3.3.2.3 Essential Fish Habitat-Habitat Areas of Particular Concern for Red Drum

Areas which meet the criteria for essential fish habitat-habitat areas of particular concern (EFH-HAPCs) for red drum include all coastal inlets, all state-designated nursery habitats of particular importance to red drum (for example, in North Carolina this would include all Primary Nursery Areas and all Secondary Nursery Areas); documented sites of spawning aggregations in North Carolina, South Carolina, Georgia, and Florida described in the Habitat Plan; other spawning areas identified in the future; and habitats identified for submerged aquatic vegetation.

These habitats include the most important habitats required during the life cycle of the species, including the spawning areas and estuarine nursery grounds. Other areas of specific concern are barrier islands in each state, as these structures are vital to maintain estuarine conditions needed by larval and juvenile stages. Passes between barrier islands into estuaries also are very important, as the slow mixing of sea water and fresh water is generally regarded as being of prime importance in the productivity of any estuary. A rapid change may cause environmental stresses too great for many estuarine organisms to withstand.

Seagrass beds or submerged aquatic vegetation (SAV) prevalent in the Chesapeake Bay and the sounds and bays of North Carolina and Florida are also critical areas for red drum, particularly for 1 and 2 year old fish (>750 mm or 29.5 in FL). Seagrass beds, shallow areas of estuarine rivers and mainland shorelines, are where many red drum reside during the summer. Based on a preliminary aerial survey in North Carolina there are approximately 200,000 acres of SAV distributed in Core Sound and eastern Pamlico Sound, making North Carolina second only to Florida in abundance of this type of fisheries habitat.

The states of South Carolina and Georgia lack seagrass beds; the preferred habitat of juveniles (<75mm) based on sampling efforts by Daniel (1988) in Charleston, South Carolina, may be high marsh areas with shell hash and mud bottoms. In South Carolina, smaller juveniles remain in the marsh system until they are around 150 mm, moving into the main creeks and river channels and lower harbor areas as they become larger. In addition, there is seasonal movement out of the marsh and into deep holes and creek channel adjoining the marsh system during the winter months. Therefore, the area of particular concern for early growth and development is seasonal and size dependant encompassing the entire estuarine system from the lower salinity portions of the river systems through the inlet mouth or lower harbor areas.

The various inlets, adjoining channels, sounds, and outer bars of ocean inlets are critical areas for spawning activity (see Figure 29 and Appendix S) as well as feeding and daily movements and may be affected by constant dredging, jettying or excessive boat traffic. Adult red drum spend a lot of time in these areas during spring and fall with large concentrations located near the least trafficked inlets.

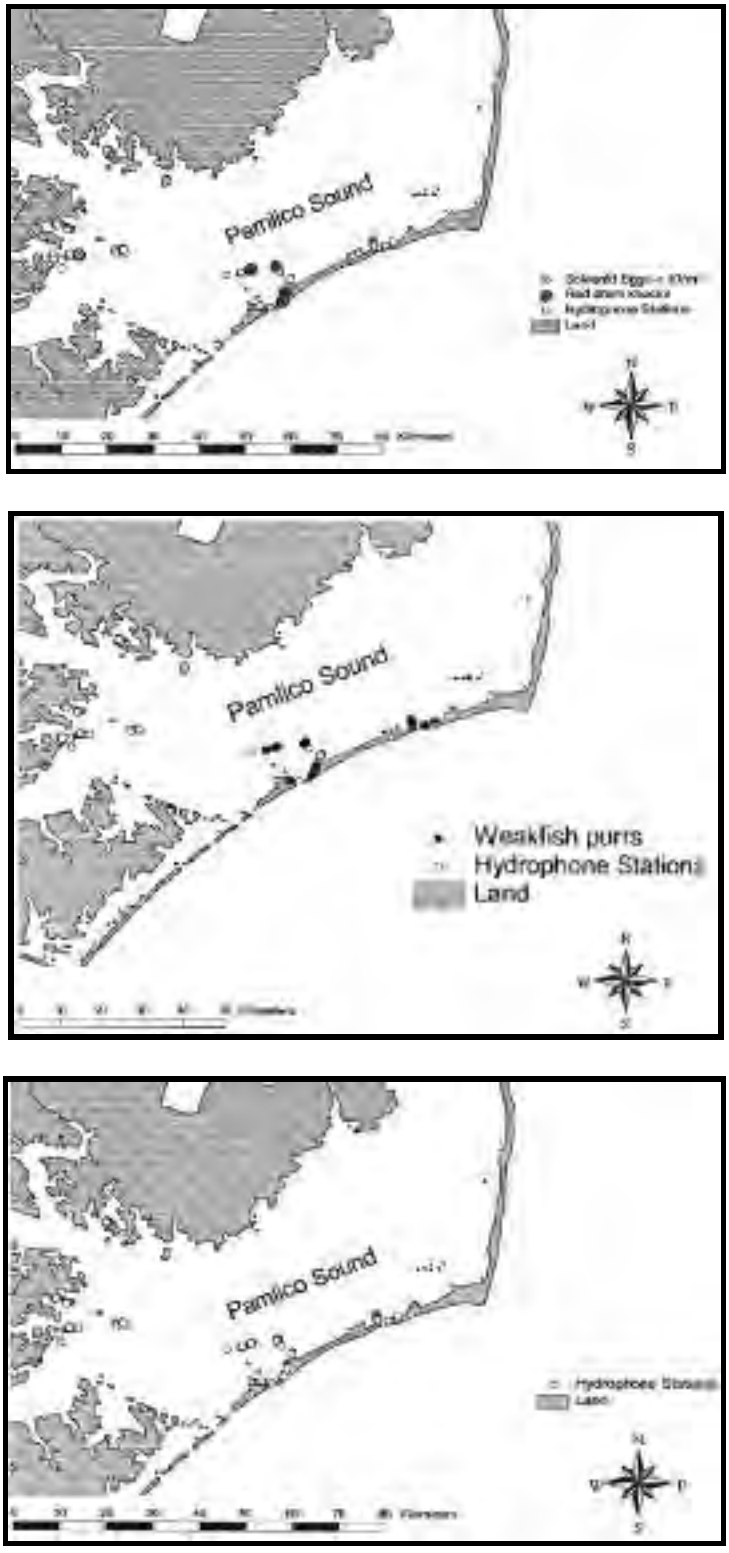


Figure 29. Sites of red drum and weakfish spawning aggregations identified in coastal North Carolina through acoutic sampling conducted by the North Carolina Division of Marine Fisheries (Louis Daniel, pers.comm. 1998).

