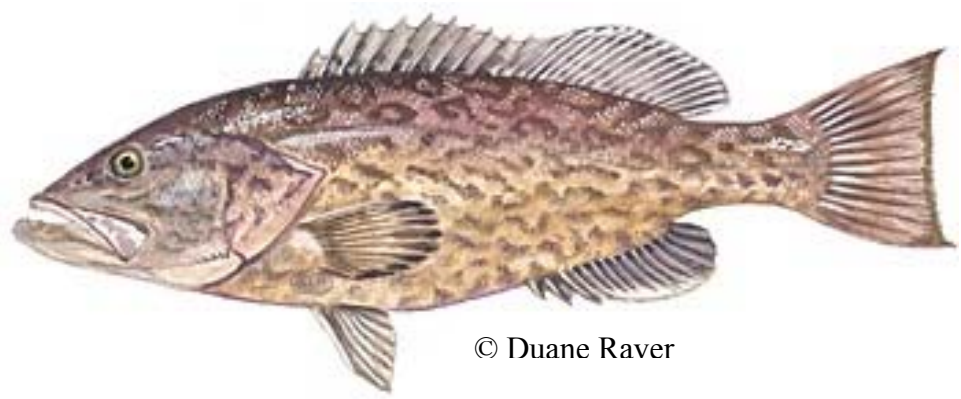
STOCK ASSESSMENT AND FISHERY EVALUATION REPORT FOR THE SNAPPER GROUPER FISHERY OF THE SOUTH ATLANTIC
NOVEMBER 18, 2005



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Gag, *Mycteroperca microlepis*

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1 INTRODUCTION

This Stock Assessment and Fishery Evaluation (SAFE) Report provides background material for the Snapper Grouper Fishery Management Plan (FMP) for the South Atlantic Region. It contains detailed information upon which the FMP and its amendments are based. In particular, this SAFE Report includes information on the biology of species in the FMP, harvest regulations, landings data, recent stock assessments, reports on fishery-independent studies, recent publications, summaries of studies funded by MARFIN and CRP, as well as recent analyses to determine reduction in harvest needed for some species. This is a "living document", which will be updated as new information becomes available.

1.1 Executive Summary

The Code of Federal Regulations defines a Stock Assessment and Fishery Evaluation (SAFE) report as a document or set of documents that provides Councils with a summary of the most recent biological condition of species in a Fishery Management Unit, and the social and economic condition of the recreational and commercial fishing industries as well as the fish processing industries (50 CFR 600.10). A SAFE report summarizes, on a periodic basis, the best available scientific information concerning the past, present, and possible future condition of the stocks and fisheries being managed under Federal regulation.

The last SAFE report that evaluated the condition of the Snapper Grouper Fishery in the Southeast Region was completed in 1999. That report provided a summary of what was known about the status of reef fish stocks, overviews of economic and social status of individuals participating in the fishery and attachments that included stock assessments, reports and, recent studies.

This report updates the 1999 SAFE report and provides new information. Species Descriptions in Section 2 provide background information including a history of management and updates on the biology of species in the FMU. Habitat issues are discussed in Section 3. Current Federal Regulations for snapper grouper species are described Section 4. Landings for species units and links to spreadsheets showing landings are provided in Section 5. Recent Status Information in Section 6 summarizes recent assessments that have been conducted through the SEDAR process as well as other recent biological studies of snapper grouper species, and provides links to these documents. Section 7 (Management Measure Analyses) describes analyses that have been conducted to determine reductions in harvest required to end overfishing in some snapper grouper species. Section 8 (Socio-Economic Information) updates the descriptions of the economic and social environments (respectively) of commercial and recreational fishing industries for South Atlantic snapper grouper fisheries.

1.2 History of Management

1.2.1 By FMP or Amendment

1.2.1.1 Snapper Grouper Fishery Management Plan (FMP)

The FMP for the Snapper Grouper Fishery of the South Atlantic Region (SAFMC 1983) was prepared by the South Atlantic Fishery Management Council to prevent growth overfishing in thirteen species in the snapper grouper complex, and to establish a procedure for preventing overfishing in other species. The FMP established a 12" total length minimum size for red snapper, yellowtail snapper, red grouper and Nassau grouper; an 8" total minimum size for black sea bass; and a 4" trawl mesh size to achieve a 12" minimum size for vermilion snapper.

Additional limitations on the use of certain gear, including poisons, explosives, fish traps, and trawls were also included in the original plan. All regulations became effective August 31, 1983 (Proposed Rule (PR): 48 FR 26843; Final Rule (FR): 48 FR 39463).

The Snapper Grouper FMP also contained a management measure to designate modified habitats or artificial reefs as special management zones (SMZs). Through a Regulatory Amendment to the Snapper Grouper FMP, fishing in these areas was prohibited except with hand-held hook-and-line gear (including manual, electric, or hydraulic rod and reel) and spearfishing gear (including powerheads and spear guns). The harvest of Goliath grouper was also prohibited within these SMZs. This regulatory amendment was implemented March 27, 1987 (PR: 51 FR 43937; FR: 52 FR 9864).

1.2.1.2 Amendment 1

Amendment 1 (SAFMC 1988) was prepared to address habitat damage and growth overfishing in the trawl fishery by prohibiting use of trawl gear to harvest fish in the directed snapper grouper fishery south of Cape Hatteras, North Carolina (35° 15 minutes N Latitude) and north of Cape Canaveral, Florida (Vehicle Assembly Building, 28° 35.1 minutes N Latitude). A vessel with trawl gear and more than 200 pounds of snapper grouper species on board was defined as a directed fishery. The amendment also established a rebuttable presumption that a vessel with snapper grouper species on board had harvested such fish in the Exclusive Economic Zone (EEZ). All regulations were effective January 12, 1989 (PR: 53 FR 42985; FR: 54 FR 1720).

1.2.1.3 Regulatory Amendments – SMZs off Florida

Through a regulatory amendment, two artificial reefs off Ft. Pierce, Florida were designated as SMZs, effective March 30, 1989 (PR: 53 FR 32412, FR: 54 FR 8342). Another SMZ was established at an artificial reef at Key Biscayne, Florida, and became effective November 2, 1990 (PR: 55 FR 28066, FR: 55 FR 40384). Fish trapping, bottom longlining, spear fishing, and harvesting of Goliath grouper were prohibited within the SMZ.

1.2.1.4 Notice of Control Date – Wreckfish Fishery

A Notice of Control Date for entry into the wreckfish fishery was published on September 24, 1990 (55 FR 39039). This notice informed the public that anyone entering the Federal wreckfish fishery off the South Atlantic states between 30° and 33°N latitude after March 28, 1990, would not be assured of future access to the fishery if a limited entry program was developed and implemented.

1.2.1.5 Amendment 2

Amendment 2 (SAFMC 1990a) prohibited the harvest or possession of Goliath grouper (jewfish) in or from the EEZ in the South Atlantic due to its overfished status, and defined overfishing for Goliath grouper and other snapper grouper species. Regulations prohibiting harvest or possession of Goliath grouper were initially implemented through an emergency rule, and Amendment 2 made them permanent as of October 30, 1990 (PR: 55 FR 31406; FR: 55 FR 46213).

1.2.1.6 Amendment 3

Amendment 3 (SAFMC 1990b) established a management program for the wreckfish fishery, due to concerns that a rapid increase in effort and catch could lead to overfishing, and that crowding of vessels could create problems with safety. Major actions in this amendment included:

- Adding wreckfish to the management unit;
- defining optimum yield and overfishing for wreckfish;
- requiring an annual permit to fish for, land or sell wreckfish;
- collecting data necessary for effective management;
- establishing a control date of March 28, 1990 after which there would be no guarantee of inclusion in a limited entry program should one be developed (later limited to the area bounded by 33° and 30° N. latitude, based on public hearing testimony);
- establishing a fishing year beginning April 16;
- establishing a process to specify annual quotas, with the initial quota set at 2 million pounds;
- establishing a 10,000 pound trip limit; and
- establishing a spawning season closure from January 15 through April 15.

Actions (6), (8) and (9) were based on public testimony. An emergency rule effective August 3, 1990 (55 FR 32257) (extended (55 FR 40181)) added wreckfish to the management unit and established: A fishing year beginning April 16, 1990; a commercial quota of 2 million pounds; and a catch limit of 10,000 pounds per trip. The wreckfish fishery in the EEZ was closed when the 2 million pound TAC was reached, effective August 8, 1990 (55 FR 32635). All regulations in Amendment 3 were effective by January 31, 1991 (PR: 55 FR 39023; FR: 56 FR 2443).

1.2.1.7 Notice of Control Date - Snapper Grouper Fishery

A Notice of Control Date for entry into the snapper grouper fishery was published on July 30, 1991 (56 FR 36052). This notice informed the public that anyone entering the Federal snapper grouper fishery (other than for wreckfish) off the South Atlantic states after July 30, 1991, would not be assured of future access to the fishery if a limited entry program was developed and implemented.

1.2.1.8 Amendment 4

Amendment 4 (SAFMC 1991a) was prepared to: Reduce fishing mortality on overfished species; establish compatible regulations, where possible, between state and federal agencies; identify the universe of fishermen; and gather data necessary for management. Amendment 4 prohibited use of the following gear in the South Atlantic EEZ:

- Fish traps, with the exception of black sea bass traps when used north of Cape Canaveral, Florida. Permit, gear, and vessel identification requirements were specified for black sea bass traps;
- entanglement nets, including gill and trammel nets;
- longline gear inside 50 fathoms (300 feet);
- bottom longlines to harvest wreckfish (emergency regulations (56 FR 18742) effective April 19, 1991, extended July 19,1991 (56 FR 33210);
- powerheads and bangsticks in all designated special management zones (SMZs) (off the South Carolina coast only).

