Larvae are characterized by spinous scales covering most of the body; with 13 series of cranial processes, and by well-developed preopercle spination (Fahay and Berrien 1981). The largest pelagic specimen captured was 8.7 mm SL, and the smallest demersal juvenile was 15.5 mm SL. Tilefish larvae in the Mid-Atlantic Bight occur in the plankton from July to September, with the center of abundance between Hudson and Baltimore canyons (Fahay and Berrien 1981).

Age and Growth. During intensive sampling at a relatively unexploited phase of the fishery, maximum sizes were 95 cm FL for females and 112 cm FL for males, and maximum ages were 35 and 26 years, respectively (Turner et al. 1983). Based on validated otoliths, both sexes grew about 10 cm FL year-1 for the first 4 years. At age 4, males and females averaged 43 and 41 cm FL, respectively. By the 9th year males averaged 74 cm FL and females averaged 64 cm FL. Females had a much smaller *Loo* (90 cm FL) and a larger *K* (0.153) than males *(Loo* = 111 cm FL and *K* = 0.130). Growth models (von Bertalanffy) for males *[Loo* = 111.3(1 *-e-{).130(t* - 0.216»)] and females *[Loo* = 90.2(1 *-e-0.IS3 (t*- 0.026»)] were significantly different with faster growth for males.

General Range. Tilefish are a demersal, shelter-seeking species that is distributed from Nova Scotia to Suriname, excluding the Caribbean Sea (Dooley 1978; Markle et al. 1980; Freeman and Turner 1982; Barans and Stender 1993). They appear most abundant over the outer continental shelf and upper slope from southern Georges Bank and south along the east coast into the Gulf of Mexico.

Occurrence in the Gulf of Maine. Stray tilefish have been frequently encountered off Nova Scotia including off La Have, Emerald, Roseway, and Yankee banks (Scott and Scott 1988). They are abundant off the southern edge of Georges Bank, particularly between Veatch and Lydonia submarine canyons and there are accounts of tilefish from fishermen as far east as Corsair Canyon on the eastern edge of Georges Bank.

Migrations. Limited information suggests that tilefish do not undergo extensive migrations (Grimes et al. 1983, 1986). In one set of observations, 12 fish that were tagged with breakaway, labeled hooks were at liberty from 115 to 577 days. All recaptures were made less than 1 nautical mile from the release location. Anecdotal accounts from fishermen also suggest relatively little movement (Freeman and Turner 1977b). However, there is evidence that there may be some seasonal movements in response to cooler winter temperatures in shallower and more northern portions of the Mid-Atlantic Bight (Grimes et al. 1986).
Stocks. Two stocks are recognized based on meristic, morphometric, and electrophoretic characters (Katz et al. 1983). The northern stock is distributed south to Cape Hatteras and the southern stock occurs from south of that area to at least the Yucatan Peninsula. Size of the dorsal flap also varies clinally with southern populations having smaller flaps (Katz et al. 1983).

Importance. In 1915, the Bureau of Commercial Fisheries undertook to popularize tilefish in the market, believing it numerous enough to support an important fishery and knowing it to be an excellent food fish. It proved so plentiful and so easily caught that a record 4,500 mt were landed in 1916, but only 5 mt were reported for 1920 (Shepherd 1998c). Beginning in the early 1970s, a directed commercial longline fishery expanded rapidly in the Mid-Atlantic and longlines have been the predominant gear used since then (Shepherd 1998c). Landings varied widely from 30 to 3,800 mt between 1962 and 1996, with a peak of 3,800 mt in 1979 (Fig. 212). Status of the populations, especially relative to the recent longline fisheries, has been summarized for the northern Mid-Atlantic Bight (Turner 1986; Shepherd 1998c) and off South Carolina and Georgia (Low et al. 1983; Hightower and Grossman 1988; Barans and Stender 1993). Landings and catch-per-unit-effort data indicate that tilefish were overexploited during the height of the fishery (1977-1982) and remain overexploited (Shepherd 1998c) owing in part to their complex life history and unusual habitat (Grimes and Turner 1999).