3.3.3 Snapper Grouper Complex

3.3.3.1 Description of the Species Complex.

Ten families of fishes containing 73 species are managed under the snapper grouper plan (Section 2.2). Their association with coral or hardbottom structure during at least part of their life cycle and their contribution to an interrelated reef fishery ecosystem are the primary criteria for inclusion within the snapper grouper plan (SAFMC, 1983). Phylogenetically, they are diverse and include representatives of two suborders of perciformes (Percoidei and Labroidei), as well as the order Tetraodontiformes. However, sixty-eight of these species are within eight percoid families. There is considerable variation in specific life history patterns and habitat use among the snapper grouper species complex. Seventeen of the 73 species in the FMP are overfished (SPR <30%) according to the most recent NMFS stock assessments and SAFMC SSC analyses. The overfished species include ten groupers, two snappers, two porgies, one grunt, one temperate bass, and one tilefish.

Space constraints in this document limit thorough characterizations of this diverse multispecies complex. To summarize some of the ecological variation among the more valuable species, short biological characterizations are provided below for 18 representative species from seven families. These include the serranid groupers (snowy grouper, yellowedge grouper, warsaw grouper, speckled hind, scamp, and jewfish), the percichthyid temperate basses (wreckfish), lutjanid snappers (gray snapper, mutton snapper, blackfin snapper, red snapper, silk snapper, and vermilion snapper), haemulid grunts (white grunt), sparid porgies (red porgy), carangid jacks (greater amberjack), and malacanthid tilefishes (golden tilefish and blueline tilefish). Seven of these species are overfished. Information on habitat use, biological attributes, and reproduction is provided for many of these and other species in Tables 19a, 20a, 21a, and 21b following the ELMR format used in Nelson et al., (1991).

More detailed information is available in the source document for the Snapper Grouper FMP (SAFMC, 1983b) and books summarizing the biology of many of these and co-occurring species, including Munro (1983), Ralston and Polovina (1987), Sale (1991), Claro (1994), and Arreguín-Sánchez (1996). In addition, many publications from areas under, or near, the Council's jurisdiction are available on individual species or species complexes (e.g., Matheson et al., 1986; Grimes et al., 1988; Cuellar et al., 1996; Ault et al., 1998) or specific habitat types (e.g., mangroves - Thayer et al. 1987; seagrasses - Sogard et al., 1987; Florida Keys coral reefs - Bohnsack et al., 1987; Chiappone and Sluka, 1996; nearshore hard bottom - Lindeman and Snyder, in press; deep reefs - Parker and Mays, In press). Many additional summaries of the use of specific habitats by snapper grouper species are enclosed in the habitat characterizations in Section 3.0 of this document.

Groupers (Serranidae):

Snowy Grouper

The snowy grouper (*Epinephelus niveatus*) is a demersal serranid distributed in the western Atlantic from NC and the Gulf of Mexico to Brazil. It also occurs in the eastern Pacific including the Gulf of California, Mexico, and Panama (Fischer, 1978). Juveniles (about 400 mm (TL)) have been observed off NC in depths of 61 m (Parker and Ross, 1986) where bottom water temperatures fluctuate from about 15.0^{o} to 29.0^{o}C. Adults occur to depths of about 180 m, and were common between 116 to 137 m off NC (Roe, 1976; Huntsman and Dixon, 1976; Parker and Ross, 1986), where the habitat contains irregularly sized boulders and ridges of bioeroded

limestone with vertical relief up to 10 m interspersed with sand, broken shell, and rock fragments.

Snowy grouper live at least 27 years, reaching a weight of 29 kg (Moore and Labisky, 1984). Average lengths for fish aged 1 to 17 years are 210, 328, 404, 462, 513, 561, 604, 648, 686, 721, 762, 797, 833, 874, 899, 924, and 958 mm (Matheson and Huntsman, 1984). They feed mostly on crabs, fishes, and cephalopods (Bielsa and Labisky, 1987; Dodrill et al., 1993). Snowy grouper are protogynous hermaphrodites, changing from females to males as they grow older. Fish first reach sexual maturity when about 4 to 5 years old and 450 to 500 mm long (Moore and Labisky, 1984). Spawning occurs April through July, and eggs and larvae are pelagic. This species is considered overfished in the most recent NMFS stock assessment and SAFMC SSC analyses.

Yellowedge Grouper

The yellowedge grouper (*Epinephelus flavolimbatus*) is a large (to 18 kg) grouper that inhabits hard bottom and rocky outcroppings in depths of 190 to 220m (Low and Ulrich, 1983). It ranges from offshore of NC along the continental shelf break to Brazil and the Gulf of Mexico. It is much more abundant in the western Gulf of Mexico than in the Atlantic (Chester et al., 1984).

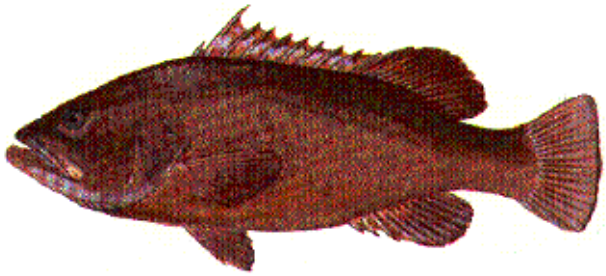
Yellowedge grouper live at least 15 years and grow to 1110 mm. Like their close relative, snowy grouper, yellowedge grouper are believed to be protogynous hermaphrodites. Sex reversal may take place over a wide range of sizes, but has usually occurred by the time a fish reaches 850 mm (Keener, 1984). Yellowedge grouper normally mature between ages five and six (450 to 469 mm). Spawning occurs from April to October with a September peak, and eggs and larvae are pelagic. Adults feed on bottom dwelling animals, including squid, octopus, crabs, eels, lizardfish, seahorses, scorpionfish, and searobins (Manooch and Raver, 1984).

Warsaw Grouper

The warsaw grouper (*Epinephelus nigritus*) is a large serranid distributed from NC to the Florida Keys and Gulf of Mexico to the northern coast of South America. It inhabits irregular bottoms including steep cliffs, notches, and rocky ledges of the continental shelf break in depths of 76 to 219 m (Manooch and Mason, 1987).