Fishermen who fished for other species with gear prohibited in the snapper grouper fishery were not allowed bycatch of snapper grouper species with no bag limit or that were prohibited. In addition, they were allowed only to retain the bag limit of snapper and grouper species that had a bag limit.

The amendment also established the following minimum sizes with a requirement that all snappers and groupers possessed in the South Atlantic EEZ have head and fins intact through landing:

- 8" TL - lane snapper and black sea bass;
- 10" TL - vermilion snapper (recreational fishery only);
- 12" TL - red porgy, vermilion snapper (commercial only), gray, yellowtail, mutton, schoolmaster, queen, blackfin, cubera, dog, mahogany and silk snappers;
- 20" TL - red snapper, gag, and red, black, scamp, yellowfin, and yellowmouth groupers;
- 28" FL - greater amberjack (recreational fishery only); and
- 36" FL or 28" core length - greater amberjack (commercial fishery only).

Amendment 4 established the following per person daily bag limits:

- 10 vermilion snapper;
- 3 greater amberjack;
- aggregate snapper bag limit of 10 fish per person per day, excluding vermilion snapper and allowing no more than two red snappers; and
- aggregate grouper bag limit of five per person per day (excluding Nassau grouper and Goliath grouper for which no retention is allowed).

Charter and head boats were allowed a two–day possession limit if there were two licensed operators on board and passengers had receipts for trips in excess of 12 hours. Excursion boats were allowed a three–day possession limit on multi–day trips. Fish harvested under the bag limit could be sold in conformance with state laws if they meet the commercial minimum sizes.

Amendment 4 also established two spawning season closures:

- Commercial harvest and/or landing of greater amberjack in excess of the three–fish bag limit prohibited in April south of Cape Canaveral, Florida; and
- commercial harvest and/or landing of mutton snapper in excess of the snapper aggregate bag limit prohibited during May and June.

Amendment 4 included the following commercial permit regulations:

- To exceed bag limits in the snapper grouper fishery, an owner or operator of a vessel that fishes in South Atlantic federal waters is required to obtain an annual vessel permit;
- for individuals to qualify for a permit, they must have at least 50% of their earned income, or $20,000 in gross sales, derived from commercial, charter, or headboat fishing;
- for a corporation to be eligible for a permit, the corporation or shareholder or officer of the corporation or the vessel operator must have at least $20,000 in gross sales derived from commercial fishing;
- for partnerships, the general partner or operator of the vessel is required to meet the same qualifications as a corporation; and

- a permit, gear, and vessel and trap identifications are required to fish with black sea bass traps.

All regulations in Amendment 4 were effective January 1, 1992, except the bottom longline prohibition for wreckfish, which was implemented on October 25, 1991 (FR: 56 FR 56016).

1.2.1.9 Amendment 5

Amendment 5 (SAFMC 1991b) was prepared to establish an Individual Transferable Quota (ITQ) management program for the wreckfish fishery, with the following characteristics:

- A limited entry program for the wreckfish sector of the snapper grouper fishery consisting of transferable percentage shares of the annual total allowable catch (TAC) of wreckfish and individual transferable quotas (ITQs) based on a person's share of each TAC;
- A requirement to hold a dealer permit to receive wreckfish;
- Rescinded the 10,000-pound (4,536-kilogram) trip limit for wreckfish;
- Required that wreckfish be off-loaded from fishing vessels only between 8:00 a.m. and 5:00 p.m.;
- Reduced the occasions when 24–hour advance notice must be made to NMFS Law Enforcement for off–loading of wreckfish; and
- Established the procedure for initial distribution of percentage shares of the wreckfish TAC.

All regulations in Amendment 5 were effective April 6, 1992, except those dealing with permits, fees, falsifying information, and percentage shares that were effective March 5, 1992 (PR: 56 FR 57302; FR: 57 FR 7886).

1.2.1.10 Emergency Regulations - Sea Bass Pots

Implementation of Amendment 4 prohibited black sea bass pot fishermen from making multi–gear trips and retaining other species, which resulted in large, unintended economic losses. Emergency regulations, effective August 31, 1992 (57 FR 39365), modified the definition of black sea bass pot, allowed multi–gear trips, and allowed retention of incidentally caught fish. These regulations were extended on November 30, 1992 (57 FR 56522). The regulatory amendment that made the above changes permanent became effective July 6, 1993 (FR: 58 FR 36155).

1.2.1.11 Regulatory Amendment – SMZs off South Carolina

Another regulatory amendment was submitted to establish eight SMZs off South Carolina, where only hand-held, hook-and-line gear (including manual, electric, or hydraulic rod and reel) and spearfishing (excluding powerheads) were allowed. This amendment was effective July 31, 1993 (PR: 58 FR 13732; FR: 58 FR 35895).

1.2.1.12 Amendment 6

Amendment 6 (SAFMC 1993) was prepared to rebuild the snowy grouper, golden tilefish, speckled hind, warsaw grouper, misty grouper, and yellowedge grouper resources. Some of the management measures established in this amendment were:

- Catch quotas (to be phased in over a three-year period beginning January 1994);
- commercial trip limits;

- recreational bag limits;
- 100% logbook coverage upon renewal of permit; and
- creation of the *Oculina* Experimental Closed Area, within which fishing for and retention of snapper grouper species was prohibited.

Data were specified to be collected to evaluate shifts in fishing effort among fisheries and for future evaluation of an "Individual Transferable Quota" (ITQ) type of management approach for these species. Commercial trip limits in Amendment 6 became effective June 6, 1994, and all other actions became effective June 27, 1994 (PR: 59 FR 9721; FR: 59 FR 27242).

1.2.1.13 Amendment 7

Amendment 7 (SAFMC 1994a) was prepared to provide additional protection to a variety of snapper grouper species. Some of the actions established in this amendment were:

- 12" fork length - hogfish;
- 16" total length – mutton snapper;
- required dealer, charter and headboat federal permits;
- allowed sale under specified conditions;
- specified allowable gear and made allowance for experimental gear [Note: allowable gear includes vertical hook & line gear, spearfishing without rebreathers except that explosive charges including powerheads are not allowed in the EEZ off SC, bottom longlines deeper than 50 fathoms only north of St. Lucie Inlet, Florida, and for species other than wreckfish, and black sea bass pots except where expressly prohibited.];
- allowed multi–gear trips in North Carolina;
- added localized overfishing to the list of problems and objectives;
- adjusted bag limit and crew specifications for charter and headboats;
- modified the management unit for scup to apply south of Cape Hatteras, North Carolina; and
- modified the framework procedure.

All regulations in Amendment 7 became effective January 23, 1995, except the requirement to apply for and possess dealer, charter, and headboat federal permits, which became effective December 23, 1994 and March 1, 1995 respectively (PR: 59 FR 47833; FR: 59 FR 66270).

1.2.1.14 Regulatory Amendment - Atlantic EEZ off Florida Only

Regulatory Amendment 6 (SAFMC 1994b) was submitted on the request of the state of Florida to increase protections for select snapper grouper species and to enhance enforcement by having the same regulations in State and Federal waters. It included the following actions, all of which applied only in the EEZ off the Atlantic coast of Florida:

- Daily recreational bag limit of 5 hogfish per person;
- Harvest and possess only 2 cubera snapper per day that measure 30" TL or more; and
- 12" TL - gray triggerfish.

These regulations became effective May 22, 1995 (PR: 60 FR 8620; FR: 60 FR 19683).

1.2.1.15 Notice of Control Date - Black Sea Bass Pot Fishery

A notice of Control Date for entry into the black sea bass pot fishery was published April 23, 1997 (62 FR 19732, corrected 62 FR 22995). This notice informed the public that anyone entering the Federal black sea bass pot fishery off the South Atlantic states after April 23, 1997,

would not be assured of future access to the fishery if a limited entry program was developed and implemented.

1.2.1.16 Amendment 8

Amendment 8 (SAFMC 1997) was prepared to limit effort in the snapper grouper fishery. The amendment:

- Established a program to limit initial eligibility for participation in the snapper grouper fishery to owners of boats/vessels that: (a) can demonstrate any landings of species in the snapper grouper management unit in 1993, 1994, 1995 or 1996 (as of August 20, 1996) and (b) held a valid snapper grouper permit between February 11, 1996 and February 11, 1997;
- granted a transferable permit to vessels that landed at least 1,000 pounds of species in the snapper grouper management unit in any of these years;
- granted a non-transferable permit with a 225-pound trip limit to all other vessels;
- modified the problems, objectives, Optimum Yield, and overfishing definition in the snapper grouper management plan;
- expanded the Council's habitat responsibility;
- allowed retention of snapper grouper species in excess of the bag limits on a permitted vessel that has a single bait net or cast nets on board; and
- allowed permitted vessels to possess filleted fish harvested in the Bahamas under certain conditions.

All regulations in Amendment 8 were effective by December 14, 1998 (PR: 63 FR 1813; FR: 63 FR 38298) except the overfishing and overfished definitions, which were disapproved.

1.2.1.17 Regulatory Amendment - SMZs off South Carolina

A regulatory amendment was submitted to establish ten SMZs at the sites of artificial reefs off South Carolina. This amendment became effective January 29, 1999 (PR: 63 FR 43656; FR: 63 FR 71793).