Little is known about the reproduction of warsaw grouper but eggs and larvae are thought to be pelagic. Warsaw grouper live at least 41 years and reach lengths of over 2,300 mm and

weights of at least 190 kg. Average lengths for fish aged 1, 5, 10, 15, 20, and 24 years are 330, 914, 1,194, 1,295, 1,397, and 1,473 mm (Manooch and Mason, 1987). Fishes and crustaceans are major foods (Manooch pers. obs.). This species is considered overfished in the most recent NMFS stock assessment and SAFMC SSC analyses.

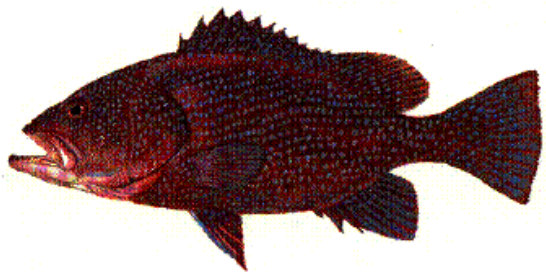


Speckled Hind

The speckled hind (*Epinephelus drummondhayi*) ranges from Bermuda and NC to FL, and throughout the Gulf of Mexico (Smith, 1971; Hoese and Moore, 1977). It inhabits high and low profile hard bottom in depths ranging from 27 to 122 m (Huntsman and Dixon, 1976; Parker, pers. obs.).

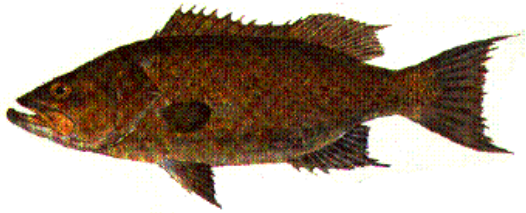
Preliminary investigation indicates that speckled hind are protogynous hermaphrodites (Matheson, 1981). Most of the larger, older fish are males. Sexual maturity is reached in about 5 years (500 mm).

Speckled hind live more than 15 years and can weigh over 20 kg. Average total lengths for fish from NC and SC aged 1 to 15 years are 186, 317, 408, 475, 528, 572, 613,45, 678, 709, 739, 774, 804, 839, and 861 mm (Matheson and Huntsman, 1984). Speckled hind generally engulf their prey whole. The diet includes fishes, shrimp, crabs, squid, and octopus (Bullock and Smith, 1991). This species is considered overfished in the most recent NMFS stock assessment and SAFMC SSC analyses.



Scamp

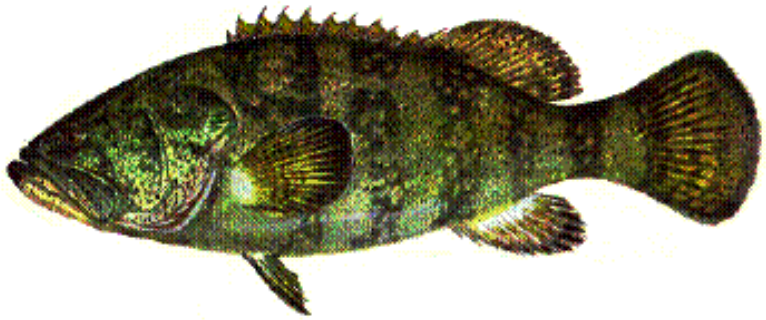
The scamp (*Mycteroperca phenax*) inhabits continental shelf waters from NC to FL and throughout the Gulf of Mexico. The species has been observed over low to high profile rock outcroppings encrusted with soft corals, sponges, hydroids, and bryozoa in waters 20 to 100 m deep (Parker and Ross, 1986).



Scamp spawn from April through August with a peak in May and June (Matheson et al., 1986). They live at least 21 years and grow to 894 mm. Average total lengths (and weights) for fish aged 1, 2, 3, 4, 5, 10, 15, 20, and 21 years are 216 mm (0.15 kg), 333 mm (0.54 kg), 414 mm (1.0 kg), 470 mm (1.4 kg), 516 mm (1.9 kg), 663 mm (3.9 kg), 770 mm (6.9 kg), 884 mm (8.9 kg), and, 894 mm (9.3 kg). Scamp feed mostly on fishes, such as round scad, *Decapterus punctatus*, tomtate, *Haemulon aurolineatum*, and vermilion snapper (Matheson et al., 1986).

Jewfish

The jewfish (*Epinephelus itajara*) is found on both Atlantic and Pacific sides of Central America (Smith, 1971). In the Atlantic, jewfish occur from Brazil throughout the Caribbean, Gulf of Mexico, Bermuda, the Bahamas and Florida (Bohlke and Chaplin, 1968; Smith, 1971; Hoese and Moore, 1977; Robins and Ray, 1986).



In the South Atlantic, jewfish are more abundant off the Florida east coast and in the Florida Keys. Spawning aggregations have been observed in the past off Palm Beach, Florida but do not occur anymore. The occurrence of jewfish north of Florida is rare and the States of Georgia and South Carolina requested jewfish be protected within Special Management Zones around their artificial reefs. This species is considered overfished in the most recent NMFS stock assessments and SAFMC SSC analyses. The Council has since prohibited the harvest or possession of jewfish in the South Atlantic EEZ.

Jewfish are suspected to be protogynous hermaphrodites (born female and changing to male later in life), similar to other groupers. Smith (1971) found evidence of ova remnants in the gonad of a six foot male collected near Bimini, Bahamas. The size or age of sexual transition is unknown and it is possible that some males pass through an immature female stage and mature only as males (L. Bullock, FMRI, FDNR, personal communication). Also, many of the larger fish taken commercially have been females. The ongoing Florida Department of Natural Resources (FDNR) study of jewfish has found no transitional fish among those sampled from the commercial fishery. Thus, it is not conclusive whether jewfish are indeed protogynous hermaphrodites or gonochoristic (sexes separate).

In the eastern Gulf of Mexico, females with ripe ova have been found during July through October with August to mid-October apparently the period of peak reproductive activity (D. DeMaria, SAFMC Snapper Grouper Advisory Panel, personal communication). Spawning aggregations of jewfish have been observed in waters as shallow as 30-40 feet.

In the FDNR study, female jewfish sexually matured at about 50-inches total length (105 pounds in weight). The youngest sexually mature female sampled was ten years of age, assuming one annulus per year. No specific information on fecundity exists. The smallest

mature male was 43-inches total length, and the youngest sexually mature male was about five years old (L. Bullock, FMRI, FDNR, preliminary unpublished data).

Jewfish are long-lived and can attain a size of 700 pounds (Smith, 1971). Randall (1968) found fishes, hawksbill turtle, crabs, slipper lobster and most often spiny lobster in the stomachs of jewfish. Smith (1971) reported a large proportion of the jewfish's prey were crustaceans.