1.2.1.18 Amendment 9

Amendment 9 (SAFMC 1998a) was prepared to provide additional protection to snapper grouper species based on the 1994 stock assessment prepared by the Southeast Fisheries Science Center. This amendment established the following regulations:

- Red porgy: increased minimum size from 12" TL to 14" TL (recreational and commercial); set recreational bag limit – 5; prohibited harvest and possession in excess of the bag limit during March and April; and prohibited purchase and sale during March and April;
- black sea bass: increased minimum size limit from 8" TL to 10" TL (recreational and commercial); set recreational bag limit – 20; required escape vents and escape panels with degradable fasteners in black sea bass pots;
- greater amberjack: reduced recreational bag limit from 3 to 1, prohibited harvest and possession in excess of the bag limit during April throughout the EEZ; established a quota at 63% of 1995 landings (quota=1,169,931 pounds); began the fishing year on May 1; prohibited sale of fish harvested under the bag limit when the season was closed; and prohibited coring;
- vermilion snapper: increased recreational minimum size limit from 10" to 11" TL;

- gag: increased minimum size limit from 20" TL to 24" TL (recreational and commercial); prohibited harvest and possession in excess of the bag limit during March and April; and prohibited purchase and sale during March and April;
- black grouper: increased minimum size limit from 20" to 24" TL (recreational and commercial); prohibited harvest and possession in excess of the bag limit during March and April; and prohibited purchase and sale during March and April;
- gag and black grouper: specified that within the 5-fish aggregate grouper bag limit, no more than 2 fish may be gag grouper or black grouper (individually or in combination);
- all snapper grouper without a bag limit: established an aggregate recreational bag limit of 20 fish per person per day, excluding tomtate and blue runners; and
- specified that vessels with longline gear aboard may only possess snowy grouper, warsaw grouper, yellowedge grouper, misty grouper, golden tilefish, blueline tilefish, and sand tilefish.

All approved measures in amendment 9 became effective February 24, 1999 (PR: 63 FR 63276; FR: 64 FR 3624). A commercial trip limit was proposed for greater amberjack in this amendment, but it was disapproved. This trip limit was resubmitted and implemented October 13, 2000 (FR: 65 FR 55203).

1.2.1.19 Regulatory Amendment - SMZs off Georgia

A regulatory amendment was submitted to establish 12 SMZs at the sites of artificial reefs in the EEZ off Georgia, to revise the boundaries of the seven existing SMZs in the EEZ off Georgia to meet Coast Guard permit specifications, and to restrict fishing in the new and revised SMZs. This amendment became effective November 15, 2000 (PR: 65 FR 41041; FR: 65 FR 61114).

1.2.1.20 Emergency Rule – Red Porgy

Even though red porgy regulations contained in Amendment 9 were implemented on February 24, 1999, new Sustainable Fisheries Act requirements required an emergency rule to prohibit harvest and possession of red porgy. This prohibition became effective September 8, 1999 (64 FR 48324) and was extended through August 28, 2000 (65 FR 10039).

1.2.1.21 Amendment 10

Amendment 10 (SAFMC 12998b); also see Habitat Plan (SAFMC 1998c), identified essential fish habitat and established Habitat Areas of Particular Concern for species in the snapper grouper management unit to address requirements of the Magnuson-Stevens Act, as amended in 1996. This amendment became effective July 14, 2000 (PR: 64 FR 37082; PR Supplement: 64 FR 59152; FR: 65 FR 37292) as part of the Comprehensive Habitat Amendment for the South Atlantic Region.

1.2.1.22 Amendment 11

Amendment 11(SAFMC 1998d) established proxies and benchmarks to determine whether a species was overfished or undergoing overfishing, as follows:

- Goliath grouper and Nassau grouper: MSY proxy = 40% Static SPR;
- all other species: MSY proxy = 30% Static SPR;
- goliath grouper and Nassau grouper: OY = 50% Static SPR;
- hermaphroditic groupers (those that switch sex): OY = 45% Static SPR;

- all other species: OY = 40% SPR;
- goliath and Nassau grouper: Overfishing level = F > F40% Static SPR;
- black sea bass: Overfishing level = F > F30% Static SPR (=MFMT, =0.72);
- black sea bass: MSST = 3.72 million pounds;
- all other species: Overfishing level = F > F30% Static SPR;
- red snapper and groupers: rebuilding timeframe ≤15 years (Year 1 = 1991);
- other snappers, greater amberjack, black sea bass, red porgy: rebuilding timeframe ≤10 years (Year 1 = 1991);

Overfishing Evaluations:

- Black sea bass – overfished; MSST=3.72 mp, 1995 biomass estimated at 1.33 mp. Undergoing overfishing; MFMT=0.72, F1991-1995=0.95. Amendment 9 would reduce commercial catch by 26%, recreational catch by 36%, and total catch by 30%.
- Vermilion snapper – overfished; static SPR = 21-27%. Amendment 9 would reduce headboat catch by 29%, MRFSS catch by 70%, and total catch by 13%.
- Red porgy – overfished; static SPR = 14-19%. Amendment 9 would reduce commercial catch by 65%, recreational catch by 50%, and total catch by 59%.
- Red snapper – overfished; static SPR = 24-32%. Amendment 9 would raise projected SPR to 35%.
- Gag –overfished; static SPR = 27%. Amendment 9 would reduce commercial catch by 37%, recreational catch by 13%, and total catch by 27%.
- Scamp - no longer overfished; static SPR = 35%.
- Speckled hind – overfished; static SPR = 8%-13%.
- Warsaw grouper – overfished; static SPR = 6-14%.
- Snowy grouper – overfished; static SPR = 5-15%.
- Golden tilefish – overfished; inadequate information to update SPR of 21%.
- Nassau grouper – overfished; inadequate information to determine SPR.
- Goliath grouper – overfished; inadequate information to determine SPR.
- White grunt - no longer overfished; static SPR = 29-39%.

Parts of Amendment 11, which was part of the comprehensive SFA Amendment for the South Atlantic Region, became effective December 2, 1999 (PR: 64 FR 27952; FR: 64 FR 59126). Stock status determination criteria were partially approved, and 10-year rebuilding schedules were approved for snappers other than red snapper, greater amberjack, black sea bass, and red porgy.

1.2.1.23 Amendment 12

Amendment 12 (SAFMC 2000) established permanent measures to rebuild red porgy based on the 1999 biomass-based assessment. Measures included the following:

- MSY = 4.38 mp;
- OY = 45% Static SPR;
- Overfishing threshold (MFMT) = 0.43;
- Overfished threshold (MSST) = 7.34 mp;
- Rebuilding timeframe = 18 years, with 1999 as year 1;
- No sale during January through April, 1 fish bag limit;
- 50-pound bycatch trip limit for commercial vessels from May through December;

- modified list of management options and actions that could be implemented as framework measures; and
- modified the limited access system that allowed same owner permit transfers regardless of vessel size for 225-pound trip limit permit holders participating in the snapper grouper limited access program.

Regulations in Amendment 12 became effective August 29, 2000, except item (9), which became effective September 22, 2000 (PR: 65 FR 35877; FR: 65 FR 51248).

1.2.1.24 Amendment 13A

Amendment 13A (SAFMC 2003) extended for an indefinite period the regulation prohibiting fishing for and possessing snapper grouper species within the *Oculina* Experimental Closed Area. The regulation became effective April 26, 2004 (PR: 68 FR 66069; FR: 69 FR 15731).

1.2.1.25 Notice of Control Date – Snapper Grouper Fishery

A notice of control date for entry into the federal fishery for snapper grouper species (excluding wreckfish) in the South Atlantic was published October 14, 2005 (70 FR 60058). This notice informed the public that anyone entering this fishery after October 14, 2005, would not be assured of future access to the fishery if measures to further limit entry were developed and implemented.

1.2.2 By Species

1.2.2.1 Gag

Table 1-1. History of gag regulations.

Regulation	Effective Date	Plan or Amendment
4" trawl mesh size	8/31/83	FMP
Prohibit trawls	1/12/89	Amendment 1
Prohibit fish traps, entanglement nets & longlines within 50 fathoms; 20" size limit and 5 grouper bag limit; rebuilding timeframe	1/1/92	Amendment 4
Oculina Experimental Closed Area	6/27/94	Amendment 6
Limited entry program: transferable permits and 225-pound non-transferable permits	12/98	Amendment 8
24" size limit and within 5 grouper bag limit only 2 may be gag or black. March & April - no harvest above bag limit & no sale. Vessels with longlines may only possess deepwater species	2/24/99	Amendment 9
Oculina Experimental Closed Area extended indefinitely	04/26/04	Amendment 13A

1.2.2.2 Goliath Grouper

Table 1-2. History of goliath grouper regulations.

Regulation	Effective Date	Plan or Amendment
Prohibit spearfishing of Goliath grouper	8/31/83	FMP
Prohibit trawls	1/12/89	Amendment 1
Prohibit harvest/possession	10/30/90	Amendment 2
Prohibit fish traps, entanglement nets & longlines within 50 fathoms; Rebuilding timeframe	1/1/92	Amendment 4
Oculina Experimental Closed Area	6/27/94	Amendment 6
Limited entry program: transferable permits and 225-pound non-transferable permits	12/98	Amendment 8
Oculina Experimental Closed Area extended indefinitely	04/26/04	Amendment 13A

1.2.2.3 Nassau Grouper

Table 1-3. History of Nassau grouper regulations.

Regulation	Effective Date	Plan or Amendment
12" TL minimum size limit; 4" trawl mesh size	8/31/83	FMP
Prohibit trawls	1/12/89	Amendment 1
Prohibit fish traps, entanglement nets & longlines within 50 fathoms; Prohibit all harvest/possession; rebuilding timeframe	1/1/92	Amendment 4
Oculina Experimental Closed Area	6/27/94	Amendment 6
Limited entry program: transferable permits and 225-pound non-transferable permits	12/98	Amendment 8
Oculina Experimental Closed Area extended indefinitely	04/26/04	Amendment 13A

1.2.2.4 Deep Water Species

Table 1-4. History of deep water species regulations.

Regulation	Effective Date	Plan or Amendment
Prohibit trawls	1/12/89	Amendment 1
Prohibit fish traps, entanglement nets & longlines within 50 fathoms; 5 grouper bag limit; rebuilding timeframe	1/1/92	Amendment 4
Commercial quota (snowy grouper = 2,500 pound trip limit & 300 pound bycatch limit; golden tilefish = 5,000 pound trip limit & 300 pound bycatch limit); Tilefish added to grouper aggregate bag limit; Established *Oculina* Experimental Closed Area; Recreational & Commercial speckled hind/warsaw bag limit of 1/vessel/trip and no sale	6/27/94	Amendment 6
Limited entry program: transferable permits and 225-pound non-transferable permits	12/98	Amendment 8
Vessels with longlines may only possess deepwater specie	2/24/99	Amendment 9
Oculina Experimental Closed Area extended indefinitely	04/26/04	Amendment 13A

1.2.2.5 Yellowtail Snapper

Table 1-5. History of yellowtail snapper regulations.

Regulation	Effective Date	Plan or Amendment
12" TL minimum size limit	8/31/83	FMP
Prohibit fish traps	1/1/92	Amendment 4
Snapper aggregate bag limit of 10 fish per person per day excluding vermilion snapper and allowing no more than 2 red snapper	1/1/92	Amendment 4
Limited entry program: transferable permits and 225-pound non-transferable permits	12/98	Amendment 8
Oculina Experimental Closed Area extended indefinitely	04/26/04	Amendment 13A

1.2.2.6 Vermilion Snapper

Table 1-6. History of vermilion snapper regulations.

Regulation	Effective Date	Plan or Amendment
4" trawl mesh size to achieve a 12" TL minimum size	8/31/83	FMP
Prohibit trawls	1/12/89	Amendment 1
Prohibit fish traps, entanglement nets & longlines within 50 fathoms; bag limit of 10 vermilion per person per day; 10" TL recreational minimum size limit & 12" TL commercial minimum size limit	1/1/92	Amendment 4
Oculina Experimental Closed Area	1/1/92	Amendment 4
Limited entry program: transferable permits and 225-pound non-transferable permits	12/98	Amendment 8
Recreational size limit increased to 11" TL; Vessels with longlines may only possess deepwater species	2/24/99	Amendment 9
Oculina Experimental Closed Area extended indefinitely	04/26/04	Amendment 13A

1.2.2.7 Red Porgy

Table 1-7. History of red porgy regulations.

Regulation	Effective Date	Plan or Amendment
4" TL trawl mesh size limit	8/31/83	FMP
Prohibit trawl gear	1/12/89	Amendment 1
Prohibit fish traps, entanglement nets, & longlines within 50 fathoms; 12" minimum size limit; vessel permit	1/1/92	Amendment 4
Oculina Experimental Closed Area	6/27/94	Amendment 6
Limited entry program: transferable permits and 225-pound non-transferable permits	12/98	Amendment 8
14" minimum size limit; 5 fish bag limit & closure March & April	2/24/99	Amendment 9
Prohibit harvest &/or possession	9/8/99-8/28/00	Emergency Rule
1 fish bag limit; no harvest, possession, or sale Jan. thru April; 50 pound com. trip limit 5/1 thru 12/31	8/29/00	Amendment 12
Oculina Experimental Closed Area extended indefinitely	04/26/04	Amendment 13A

1.2.2.8 Black Sea Bass

Table 1-8. History of black sea bass regulations.

Regulation	Effective Date	Plan or Amendment
8" TL minimum size limit and 12" trawl mesh size	8/31/83	FMP
Prohibit trawls	1/12/89	Amendment 1
Prohibit fish traps, entanglement nets, & longline gear within 50 fathoms; black sea bass pot gear and identification requirements	1/1/92	Amendment 4
Limited entry program: transferable permits and 225-pound non-transferable permits	12/98	Amendment 8
10" TL minimum size limit and 20 black sea bass bag limit; escape panel	2/24/99	Amendment 9
Oculina Experimental Closed Area extended indefinitely	04/26/04	Amendment 13A

1.3 The SEDAR Process

The Southeast Data, Assessment, and Review (SEDAR) process was initiated in 2002. The SEDAR process addresses the stock assessment needs of all three Fishery Management Councils in the Southeast Region (South Atlantic, Gulf of Mexico, and Caribbean), as well as the Atlantic and Gulf States Marine Fisheries Commissions. SEDAR is based on a series of three workshops.

First, representatives from NOAA Fisheries, state agencies, and the South Atlantic Fishery Management Council (SAFMC), as well as experts from non-governmental organizations and academia, participate in a data workshop that involves the assembly and review of all available fishery data and life history information from fishery-dependent and fishery-independent sources, resulting in consensus databases to be used in stock assessments. Pertinent analytical techniques and models appropriate for the datasets are identified at the data workshop.

Second, assessment biologists from these agencies and organizations participate in a stock assessment workshop, where data from the data workshop are input into one or more stock assessment models (e.g. production, age-structured, length structured) to generate estimates of stock status and fishery status. Generally, multiple runs of each model are conducted: base runs, and a number of additional runs to examine sensitivity of results to various assumptions (e.g., different natural mortality rates, different data sets/catch periods).

Finally, a stock assessment review workshop is convened to provide representatives from NOAA Fisheries, the SAFMC, constituent groups, and the Center for Independent Experts the opportunity to peer review the results of the stock assessment workshop. The SAFMC's Scientific and Statistical Committee (SSC) then reviews the report of the stock assessment review workshop.

Stocks in the Snapper Grouper Fishery Management Unit (FMU) that have gone through the SEDAR process include red porgy, black sea bass, vermilion snapper, yellowtail snapper,

hogfish, goliath grouper, snowy grouper, and tilefish. Brief summaries of these assessments are provided in Section 3 as well as links to the assessments.

1.4 Defining FMUs and FMU sub-units

The FMU defined by each regional fishery management council FMP identifies the specific fishery (or that portion thereof) that is relevant to the FMP's management objectives. Decisions about the composition of FMUs are an integral part of the plan development process, as FMUs define the specific species that are to be the target of conservation and management. The South Atlantic Council's Snapper Grouper FMU is currently composed of 72 species identified at 50 CFR 622, and listed in Table 1. Amendment 13B is considering alternatives that would redefine the composition of the Snapper Grouper FMU and that would organize species within the FMU into multispecies complexes based on biological, geographic, economic, technical, social, and/or ecological goals as provided for by 50 CFR 600.320(d)(1). Landings for species in the FMU are provided in Appendix 3. Information on spawning seasonality for each species can be found in Appendix 4.

2 SPECIES DESCRIPTIONS

Table 2-1: Species in the South Atlantic Snapper Grouper FMU by unit.

SHALLOW WATER GROUPER

UNIT 1A
Gag
Red grouper
Scamp
Black grouper
Rock hind
Red hind
Graysby
Yellowfin grouper
Coney
Yellowmouth grouper
Tiger grouper

UNIT 1B
Goliath grouper

UNIT 1C
Nassau grouper

DEEP WATER GROUPER, TILEFISH & SNAPPER

UNIT 2A
Snowy grouper
Yellowedge grouper
Warsaw grouper
Speckled hind
Misty grouper
Queen snapper

UNIT 2B
Tilefish (golden)
Blueline tilefish

SHALLOW WATER SNAPPER, TILEFISH, AND WRASSE UNIT 3
Yellowtail snapper
Gray (mangrove) snapper
Mutton snapper
Lane snapper
Hogfish
Cubera snapper
Sand tilefish
Dog snapper
Schoolmaster
Puddingwife
Mahogany snapper

MID-SHELF SNAPPER UNIT 4
Vermilion snapper
Red snapper
Silk snapper
Blackfin snapper
Black snapper

TRIGGERFISH AND SPADEFISH UNIT 5
Gray triggerfish
Atlantic Spadefish
Ocean triggerfish
Queen triggerfish

JACK UNIT 6
Greater amberjack
Crevalle jack
Blue runner
Almaco jack
Banded rudderfish
Bar jack
Lesser amberjack
Yellow jack

GRUNT AND PORGY

UNIT 7A
Red porgy

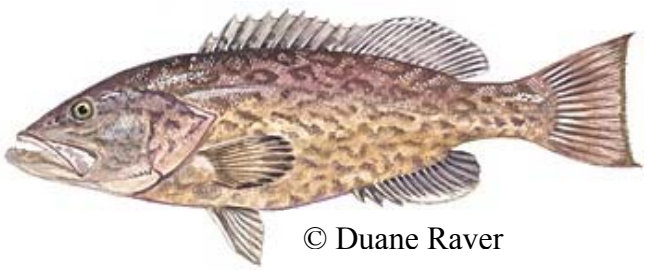
UNIT 7B
Sheepshead
White grunt
Black margate
Knobbed porgy
Tomtate
Jolthead porgy
Scup
Whitebone porgy
Sailors choice
Porkfish
Bluestriped grunt
Saucereye porgy
French grunt
Cottonwick
Spanish grunt
Grass porgy
Longspine porgy
Smallmouth grunt

SEA BASS UNIT 8
Black sea bass
Bank sea bass
Rock sea bass

WRECKFISH UNIT 9
Wreckfish

2.1 Shallow Water Grouper Unit 1A

2.1.1 Gag, *Mycteroperca microlepis*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Gag occur in the Western Atlantic from North Carolina to the Yucatan Peninsula, and throughout the Gulf of Mexico. Juveniles are sometimes observed as far north as Massachusetts (Heemstra and Randall 1993, in Froese and Pauly 2003). Gag commonly occurs at depths of 39-152 m (131-498 ft) (Heemstra and Randall 1993, in Froese and Pauly 2003) and prefers inshore-reef and shelf-break habitats (Hood and Schlieder 1992). Bullock and Smith (1991) indicated that gag probably do not move seasonally between reefs in the Gulf of Mexico, but show a gradual shift toward deeper water with age. McGovern *et al.* (2005) reported extensive movement of gag along the Southeast United States. In a tagging study, 23% of the 435 recaptured gag moved distances greater that 185 km. Most of these individuals were tagged off South Carolina and were recaptured off Georgia, Florida, and in the Gulf of Mexico (McGovern *et al.* 2005).