Adult and juvenile jewfish inhabit shallow waters and reside around bottom features which provide cover and protection (e.g. shipwrecks, reefs, ledges, piers, bridges and mangrove lined shores) (Godcharles, personal communication; Hoese and Moore, 1977; Robins and Ray, 1986; Smith, 1971; Thompson and Munro, 1978). Juveniles have been found along bulkheads and bridges (Springer and Woodburn, 1960) and in upland canals in Tampa Bay (Lindall et al., 1975). The preferred habitat of adults is the high-relief ledges and wrecks further offshore (Smith, 1976). The habitat preferences of jewfish make them easily accessible to fishermen, and especially vulnerable to spearfishermen. Furthermore, their narrow habitat preference causes this species to be highly susceptible to hypothermia (Gilmore et al., 1978) and red tide (Smith, 1976) induced mortalities. Large numbers of these fish are reported to aggregate around isolated reefs, rock ledges and wrecks in 150 foot depths and less on the southwest and southeast Florida shelf during the spawning season (P. Colin and D. DeMaria, personal communication). Indeed, aggregations up to 24 fish in depths as shallow as 15 feet have been observed in Hobe Sound, Florida (W. Parks, personal communication).

"The jewfish's ecological role in Georgia's offshore live bottom communities is also unknown and subject to conjecture. Based on diver observations, however, it has been suggested that jewfish may slow sandwave inundation of low-relief or isolated outcrops that have been established as residences by this species. Besides maintaining an open substrate for invertebrates, these outcrops also support related live bottom fisheries, including scamp, black seabass, snapper and other reeffish. In light of the low occurrence of live bottoms off Georgia, this type of function could be important in maintaining some of the state's offshore live bottoms" (D. Harris, personal communication).

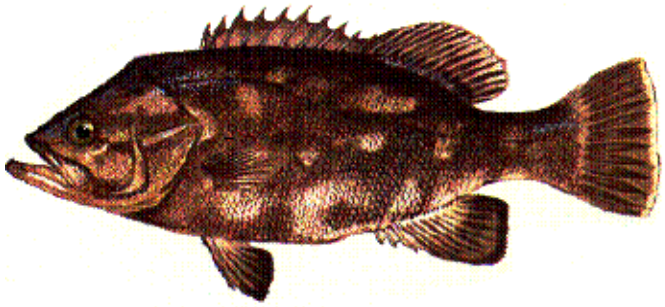
Temperate Basses (Percichthyidae):

Wreckfish

The wreckfish (*Polyprion americanus*), has a wide geographic distribution but little is known of its biology and fisheries potential. Hardy (1978) reported the distribution of *Polyprion americanus* in the western Atlantic as extending from Grand Banks, Newfoundland to La Plata River, Argentina. The available literature consists primarily of occurrence records or behavioral observations (Roberts, 1977; Ryall and Hargrave, 1984; Schroeder, 1930), with limited life history data (Roberts, 1989). Wreckfish are pelagic for the first several years of their life (up to 30 cm length), often associated with floating debris (Roberts, 1989), the habit responsible for their common name. They grow to large size (100 kg weight, 2 m length), and are commercially fished in portions of their range (Roberts, 1989). The shallowest reported demersal populations of *Polyprion* in the western Atlantic were reported off Argentina in depths of 66-84 m (Menni and Lopez, 1979). The maximum reported depth for wreckfish is 1000 m (Lythgoe and Lythgoe, 1971). The presence of fishable concentrations of wreckfish in the northwestern Atlantic was unknown until 1987, when a fishery began to develop on the Blake Plateau, adjacent to South Carolina and Georgia.

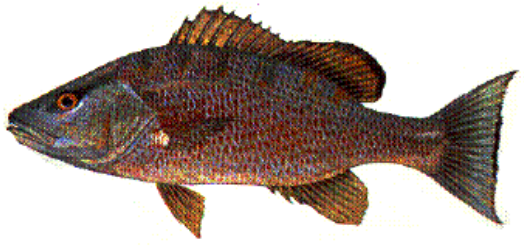
The fishing grounds and known distribution of wreckfish comprise an area of the Blake Plateau of approximately 50-75 square nm, characterized by a rocky ridge system having a vertical relief of >50 m and a slope of >15 degrees. The depth range in this area is 450-600 m.

The substrates in areas of the Blake Plateau exhibiting significant relief are generally characterized as composed of manganese - phosphate pavements, phosphorite slabs and coral banks (Pratt and McFarlin, 1966: Stetson et al, 1979). Bottom samples obtained from commercial fishermen indicate that wreckfish concentrations occur primarily on the manganese-phosphate bottoms. Prior observations from the research submersible, Johnson Sea-Link I, showed low densities of wreckfish associated with coral mounds or banks [C. A. Wenner (SCWMRD), personal communication]. There has been some exploratory efforts by commercial vessels but most of the fishing effort occurs on the initially discovered grounds of the Hoyt Hill area. This species is considered overfished in the most recent NMFS stock assessment and SAFMC SSC analyses.



Snappers (Lutjanidae):
Gray Snapper

One of the most commonly caught marine fishes in Florida, the gray snapper (*Lutjanus griseus*) occurs in marine and estuarine waters from North Carolina and Bermuda through Brazil (Robins and Ray, 1986). Spawning activity occurs offshore and peaks during the summer and early fall (Grimes, 1987; García-Cagide et al., 1994, Domeier et al., 1996). Eggs and larvae are planktonic and occur offshore (Bortone and Williams, 1986). Flexion of the caudal fin occurs at 4.2 mm (Richards and Saksena, 1980). Planktonic larval duration is estimated to range from at least 25 to 40 days, with a mean of 33 days postfertilization based on otolith microstructure (Lindeman et al., MSa). Settlement sizes range from approximately 10 to 20 mm (Starck, 1970). Larvae appear competent to settle at ages from approximately three to five weeks. The mean growth rate estimated for early juveniles is 0.92 mmd^{-1} (Lindeman et al., MSa). Maturity is reached at about 200 mm TL, probably during the third year (Starck, 1970). A variety of adult growth data are summarized in Claro and Garcia (1994). Based on literature reviews, Ault et al. (1998) estimated gray snapper reach a maximum size of .72 meters and a maximum age of 10 years.