Gag are probably estuarine dependent (Keener *et al.* 1988; Ross and Moser 1995; Koenig and Coleman 1998; Strelcheck *et al.* 2003). Juveniles (age 0) occur in shallow grass beds along Florida's east coast during the late spring and summer (Bullock and Smith 1991). Sea grass is also an important nursery habitat for juvenile gag in North Carolina (Ross and Moser 1995). Post-larval gag enter South Carolina estuaries when they are 13 mm TL and 40 days old during April and May each year (Keener *et al.* 1988), and utilize oyster shell rubble as nursery habitat. Juveniles remain in estuarine waters throughout the summer and move offshore as water temperatures cool during September and October. Adults are often seen in shallow water 5-15 m (16-49 ft) above the reef (Bullock and Smith 1991) and as far as 40-70 km (25-44 ft) offshore.

Huntsman *et al.* (1999) indicated that gag are vulnerable to overfishing since they are long-lived, late to mature, change sex, and aggregate to spawn. The estimated natural mortality rate is 0.15 (Potts *et al.* 1998a). Maximum reported size for gag is 145 cm (57.5 in) TL and 36.5 kg (81 lbs) (Heemstra and Randall 1993, in Froese and Pauly 2003), and maximum reported age is 26 years (Harris and Collins 2000). This fish is a sequential hermaphrodite, changing sex from female to male with increased size and age (Coleman *et al.* 1996; McGovern *et al.* 1998; Coleman *et al.* 2000). All individuals less than 87.5 cm (34.7 in) TL are females. At 105.0 cm (41.6 in) TL, 50% of fishes are males. Almost all gag are males at sizes greater than 120.0 cm (47.5 in) TL (McGovern *et al.* 1998).

Along the southeastern United States (1994-1995), size at first maturity is 50.8 cm (20.2 in) TL, and 50% of gag females are sexually mature at 62.2 cm (24.7 in) (McGovern *et al.* 1998). According to Harris and Collins (2000), age-at-first-maturity is 2 years, and 50% of gag are mature at 3 years. For data that were collected during 1978-1982 off the southeastern United States, McGovern *et al.* (1998) reported that the smallest mature females were 58.0 cm (22.9 in) TL and 3 years old. Hood and Schlieder (1992) indicated that most females reach sexual maturity at ages 5-7 in the Gulf of Mexico. Off the southeastern United States, gag spawn from December through May, with a peak in March and April (McGovern *et al.* 1998; Appendix 4). Duration of planktonic larvae is about 42 days (Keener *et al.* 1988; Koenig and Coleman 1998; Lindemen *et al.* 2000). McGovern *et al.* (1998) reported that the percentage of male gag landed

by commercial fishermen decreased from 20% during 1979-1981 to 6% during 1995-1996. This coincided with a decrease in the mean length of fish landed. A similar decrease in the percentage of males was reported in the Gulf of Mexico (Hood and Schleider 1992; Coleman *et al.* 1996).

Adults are sometimes solitary, and can occur in groups of 5 to 50 individuals. They feed primarily on fishes, crabs, shrimps, and cephalopods (Heemstra and Randall 1993, in Froese and Pauly 2003), and often forage in small groups far from the reef ledge (Bullock and Smith 1991). Juveniles feed primarily on crustaceans, and begin to consume fishes when they reach about 25 mm (1 in) in length (Bullock and Smith 1991; Mullaney 1994).

2.1.2 Red grouper, *Epinephelus morio*

Red grouper occur in the Western Atlantic, ranging as far north as Massachusetts to southeastern Brazil, including the eastern Gulf of Mexico (Robins and Ray 1986 in Froese and Pauly 2003). The red grouper is uncommon around coral reefs; it generally occurs over flat rock perforated with solution holes (Bullock and Smith 1991), and is commonly found in the caverns and crevices of limestone reef in the Gulf of Mexico (Moe 1969). It also occurs over rocky reef bottoms (Moe 1969).


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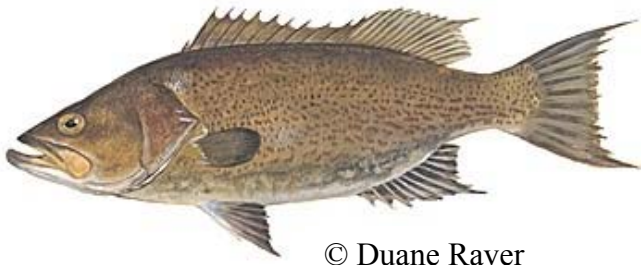
Adult red grouper are sedentary fish that are usually found at depths of 5-300 m (16-984 ft). Fishermen off North Carolina commonly catch red grouper at depths of 27-76 m (88-249 ft) for an average of 34 m (111 ft). Fishermen off southeastern Florida also catch red grouper in depths ranging from 27-76 m (88-249 ft) with an average depth of 45 m (148 ft) (Burgos 2001; McGovern *et al.* 2002a). Moe (1969) reported that juveniles live in shallow water nearshore reefs until they are 40.0 cm (16 in) and 5 years of age, when they become sexually mature and move offshore. Spawning occurs during February-June, with a peak in April (Burgos 2001; Appendix 4). In the eastern Gulf of Mexico, ripe females are found December through June, with a peak during April and May (Moe 1969). Based on the presence of ripe adults (Moe 1996) and larval red grouper (Johnson and Keener 1984) spawning probably occurs offshore. Coleman *et al*. (1996) found groups of spawning red grouper at depths between 21-110 m (70-360 feet). Red grouper do not appear to form spawning aggregation or spawn at specific sites (Coleman *et al.* 1996). They are reported to spawn in depths of 30-90 m (98-295 ft) off the Southeast Atlantic coast (Burgos 2001; McGovern *et al.* 2002a).

Red grouper are protogynous, changing sex from female to male with increased size and age. Off North Carolina, red grouper first become males at 50.9 cm (20.1 in) TL and males dominate size classes greater than 70.0 cm (27.8 in) TL. Most females transform to males between ages 7 and 14. Burgos (2001) reported that 50% of the females caught off North Carolina are undergoing sexual transition at age 8. Maximum age reported by Heemstra and Randall (1993) was 25 years. Burgos (2001) and McGovern *et al.* (2002a) indicated that red grouper live for at least 20 years in the Southeast Atlantic and a maximum age of 26 years has been reported for red grouper in the Gulf of Mexico (L. Lombardi, NMFS Panama City, personal communication). Natural mortality rate is estimated to be 0.20 (Potts and Brennan 2001). Maximum reported size is 125.0 cm (49.2 in) TL (male) and 23.0 kg (51.1 lb). For fish collected off North Carolina during the late 1990s, age at 50% maturity of females is 2.4 years and size at

50% maturity is 48.7 cm (19.3 in) TL. Off southeastern Florida, age at 50% maturity was 2.1 years and size at 50% maturity was 52.9 cm (21.0 in) TL (Burgos 2001; McGovern *et al.* 2002a). These fish eat a wide variety of fishes, octopuses, and crustaceans, including shrimp, lobsters, and stomatopods (Bullock and Smith 1991, Heemstra and Randall 1993).

2.1.3 Scamp, *Mycteroperca phenax*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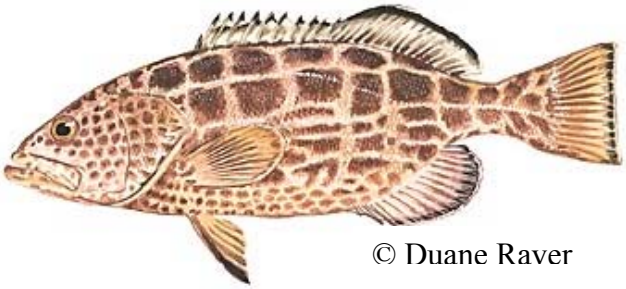
Scamp occur in the Western Atlantic, from North Carolina to Key West, in the Gulf of Mexico, and in the southern portion of the Caribbean Sea. Juveniles are sometimes encountered as far north as Massachusetts (Heemstra and Randall 1993, in Froese and Pauly 2003). Its reported depth range is 30-100 m (98-328 ft) (Heemstra and Randall 1993, in Froese and Pauly 2003). Juveniles are found in estuarine and shallow coastal waters (Bullock and Smith 1991; Heemstra and Randall 1993, in Froese and Pauly 2003).

Scamp are protogynous, with females dominating sizes less than 70.0 cm (27.8 in) (Harris *et al.* 2002). Scamp live for at least 30 years (Harris *et al.* 2002), and attain sizes as great as 107.0 cm (42.4 in) TL and 14.2 kg (31.3 lbs) (Heemstra and Randall 1993, in Froese and Pauly 2003). Natural mortality rate is estimated to be 0.15 (Potts and Brennan 2001). Harris *et al.* (2002) report that the length and age at first spawning of females off North Carolina to southeast Florida was 30.0-35.0 cm (11.9-13.8 in) TL and age 1. Length and age at 50% maturity was 35.3 cm (13.9 in) TL and 1.28 years, respectively (Harris *et al.* 2002). In a study conducted in the eastern Gulf of Mexico, all fish larger than 35.0 cm TL were sexually mature (M. Godcharles and L. Bullock, unpublished data).

Spawning occurs from February through July in the South Atlantic Bight and in the Gulf of Mexico, with a peak in March to mid-May (Harris *et al.* 2002; Appendix 4). Hydration of eggs occurs primarily during the morning and late afternoon, which indicates that scamp spawn during late afternoon and evening. Spawning individuals have been captured off South Carolina and St. Augustine, Florida at depths of 33 to 93 m. Scamp aggregate to spawn. Spawning locations and time of spawning overlaps with gag (Gilmore and Jones 1992). Fish are the primary prey of this species (Matheson *et al.* 1986).

2.1.4 Black grouper, *Mycteroperca bonaci*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The black grouper occurs in the Western Atlantic, from North Carolina to Florida, Bermuda, the Gulf of Mexico, West Indies, and from Central America to Southern Brazil (Crabtree and Bullock 1998). Adults are found over hard bottom such as coral reefs and rocky ledges. Black grouper occur at depths of 9 to 30 m (30 to 98 ft). Juveniles sometimes occur in estuarine seagrass and oyster rubble habitat in North Carolina and South Carolina (Keener *et al.* 1988; Ross and Moser 1995). In the Florida Keys, juveniles settle on patch reefs (Sluka *et al.*

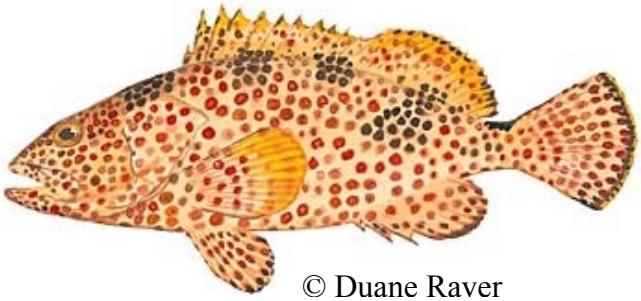
1994). Commercial landings of black grouper exceed landings of any other grouper in the Florida Keys.

Natural mortality (M) is estimated to be 0.15 (Potts and Brennan 2001). Crabtree and Bullock (1998) found that black grouper live for at least 33 years and attain sizes as great as 151.8 cm (60.1 in) TL. Females ranged in length from 15.5 to 131.0 cm (6.1-51.9 in) TL and males range in length from 94.7 to 151.8 cm (38.3-60.1 in) TL. Black grouper are protogynous. Approximately 50% of females are sexually mature by 82.6 cm (32.7 in) TL and 5.2 years of age. At a length of 121.4 cm (48.1 in) TL and an age of 15.5 years, approximately 50% of the females have become males. Black grouper probably spawn throughout the year, however, peak spawning of females occurs from January to March (Appendix 4).

Off Belize, black grouper are believed to spawn in aggregations at the same sites used by Nassau grouper (Carter and Perrine 1994). Eklund *et al.* (2000) describe a black grouper spawning aggregation discovered during winter 1997-1998, less than 100 m outside a newly designated marine reserve. Adults feed primarily on fishes.

2.1.5 Rock hind, *Epinephelus adscensionis*

Rock hind are found in the western Atlantic from Massachusetts to southern Brazil, Bermuda, the Gulf of Mexico, and the Caribbean, (Smith 1997). They also occur in the eastern Atlantic from Ascension Island and St. Helena Island (Smith 1997). The rock hind is a demersal species, inhabiting rocky reef habitat to depths of 120 m (394 ft). It is usually solitary.



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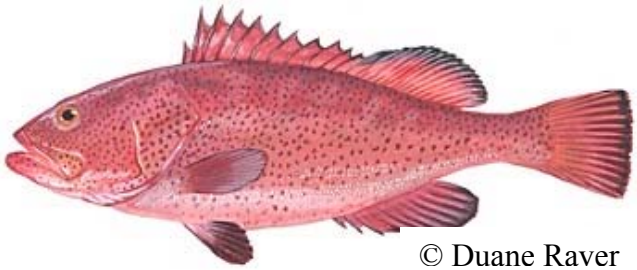
Maximum reported size is 61.0 cm (24.2 in) TL (male) and 4.1 kg (9.1 lbs) (Heemstra and Randall 1993 in Froese and Pauly 2003). Size at maturity and age at first maturity are estimated as 28.0 cm (11.1 in) TL and 6.1 years, respectively. Maximum reported age is 12 years (Potts and Manooch 1995). The natural mortality rate is estimated as 0.25 (Ault *et al*. 1998).

Heemstra and Randall (1993) indicated that rock hind in the Gulf of Mexico are protogynous. This fish has been observed to spawn in aggregations near the shelf edge off the southwest coast of Puerto Rico in January at depths of 20-30 m (66 – 98 ft) (Rielinger 1999). Off Cuba, rock hind spawn during January through March (García-Cagide *et al.* 1994). Off South Carolina, females in spawning condition (hydrated oocytes or postovulatory follicles) have been collected during May through August (Unpublished MARMAP data; Appendix 4). Crabs comprise the majority of their diet, but rock hind have also been observed to feed on fishes and young sea turtles (Heemstra and Randall 1993 in Froese and Pauly 2003).

2.1.6 Red hind, *Epinephelus guttatus*

Red hind is found in the Western Atlantic from North Carolina to Venezuela and is the most common species of *Epinephelus* in Bermuda and the West



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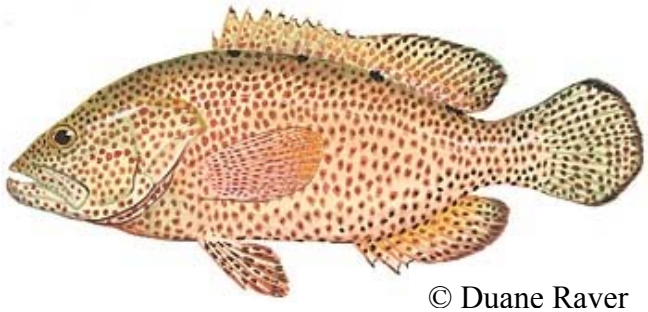
Indies (Smith 1997). The red hind is found in shallow reefs and rocky bottoms, at depths of 2-100 m (7 – 328 ft; Froese and Pauly 2003). It is usually solitary and territorial.

Maximum reported size is 76.0 cm (30.0 in) TL (male) and 25.0 kg (55.5 lbs) (Heemstra and Randall 1993 in Froese and Pauly 2003). Natural mortality rate is estimated to be 0.18 (Ault *et al.* 1998). Potts and Manooch (1995) examined 146 otoliths of red hind that were collected from North Carolina to the Dry Tortugas during 1980-1992 and report a maximum age of 11 years and maximum sizes of 49.0 cm (19.4 in) TL. Sadovy *et al.* (1992) conducted an age and growth study of red hind from Puerto Rico (n = 624) and St. Thomas, USVI (n = 162) and report a maximum age of 18 and a maximum size of 47.5 cm (18.8 in) TL. Luckhurst *et al.* (1992) captured a red hind off Bermuda that was 72.0 cm (28.5 in) TL and 22 years old.

Sadovy *et al.* (1994) found that red hind collected off Puerto Rico are protogynous. Females (n = 390) become sexually mature at 21.5 cm (9.7 in) TL, the size at 50% maturity is 28.5 cm (11.3 in) TL, and they range in size from 11.0 to 48.0 cm (4.4 to 19.0 in) TL. Males (n = 120) range in size from 27.3 to 51.0 cm (10.8 to 20.2) TL and transitional individuals (n = 7) were from 27.5 to 34.5 cm (10.9 to 13.7 in) TL. Annual spawning aggregations occur during the full moon in January and February off the southwest coast of Puerto Rico, and during the summer in Bermuda with no relation to lunar periodicity (Shapiro *et al.* 1993; Sadovy *et al.* 1994). Spawning off Jamaica, Puerto Rico, and USVI occurs from December to February (Thompson and Munro 1978; Colin *et al.* 1987; Sadovy *et al.* 1992; Sadovy *et al.* 1994). Burnett-Herkes (1975) report that red hind spawn from April to July off Bermuda. Red hind spawn during the summer off the southeastern United States (MARMAP unpublished data; Appendix 4).

This species aggregates in large numbers during the spawning season (Coleman *et al*. 2000; Sadovy *et al.* 1994). A number of spawning aggregation sites have been documented in the Caribbean. The timing of aggregations is somewhat variable. Aggregations off Puerto Rico generally occur from January through March in association with the full moon, while those off the USVI generally occur from December through March in association with the full moon (Rielinger 1999). The red hind feeds mainly on crabs and other crustaceans, fishes, such as labrids and haemulids, and octopus (Heemstra and Randall 1993 in Froese and Pauly 2003).

2.1.7 Graysby, *Cephalopholis cruentata*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Graysby occur from North Carolina to south Florida and in the Gulf of Mexico, Caribbean and Bermuda. The graysby inhabits seagrass (*Thalassia*) beds and coral reefs, and is found as deep as 170 m (557 ft). It is sedentary, solitary, and secretive, usually hiding during the day, and feeding at night. This small grouper is rare in landings off the southeast United States, and is more commonly seen in the Caribbean (Potts and Manooch 1999). Graysby are probably most often landed as unclassified grouper by commercial fishermen off the southeastern United States.

Maximum reported size is 42.6 cm (16.9 in) TL (male) and 1.1 kg (2.4 lbs). In the northeastern Caribbean, individuals in spawning condition have been observed in March, and from May to July (Erdman 1976). Nagelkerken (1979) determined that graysby collected in the Caribbean spawn from July through October. Graysby spawn during summer off the

Southeastern United States (MARMAP unpublished data; Appendix 4). Size at maturity and age at first maturity are estimated as 14.0 cm (5.5 in) TL and 3.5 years (Nagelkerken 1979). The graysby is protogynous (Nagelkerken 1979). Sexual transition occurs at sizes ranging from 14.0 to 26.0 cm (5.5-10.3 in) TL with most transitional individuals occurring between the sizes of 20.0-23.0 cm (7.9-9.1 in) TL and ages 4-5.

Potts and Manooch (1999) examined otoliths from 118 graysby that were collected from 1979 to 1997. Maximum reported age is 13 years and maximum size is 40.5 cm (16.0 in) TL. Juveniles feed on shrimp, while adults eat primarily fishes. Natural mortality rate is estimated as 0.20 (Ault *et al.* 1998). Adult graysby eat bony fish, shrimp, stomatopods, crabs, and gastropods (Randall 1967).

2.1.8 Yellowfin grouper, *Mycteroperca venenosa*

Yellowfin grouper occur in the Western Atlantic, ranging from Bermuda to Brazil and the Guianas, including the Gulf of Mexico and Caribbean Sea at depths of 2-137 m (7-449 ft). Juveniles are commonly found in shallow sea grass beds, while adults occur over rocky areas and coral reefs.