The majority of western Atlantic snappers are easily distinguished as adults and larger juveniles. However, newly settled stages (<25 mm SL) of *Lutjanus griseus, L. apodus, L. jocu,* and *L. cyanopterus* can co-occur in shallow water, have essentially identical fin meristics, lack

dorsolateral spots, and can be difficult to distinguish. Diagnostic methods for these species and other snappers at settlement are summarized in Richards et al. (1994) and Lindeman (1997).

Juvenile gray snapper are euryhaline and occur at salinities from 0-37 ppt (Tabb et al., 1961; Starck, 1970; Rutherford et al., 1983; Bortone and Williams, 1986). Exposure to freshwater pulses caused no mortality in laboratory experiments with juveniles (Serafy et al., 1997). Lower lethal temperature have been estimated at 11-14^{o} C (Starck, 1970) and several authors report mortality at low water temperatures caused by freezes (Tabb and Manning, 1961; Starck, 1970; Gilmore et al., 1978). Gray snapper are carnivorous at all life stages. Juveniles primarily prey on crustaceans, but can also consume fish, mollusks and polychaetes (Starck, 1970; Hettler, 1989). Adults are typically nocturnal predators, consuming mostly fish, but also taking shrimp and crabs (Longley and Hildebrand, 1941; Starck and Davis, 1966; Randall, 1968; Starck, 1970; Moe, 1972). Adults may show seasonal spawning migrations (Starck, 1970; Domeier and Colin, 1997).

In contrast to most snapper species, there is a substantial literature on habitat use in juvenile stages of gray snapper. Most information is from south or central Florida. Starck (1970) summarized information available through the 1960s for the Florida Keys and concluded that settlement stages and early juveniles primarily used grassbeds before migrating to hard structure in deeper waters with growth. In the Florida Bay area, gray snappers have been examined indirectly or directly in various studies, including Odum and Heald (1972), Thayer et al. (1987), Sogard et al. (1987), Hettler (1989), Chester and Thayer (1989), and Rutherford et al. (1989). These studies found gray snapper to be the most abundant lutjanid in the northern and eastern areas of this complex estuary, with hundreds of turbid basins and limited flushing. In grassbeds of the Indian River Lagoon, gray snapper was the most frequently occurring and second most abundant snapper collected (Gilmore, 1988). Work in high-salinity, low-turbidity mangrove habitats in Cuba (Claro and García-Arteaga, 1993) and Puerto Rico (Rooker and Dennis, 1991) also recorded gray snapper as the most abundant lutjanid.

Based on reviews of 40 years of surveys, and new sampling, in the Biscayne Bay area, newly settled stages commonly occurred in grassbeds, were consistently absent from mangrove and hardbottom habitats, and were uncommon or rare from all habitats exceeding 5 m in depth (Lindeman et al., In press). Early juvenile stages (2.5-7 cm) were more widely distributed, particularly on the habitat scale, occurring among a variety of hard structures as well as mangroves and grassbeds. The absence of newly settled life stages from hardbottom and mangrove habitats may result from the older resident fauna and more concentrated predation pressures in these habitats (Lindeman, 1997).

In summary, early stages can occur in estuaries and shallow marine areas (Hildebrand and Schroeder, 1928; Reid, 1954; Loftus and Kushlan, 1987; Bohlke and Chaplin, 1968; Randall, 1968; Starck, 1970; Chester and Thayer, 1989). Bottom types of high value include seagrass flats (*Thalassia*, *Syringodium*, and *Halodule*); soft marl bottoms, fine marl mud with shell and rock outcrops; mangrove roots; hardbottom structures; and shallow basins with seagrasses adjacent to mud banks (Bortone and Williams, 1986, Starck, 1968, Hildebrand and Schroeder, 1928, Starck 1970, Gunter, 1957, Chester and Thayer 1989). Adults are primarily marine and utilize deeper waters than juveniles, but can occur in estuaries and rivers. Adults are euryhaline, ranging from 0-47 ppt waters (Croker, 1960, Hardy, 1978, Briggs, 1958) and have been reported from depths of 77 m (Rivas, 1970). Bottom types of high value for adults are diverse and include coral reefs and hardbottom offshore, ledges of channels, artificial structures, mangroves and grassbeds, alcyonarians, and sponges (Starck and Davis, 1966, Gunter, 1957, Hildebrand and

Schroeder, 1928, Kilby, 1955, Moe, 1972, Springer and Woodburn, 1960; Starck, 1970; Bohnsack et al., 1987).

Mutton Snapper

A premier demersal fishery species, the mutton snapper (*Lutjanus analis*), ranges from Florida and Bermuda to Brazil (Robins and Ray, 1986). Unlike the gray snapper, mutton snapper are not appreciably present north of central Florida or in the northern Gulf of Mexico. Spawning activity occurs offshore and may peak during the summer and fall (Grimes, 1987; Garcia-Cagide et al., 1994). Sizeable aggregations can be formed during spawning (Domeier and Colin, 1997). Eggs and larvae are probably planktonic and occur offshore (Richards et al., 1994). Planktonic larval duration is estimated to range from at least 27 to 37 days, with a mean of 31 days postfertilization (Lindeman et al., MSa). Settlement sizes range from approximately 10 to 20 mm (Starck, 1970). The mean growth rate estimated for early juveniles is 0.68 mmd^{-1} for winter-spawned individuals (Lindeman et al., MSa). Adult growth data are summarized in Claro and Garcia (1994). Based on literature reviews, Ault et al. (1998) estimated that mutton snapper reach a maximum size of .94 meters and a maximum age of 14 years.

Mutton snapper are recorded from salinities of 4.5-37.3 ppt (Christensen 1965) and temperatures of 18.5-30^{o} C (Roessler, 1970). Mortality from hypothermal stress has been documented at 6-13^{o} C (Gilmore et al., 1978). Larvae and newly settled stages are presumed to be planktivorous and benthic invertebrate foragers, respectively. Large juveniles and adults feed predominately on a wide array of crustaceans and fishes, although gastropods and octopii may also be consumed (Randall 1967; Starck, 1970; Parrish 1987).

In contrast to the gray snapper, there is little literature on habitat use in early stages of nutton snapper. Eggs and larvae probably utilize water column habitats over the continental shelf, based on similar lutjanids (Grimes 1987; Leis 1987). Recruitment of early juveniles 10-25 mm SL to the Indian River Lagoon occurs principally from June to November; however, juveniles <20 mm SL have been captured in July, and October through January (Gilmore, unpubl data). From 1974 to 1977 the largest single collections of juveniles consistently occured in November, but the wide distribution of early juveniles through the summer, fall and winter indicates a prolonged spawning and recruitment period for southeast Florida mutton snapper populations (Gilmore, unpubl. data).