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Maximum reported size is 100.0 cm (39.6 in) TL (male) and 18.5 kg (41.1 lbs) (Heemstra and Randall 1993 in Froese and Pauly 2003). Thompson and Munro (1978) reported that yellowfin grouper off Jamaica are 4 years old between 46.0-57.0 cm (18.1-22.4 in) TL, and by 80.0 cm (31.5 in) TL, they are 10 years of age. Manooch (1987) reported a maximum age of 15 years for yellowfin grouper. Natural mortality rate is estimated to be 0.18 (Ault *et al.* 1998). This fish is believed to be protogynous. Yellowfin grouper aggregate at some of the same sites utilized by tiger grouper, Nassau grouper, and black grouper (Sadovy *et al.* 1994). Spawning occurs during March in the Florida Keys (Taylor and McMichael 1983), and from March and May to August in the Gulf of Mexico (Bullock and Smith 1991; Appendix 4). Most spawning occurs in Jamaican waters between February and April (Thompson and Munro 1978), and during July off Bermuda (Smith 1958). Yellowfin grouper feed mainly on fishes (especially coral reef species) and squids (Heemstra and Randall 1993 in Froese and Pauly 2003).

2.1.9 Coney, *Cephalopholis fulva*

Coney is a small grouper that occurs in the Western Atlantic, ranging from South Carolina (USA) and Bermuda to southern Brazil, including Atol das Rocas. The coney is a sedentary species. It prefers coral reefs and clear water, and can be found to depths as great as 150 m (492 ft). Coney are most commonly taken in the Caribbean, where they are found associated with patch reefs. Most commercial landings of coney are off southeast Florida and are often labeled as unclassified grouper.

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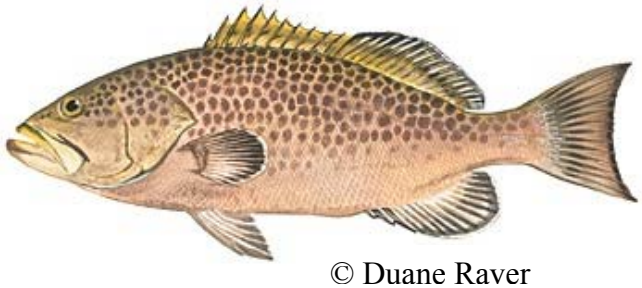
Maximum reported length is 41.0 cm (16.2 in) TL (male). This species is protogynous (Heemstra and Randall 1993 in Froese and Pauly 2003). Size at 50% maturity for females sampled off the west coast of Puerto Rico was 13.0 cm (5.1 in) FL (Figuerola and Torrez Ruiz 2000). Heemstra and Randall (1993) (in Froese and Pauly (2003)) report that females mature at 16.0 (6.3 in) cm TL and transform to males at about 20.0 (7.9 in) cm TL.

Potts and Manooch (1999) examined the otoliths from 55 coney that were collected during 1979-1997 from North Carolina to the Dry Tortugas, Florida. The maximum reported age is 11 years and maximum size is 39.7 cm (15.7 in) TL. Natural mortality rate is estimated as 0.18 (Ault *et al.* 1998).

Spawning occurs in small groups composed of one male and multiple females. Although ripe ovaries are found from November to March off the west coast of Puerto Rico, spawning activity appears to be limited to several days around the last quarter and new moon phases during January and February (Figuerola *et al.* 1997). The diet is composed primarily of small fishes and crustaceans (Randall 1967).

2.1.10 Yellowmouth grouper, *Mycteroperca interstitialis*

Yellowmouth grouper occur along the eastern U.S. coast, Bermuda, Bahamas, Gulf of Mexico, and in the Caribbean south to Brazil (Smith 1971; Froese and Pauly 2003). Adults are found over rocky hard bottom and coral reefs near the shoreline as deep as 55 m (100 ft). Individuals have been found as deep as 150 m (275 ft). Young commonly occur in mangrove line lagoons.



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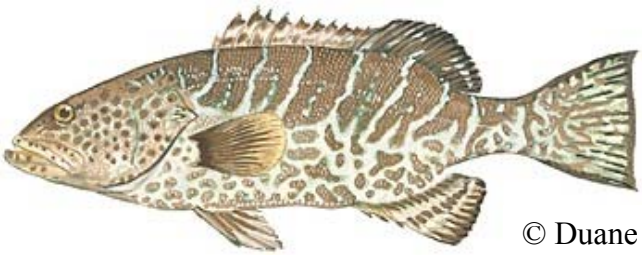
The maximum reported size of yellowmouth grouper is 84.0 cm (33.2 in) TL (male) and 10.2 kg (22.6 lbs) (Froese and Pauly 2003). In the Gulf of Mexico, maximum reported age for yellowmouth grouper is 28 years (Bullock and Murphy 1994). Males (2-28 years) are generally older than females (2-17 years). Females become sexually mature between 40.0-45.0 cm (15.8-17.7 in) TL and ages 2-4 years. Fifty percent are males at 60.0-64.9 cm (23.6-25.6 in) TL. Fish undergo sexual transition from female to male at lengths from 50.3 to 64.3 cm (19.8-25.3 in) TL, between the ages of 5 and 14 years. Yellowmouth grouper may spawn all year, but peak spawning of females in the Gulf of Mexico occurs during March to May (Bullock and Murphy 1994; Appendix 4). Finfish constitute a large part of the diet of yellowmouth grouper (Randall 1967).

2.1.11 Tiger grouper, *Mycteroperca tigris*

Tiger grouper occur in the Western Atlantic, ranging from Bermuda and south Florida (USA) to Venezuela and, possibly Brazil, including the Gulf of Mexico and the Caribbean Sea. It inhabits coral reefs and rocky areas at depths of 10 to 40 m (33-131 ft).



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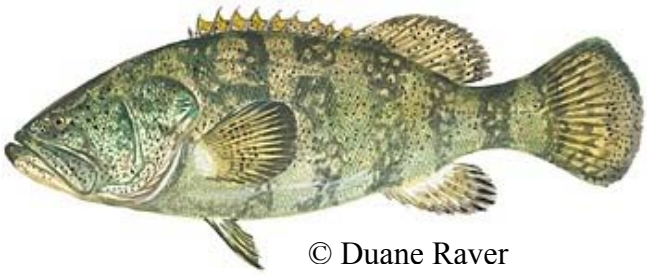
Maximum reported size is 101.0 cm

(40.0 in) TL (male) and 10 kg (22.2 lbs) (Heemstra and Randall 1993 in Froese and Pauly 2003). Approximate life span is 26 years, and M is estimated at 0.12 (Ault *et al.* 1998).

The size-sex ratios described in a study conducted off Bermuda indicate this fish is probably protogynous (Heemstra and Randall 1993 in Froese and Pauly 2003). It forms aggregations at specific times and locations each year, but only during the spawning season (Coleman *et al*. 2000; White *et al.* 2002). White *et al.* (2002) reported that spawning aggregations of tiger grouper occurred one week after the full moon during January through April off Puerto Rico. Tiger grouper spawn from December through April off southwest Cuba (García-Cagide *et al*. 1999; Appendix 4). The tiger grouper preys on a variety of fishes, and frequents cleaning stations (Heemstra and Randall 1993 in Froese and Pauly 2003).

2.2 Shallow Water Grouper Unit 1B

2.2.1 Goliath grouper, *Epinephelus itajara*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Goliath grouper, formerly known as the "jewfish," occurs in the Western and Eastern Atlantic, and in the Eastern Pacific Ocean. In the Western Atlantic, its range extends from Florida to southern Brazil, including the Gulf of Mexico and the Caribbean Sea. A solitary species, goliath grouper inhabits rock, coral, and mud bottom habitats in both shallow, inshore areas and as deep as 100 m (328 ft) (Heemstra and Randall 1993 in Froese and Pauly 2003). Juveniles are generally found in mangrove areas and brackish estuaries. Large adults also may be found in estuaries. They appear to occupy limited home ranges with little movement (Heemstra and Randall 1993 in Froese and Pauly 2003).

The goliath grouper is the largest grouper in the Western North Atlantic. Maximum reported size is 250 cm (99 in) TL (male) and 455 kg (1,003 lbs) (Heemstra and Randall 1993 in Froese and Pauly 2003). Bullock *et al.* (1992) indicated that fish taken from exploited populations have a maximum age of 37 years. However, it is likely that this species could live much longer if left unexploited. Froese and Pauly (2003) estimate M to be 0.13. Porch *et al.* (2003) use M between 0.04 and 0.19.

There is some evidence that males may transform from immature females (Bullock *et al.* 1992). Males exhibit a similar testicular structure to those of other serranids that are protogynous, however, mature males are observed at smaller lengths than those of mature females. Bullock *et al.* (1992) found that males become mature at slightly smaller sizes and at younger ages than females. They first become mature at 110.0 cm (43.6 in) TL and age 4. All males are mature by 115.2 cm (45.6 in) and age 7. Females first become mature at 120.0 cm (47.0 in) TL and age 6, and all are mature by 135.0 cm (53.1 in) TL and age 8.

Goliath grouper form consistent aggregations (always containing the largest, oldest individuals in the population), but only during the spawning season (Sadovy and Eklund 1999; Coleman *et al*. 2000). Aggregations off Florida declined in the 1980s from 50 to 100 fish per site to less than 10 fish per site. Since the harvest prohibition, aggregations have rebounded somewhat to 20-40 fish per site. Spawning off Florida occurs July through September during the full moon (Appendix 4). Fish may move distances as great as 100 km from inshore reefs to the offshore spawning aggregations in numbers of up to 100 or more on shipwrecks, rock ledges,

and isolated patch reefs along the southwest coast. In the northeastern Caribbean, individuals in spawning condition have been observed in July and August (Erdman 1976). Bullock *et al.* (1992) reported that goliath grouper spawn during June through December with a peak in July to September in the eastern Gulf of Mexico.