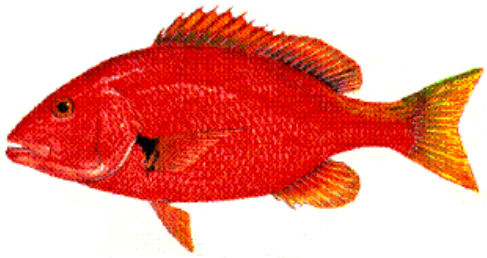
Newly settled stages occur in seagrass meadows (10-15 mm SL at settlement, with size ranges of 10-200 mm SL, n = 250; Gilmore, unpubl. data) and generally use mangrove prop roots or adjacent shallow rock and coral reef formations as larger juveniles (>100 mm SL; Gilmore, unpubl. data). Christensen (1965) captured 297 juveniles, 15-176 mm SL in seagrass meadows at Jupiter Inlet in the southern terminous of the Indian River Lagoon, while Springer and McErlean (1962) captured 67 individuals 16-66 mm SL in nearshore seagrass meadows of the Florida Keys. Ocean inlet seagrass meadows are preferred habitat for mutton snapper juveniles in the Indian River Lagoon although they occurred at all seagrass stations from Sebastian Inlet to St. Lucie Inlet (Gilmore 1988; Gilmore unpublished data).

Adults utilize a variety of deeper reef environments over reef, sand and mud substrates and can occur to depths of 100 m (Starck, 1970; Rivas, 1970; Gilmore 1977; Claro, 1981). Adult may make migrations to spawning sites (Domeier and Colin, 1997). Adults are generalized top predators on a variety of reef invertebrates and fishes, particularly slow-moving or sedentary benthic and epibenthic prey species. Feeding predominately takes place near the bottom during the day or night (Randall, 1968; Parrish, 1987).

Blackfin Snapper

The blackfin snapper (*Lutjanus buccanella*) occupies shelf edge habitat from Cape Hatteras, NC to the Caribbean Antilles, and in the Gulf of Mexico (Böhlke and Chaplin, 1993). While juveniles and subadults sometimes inhabit hard bottom at shallow depths (12 to 40 m), adult fish usually occur from 40 to 300 m (Rivas, 1970*;* Nagelkerken, 1981).

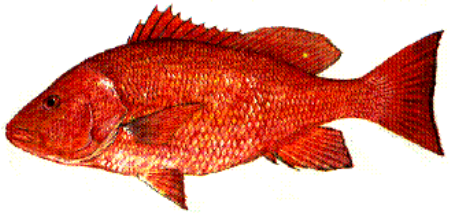
Male fish grow larger (to 740 mm) than females but are less common (Boardman and Weiler, 1980). Adult fish more commonly reach 500 mm on a diet of fish and crustaceans (Nagelkerken, 1981).



Red Snapper

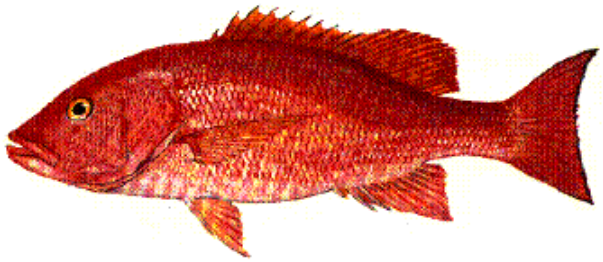
The red snapper (*Lutjanus campechanus*) ranges from Cape Hatteras, NC to FL and throughout the Gulf of Mexico. It is found over rocky bottom at depths from 10 to 190 m and feeds on fishes and invertebrates, i.e. shrimp, cephalopods, and worms (Fischer, 1978).

Red snapper mature after 3 years (Bradley and Bryan, 1975) and spawn throughout the warmer months. Eggs and larvae are pelagic. Red snapper lives at least 16 years and grow to 1,025 mm. Average total lengths for fish aged 1, 2, 3, 4, 5, 10, and 15 are 224, 379, 453, 536, 577, 845, and 1,025 mm (Nelson and Manooch, 1982).



Silk Snapper

The silk snapper (*Lutjanus vivanus*) ranges from Cape Hatteras, NC to Brazil and in the Northern Gulf of Mexico along the continental shelf edge, 64 to 242 m in depth (Böhlke and Chaplin, 1993). This shelf edge habitat consists of algal limestone cliffs and ledges interspersed with shell hash and sandstone (Grimes, 1976).



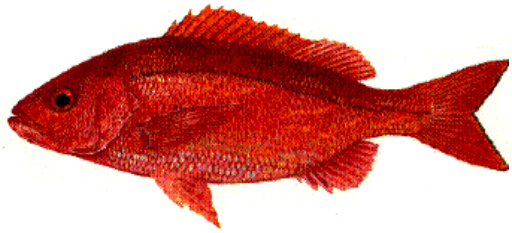
Young adult and juvenile fish occupy shallower depths than adult fish, to as shallow as 12 m where preferred bottom type occurs (Nagelkerken, 1981). Fish and crustaceans make up the majority of the diet. Silk snapper reach sexual maturity by 500 to 555 mm and grow to 750

mm. Thought to travel in loose schools, silk snapper aggregate year round for spawning with apparent peaks in July through September and October through December. Female fish outnumber males (Boardman and Weiler, 1980).

Vermilion Snapper

The vermilion snapper (*Rhomboplites aurorubens*) occurs over rough bottom from Bermuda and NC to Brazil, including the West Indies (Bohlke and Chaplin, 1993). Their diet consists mostly of small pelagic crustacea (ostracods, copepods, stomatopods, amphipods, shrimp, and crabs), cephalopods, pelagic gastropods, and small fish (Dixon, 1975; Grimes, 1979).

Vermilion snapper mature in 3 to 4 years, and spawn April through September off NC (Grimes, 1976) and year around off Puerto Rico (Boardman and Weiler, 1980). Ovaries contain 100 thousand to 1.8 million eggs (Grimes, 1976). Eggs and larvae are pelagic. Vermilion snapper live at least 10 years and grow to 618 mm (Grimes, 1978). This species is considered overfished in the most recent NMFS stock assessments and SAFMC SSC analyses.

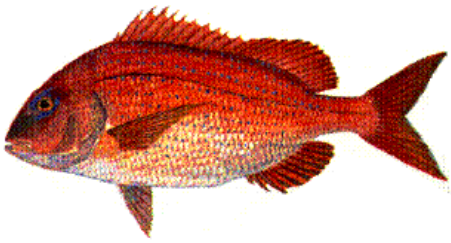


Porgies (Sparidae):

Red Porgy

In the western Atlantic the red porgy (*Pagrus pagrus*) occurs from NC to Argentina over rough bottom at depths from 18 to 280 m (Murray and Hjort, 1912), but has not been reported from the Caribbean (Manooch and Huntsman, 1977). Red porgy are protogynous hermaphrodites; most fish longer than 457 mm are males. Females mature in 2 to 4 years and may spawn 47,000 to 500,000 eggs.

Spawning occurs from January through April and eggs and larvae are pelagic (Manooch, 1975). Red porgy live up to 15 years. Average lengths for ages 1 to 12 years are 238, 290, 341, 382, 419, 451, 483, 505, 527, 543, 558 and 604 mm. The red porgy feeds on crabs, snails, worms, sea urchins, and occasionally small fishes such as round scad and tomtate (Manooch, 1977). This species is considered overfished in the most recent NMFS stock assessments and SAFMC SSC analyses.



Grunts (Haemulidae):

White Grunt

The white grunt (*Haemulon plumieri*) ranges from North Carolina to Brazil. Eggs and early larvae are pelagic (Johnson, 1978). Juveniles and adults are found from the shore to at least 35 m (Fischer, 1978), occupying a variety of habitats including reefs and hardbottom, grass flats, and mangrove habitats (Gilmore, 1977; Darcy, 1983). They are often found individually or in small groups, but can also form large schools over reefs and gorgonians, particularly during the day (Longley and Hildebrand, 1941; Gilmore, 1977; Darcy, 1983; Christensen, 1965). Spawning occurs over much of the year with one or more peaks in warmer months (Garcia-Cagide, 1994).

Larvae reared in the laboratory grew at a rate of 0.32 mm/d (Saksena and Richards, 1975). Otolith increment deposition has been validated as daily and the mean growth rate of field-collected early juveniles has been estimated at 0.38 mm/d (Lindeman et al., MSa). Adults tagged on the Florida west coast showed a growth rate ranging from 1.4 to 3.6 mm/month (Moe 1966). Maximum length is estimated at 450 to 460 mm (Hoese and Moore, 1977; Robins et al., 1986; Evermann and Marsh 1902; Breder, 1948).

White grunt are fished commercially and recreationally throughout their range (Manooch, 1976; Fernando, 1966). They are important in energy exchange between reef and seagrass communities because of nocturnal foraging migrations (Darcy, 1983). Newly settled stages feed on plankton directly from the water column during the day (Ogden and Ehrlich, 1977). Adults are generalized carnivores which feed mainly on benthic invertebrates (Manooch, 1976). These include echinoderms, polychaetes, majid crabs, alpheid shrimp, isopods, other shrimp, crabs, and small fish (Bebe and Tee-Van, 1928; Davis, 1967; Fischer, 1978; Darcy, 1983). Because of their abundance, they are probably important prey for many larger species of groupers and snappers (Darcy, 1983).

Jacks (Carangidae):

Greater Amberjack

The greater amberjack (*Seriola dumerili*) occurs in the western Atlantic from Nova Scotia and Bermuda to Brazil, including the West Indies and Gulf of Mexico (Fischer, 1978). Greater amberjack probably spawn year around but are reproductively most active from March through June (Burch, 1979). Spawning concentrations occur in southeast FL and the Keys.

The relatively new (since 1985) commercial fishery, especially that conducted by divers with spearguns, focuses on these aggregations. Greater amberjack have been aged to 17 years; they reach a weight of at least 30.5 kg and a length (FL) of 1,552 mm (Manooch and Potts, in press). Average lengths for fish aged 1 to 10 years are 407, 643, 908, 1000, 1094, 1169, 1218, 1333, 1397, and 1435 mm (Burch, 1979). Amberjacks are voracious feeders; major foods are fishes, cephalopods, and crustaceans (Manooch and Haimovici, 1983).

Tilefishes (Malacanthidae):

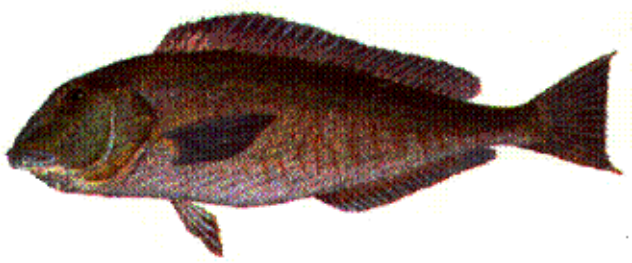
Golden Tilefish

The golden tilefish (*Lopholatilus chamaeleonticep*s) is a demersal malacanthid species that inhabits the outer continental shelf and upper continental slope along the entire east coast of the United States and the Gulf of Mexico south to Venezuela. It is a bottom dweller, living in burrows in clay substrate at depths from 76 to 457 m (Freeman and Turner, 1977) in water temperatures from 9 to 14%C (Grimes et al., 1986).

Fifty percent of males mature by age 5 (450 mm) while 50% of females mature by age 6 (500 mm) (Erickson and Grossman, 1986). Females spawn 1 to 10 million eggs, and spawn fractionally from March to November (Grimes et al., 1988). Golden tilefish live at least 33 years and mean sizes for fish aged 5, l0, l5, 20, 25 and 30 years are 471, 554, 689, 790, 883 and 852 mm (Harris and Grossman, 1985). Adult tilefish feed on fish, crabs, shrimp, squid, worms, sea cucumbers, anemones, tunicates, and sea urchins (Freeman and Turner, 1977). This species is considered overfished in the most recent NMFS stock assessment and SAFMC SSC analyses.

Blueline Tilefish

The blueline tilefish (*Caulolatilus microps*) occurs from Cape Charles, VA to the Campeche Banks, Mexico in water depths between 68 and 236m, but is found principally south of Cape Hatteras (Dooley, 1978). The species frequents irregular bottom comprised of troughs and terraces inter-mingled with sand, mud, or shell hash bottom along the continental shelf break. This habitat is commonly shared with some of the deep water snappers and groupers, especially snowy grouper. Blueline tilefish have been observed hovering near and entering burrows under rocks (Parker and Ross, 1986). Water temperatures typically range from 15 to 23 ^{o}C (Ross, 1978). These tilefish are epibenthic browsers, often feeding upon crabs, shrimps, snails, worms, sea urchins, and fish (Ross, 1982; Bielsa and Labisky, 1987).



Long lived and slow growing, blueline tilefish may attain 820 mm in 17 years (Ross, 1978; Ross and Huntsman, 1982; Labisky et al., 1983). They commonly reach 150 mm by the end of year one. Labisky et al. (1983) reported average lengths for age 1-15 fish of 165, 279, 358, 414, 464, 505, 544, 576, 607, 632, 655, 676, 693, 709, and 726 mm respectively.

Some females mature at age 1, all are mature by age 6. Large females spawn up to 4 million pelagic eggs between April and September, with peak spawning in May and September (Ross and Merriner, 1982). Early researchers believed that blueline tilefish might be protogynous hermaphrodites; however, a recent study indicates normal sexual dimorphism (Labisky et al., 1983).

3.3.3.2 Distribution and Use of Inshore/Estuarine Habitat.

Snapper grouper species utilize both pelagic and benthic habitats during their life cycle. Planktonic larval stages live in the water column and feed on zooplankton. Juveniles and adults are typically demersal and usually associate with hard structures on the continental shelf that have moderate to high relief; i.e., coral reefs, artificial reefs, rocky hard-bottom substrates, ledges and caves, sloping soft-bottom areas, and limestone outcroppings. More detail on these habitat types is found in Sections 3.2.1 and 3.2.2. However, juveniles of some species, such as *Lutjanus analis, L. griseus, L. jocu, L. synagris, Ocyurus chrysurus, Epinephelus itajara, E. morio, Mycteroperca microlepis , M. venenosa, C. faber,* and *L.maximus* may occur in inshore seagrass beds, mangrove estuaries, lagoons, and bay systems. In many species, various combinations of these habitats may be utilized during diurnal feeding migrations or seasonal shifts in cross-shelf distributions.

NOAA's Estuarine Living Marine Resource Program (ELMR) has compiled regional information on the use of estuarine habitats by select marine fish and invertebrates. A report prepared through the ELMR program (NOAA 1991b) and revised information (NOAA 1998), provided to the Council during the Habitat Plan development process, summarizes known spatial and temporal distributions and relative abundances of fish and invertebrates using southeast estuarine habitats. Twenty southeast estuaries selected from the National Estuarine Inventory (NOAA 1985) are included in an analysis based on a review of published and unpublished literature and expert consultations.

Detailed information on the distribution and seasonal use of estuarine habitat by gray snapper exists in the NOAA ELMR program. This information emphasizes the importance and essential nature of estuarine habitats to gray snapper. Since it is the only estuarine dependant species under the Snapper Grouper FMP in the ELMR data set, it is used here as a proxy for other estuarine dependent snapper grouper species. As information is compiled on other estuarine dependent species, such as gag, spatial coverages of juvenile distribution and use of inshore habitat essential to the species will be spatially portrayed on maps. Figures 30-32 present a representative sample of the distibution maps for juvenile gray snapper. The remainder of the coverages and additional information on species and habitat distribution are available over the Internet on the Council web page under the habitat homepage (www.safmc.noaa.gov). These maps portray salinity and relative abundances for estuaries and coastal embayments on state and/or regional maps. Depending on data availability, maps were produced at various scales: 1:24K, 1:80K, and 1:250K. These maps will eventually be provided to the Council as ArcView shape files with associated data for inclusion into the Council's GIS system.

3.3.3.3 Offshore Habitat

3.3.3.3.1 Distribution and Use of Offshore Habitat

The principal snapper grouper fishing areas are located in live bottom and shelf-edge habitats. Temperatures range from 11° to 27° C over the continental shelf and shelf-edge due to the proximity of the Gulf Stream, with lower shelf habitat temperatures varying from 11° to 14° C. Depths range from 54 to 90 feet or greater for live-bottom habitats, 180 to 360 feet for the shelf-edge habitat, and from 360 to 600 feet for the lower-shelf habitat.

The exact extent and distribution of productive snapper grouper habitat on the continental shelf north of Cape Canaveral is unknown. Current data suggest that from 3 to 30 percent of the shelf is suitable bottom. These hard, live-bottom habitats may be low relief areas supporting sparse to moderate growth of sessile invertebrates, moderate relief reefs from 1.6 to 6.6 feet, or high relief ridges at or near the shelf break consisting of outcrops of rock that are heavily encrusted with sessile invertebrates such as sponges and sea fans. Live-bottom habitat is scattered irregularly over most of the shelf north of Cape Canaveral, but is most abundant off northeastern Florida. South of Cape Canaveral the continental shelf narrows from 35 to 10 mi and less off the southeast coast of Florida and the Florida Keys. The lack of a large shelf area, presence of extensive, rugged living fossil coral reefs, and dominance of a tropical Caribbean fauna are distinctive characteristics.

Rock outcroppings occur throughout the continental shelf from Cape Hatteras, NC to Key West, FL (MacIntyre and Milliman, 1970; Miller and Richards, 1979; Parker et al., 1983). Generally, the outcroppings are composed of bioeroded limestone and carbonate sandstone (Newton et al., 1971) and exhibit vertical relief ranging from <0.5 to over 10 m. Ledge systems formed by rock outcrops and piles of irregularly sized boulders are common. Parker et al. (1983) estimated that 24% (9,443 km^2) of the area between the 27 and 101 m isobaths from Cape Hatteras to Cape Canaveral is reef habitat. Although the area of bottom between 100 and 300 m depths from Cape Hatteras to Key West is small relative to the shelf as a whole, it constitutes prime reef fish habitat according to fishermen and probably contributes significantly to the total amount of reef habitat.

Man-made artificial reefs are also utilized to attract fish and increase fish harvests. Research on man-made reefs is limited and opinions differ as to whether or not artificial structures actually promote an increase of biomass or merely concentrate fishes by attracting them from nearby natural areas.

The distribution of coral and live hard bottom habitat as presented in the SEAMAP Bottom Mapping Project is a proxy for the distribution of the species within the snapper grouper complex. The methodology used to determine hard bottom habitat relied on the identification of reef obligate species including members of the snapper grouper complex. ArcView maps were prepared for the four-state project by FMRI (FDEP) showing the best available information on the distribution of hard bottom habitat in the south Atlantic region. The maps which consolidate known distribution of coral, hard/live bottom and artificial reefs as hard bottom are included in Appendix E. These maps are also available over the Internet on the Council web page under the habitat homepage (www.safmc.noaa.gov). General snapper grouper species distribution maps are available for black sea bass and red porgy (Figures 34a and 34b).