Goliath grouper feed primarily on crustaceans, particularly spiny lobsters, as well as turtles and fishes, including stingrays. It is a territorial species, and larger individuals have reportedly stalked and attempted to eat human divers (Heemstra and Randall 1993 in Froese and Pauly 2003).

2.3 Shallow Water Grouper Unit 1C

2.3.1 Nassau grouper, *Epinephelus striatus*


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The Nassau grouper occurs in the tropical Western Atlantic, ranging from Bermuda, the Bahamas, and Florida to southern Brazil. It has not been found in the Gulf of Mexico, except at the Campeche Bank off the coast of Yucatan, at Tortugas, and off Key West. The Nassau grouper occurs from the shoreline to depths of at least 90 m (295 ft). It is a sedentary, reef-associated species and usually encountered close to caves, although juveniles are common in seagrass beds (Heemstra and Randall 1993 in Froese and Pauly 2003). Adults lead solitary lives, except when they aggregate to spawn (Sadovy and Eklund 1999).

Maximum reported size is 122 cm (48.3 in) TL (male) and 23-27 kg (51.1-29.9 lbs), and maximum reported age is 29 years (Sadovy and Eklund 1999). M has been estimated at 0.18 (Ault *et al.* 1998).

Unlike most other serranids where males are derived from females (protogyny), Sadovy and Colin (1995) indicated that Nassau grouper is primarily a gonochoristic species (separate sexes) with a potential for sex change. Male and female Nassau grouper mature between 40.0-50.0 cm (15.8-19.8 in) SL and 4-8 years of age. Most individuals attain maturity by 50.0 cm (19.8 in) SL and 7 years.

This species aggregates to spawn at specific times and locations each year (Coleman *et al*. 2000; Sadovy *et al.* 1994), reportedly at some of the same sites utilized by the tiger grouper, yellowfin grouper, and black grouper (Sadovy *et al.* 1994). Concentrated aggregations of from a few dozen to 30,000 Nassau grouper have been reported off the Bahamas, Jamaica, Cayman Islands, Belize, and the Virgin Islands (Heemstra and Randall 1993 in Froese and Pauly 2003). Spawning aggregations composed of about 2,000 individuals have been documented north and south of St. Thomas, USVI at depths of 10-40 m, from December through February, around the time of the full moon (Rielinger 1999).

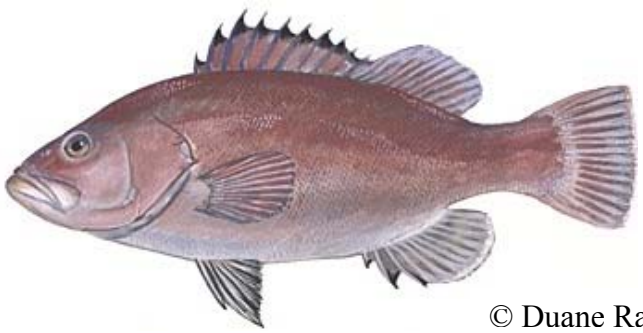
The spawning season is brief and associated with water temperature and the moon phase. At lower latitudes, reproductive activity lasts for about one week per month during December-February. In more northern latitudes (e.g. Bermuda), reproduction occurs between May and August, with a peak in July. Spawning aggregations in the Caribbean occurs at depths of 20-40 m on the outer reef shelf edge, in December and January around the time of the full moon in waters 25-26° C (Sadovy and Eklund 1999; Appendix 4).

Juveniles feed primarily on crustaceans (Eggleston *et al.* 1998), while adults forage on fishes, bivalves, lobsters, and gastropods (Sadovy and Eklund 1999).

2.4 Deep Water Grouper, Tilefish, and Snapper Unit 2A

2.4.1 Snowy grouper, *Epinephelus niveatus*

Snowy grouper occur in the Eastern Pacific and the Western Atlantic from Massachusetts to southeastern Brazil, including the northern Gulf of Mexico (Robins and Ray 1986 in Froese and Pauly 2003). It is found at depths of 30-525 m (98-1,722 ft). Adults occur offshore over rocky bottom habitat. Juveniles are often observed inshore and occasionally in estuaries (Heemstra and Randall 1993, in Froese and Pauly 2003).



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The snowy grouper is a protogynous species. The smallest, youngest male examined by Wyanski *et al.* (2000) was 72.7 cm (28.8 in) TL and age 8. The median size and age of snowy grouper was 91.9 cm (34.5 in) and age 16. The largest specimen observed was 122 cm (48 in) TL and 30 kg (66 lbs), and 27 years old (Heemstra and Randall 1993, in Froese and Pauly 2003). The maximum age reported by Wyanski *et al.* (2000) is 29 years for fish collected off of North Carolina and South Carolina. Radiocarbon techniques indicate that snow grouper may live for as long as 40 years (Harris, South Carolina Department of Natural Resources, personal communication). Wyanski *et al.* (2000) reported that 50% of the females are mature at 54.1 cm (21.3 in) TL and 5 years of age. The smallest mature female was 46.9 cm (18.5 in) TL, and the largest immature female was 57.5 cm (22.6 in) TL.

Females in spawning condition have been captured off western Florida during May, June, and August (Bullock and Smith 1991). In the Florida Keys, ripe individuals have been observed from April to July (Moore and Labinsky 1984). Spawning seasons reported by other researchers are as follows: South Atlantic (north of Cape Canaveral), April through September (Wyanski *et al.* 2000) and April through July (Parker and Mays 1998); and South Atlantic (south of Cape Canaveral), May through July (Manooch 1984). Wyanski *et al.* (2000) reported that snowy grouper spawn at depths from 176 to 232 m (577 to 761 ft) off South Carolina (Appendix 4). Adults feed on fishes, gastropods, cephalopods, and crustaceans (Heemstra and Randall 1993, in Froese and Pauly 2003).

2.4.2 Yellowedge grouper, *Epinephelus flavolimbatus*

Yellowedge grouper occur in the Western Atlantic from North Carolina to southern Brazil, including the Gulf of Mexico. A solitary, demersal, deep-water species, the yellowedge grouper occurs in rocky areas and on sand mud bottom, at depths ranging from 64 to 275 m (210 to 902 ft). On soft bottom habitats, this fish is often seen in or near trenches or burrow-like excavations (Heemstra and Randall 1993, in Froese and Pauly 2003).

Maximum reported size is 114 cm (45.3 in) TL (male) and 18.6 kg (41 lbs). Cass-Calay and Bahnick (2002) observed a maximum age of 85 years that was validated by the use of radiocarbon dating. M is estimated to be 0.05 (Cass-Calay and Bahnick 2002).

Bullock *et al.* (1996) in the Gulf of Mexico reported that 50% of fishes are mature at 22.4 in, and that 50% of females transform into males by 81 cm (32.2 in) TL. Spawning occurs from April through October in the South Atlantic (Keener 1984; Manooch 1984; Parker and Mays 1998; Appendix 4). Ripe females were found in the eastern Gulf of Mexico from May through September (Bullock *et al.* 1996). Yellowedge grouper eat a wide variety of invertebrates (mainly brachyuran crabs) and fishes (Bullock and Smith 1991; Heemstra and Randall 1993, in Froese and Pauly 2003).

2.4.3 Warsaw grouper, *Epinephelus nigritus*


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Warsaw grouper occur in the Western Atlantic from Massachusetts to southeastern Brazil (Robins and Ray 1986 in Froese and Pauly 2003), and in the Gulf of Mexico (Smith 1971). The Warsaw grouper is a solitary species (Heemstra and Randall 1993, in Froese and Pauly 2003), usually found on rocky ledges and seamounts (Robins and Ray 1986 in Froese and Pauly 2003), at depths from 55 to 525 m (180-1,722 ft) (Heemstra and Randall 1993, in Froese and Pauly 2003). Juveniles are sometimes observed in inshore waters (Robins and Ray 1986 in Froese and Pauly 2003), on jetties and shallow reefs (Heemstra and Randall 1993, in Froese and Pauly 2003).

Maximum reported size is 230 cm (91 in) TL (Heemstra and Randall 1993, in Froese and Pauly 2003) and 263 kg (580 lbs) (Robins and Ray 1986 in Froese and Pauly 2003). The oldest specimen was 41 years old (Manooch and Mason 1987). M was estimated by the SEDAR group during November 2003 to range from 0.05 to 0.12 (SEDAR 4, 2004). The Warsaw grouper spawns during August, September, and October in the Gulf of Mexico (Peter Hood, NOAA Fisheries, personal communication; Appendix 4), and during April and May off Cuba (Naranjo 1956). Adults feed on benthic invertebrates and on fishes (Heemstra and Randall 1993, in Froese and Pauly 2003).

2.4.4 Speckled hind, *Epinephelus drummondhayi*


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Speckled hind occur in the Western Atlantic Ocean from North Carolina and Bermuda to the Florida Keys, and in the northern and eastern Gulf of Mexico (Heemstra and Randall 1993, in Froese and Pauly 2003). The speckled hind is solitary and found in depths from 25 m (98 ft) (Heemstra and Randall 1993, in Froese and Pauly 2003) to 400 m (1,312 ft) (Bullock and Smith 1991). Heemstra and Randall (1993), in Froese and Pauly (2003), reported that it most commonly occurs at depths of 60-120 m (197-394 ft). Bullock and Smith (1991) indicated that most commercial catches are taken from depths of 50 m (164 ft) or more. Juveniles occur in shallower waters.

Maximum reported size is 110 cm (43.3 in) TL and 30 kg (66 lbs) Heemstra and Randall 1993, in Froese and Pauly 2003). The maximum size and age of individuals examined by Matheson and Huntsman (1984) in the South Atlantic Bight was 110 cm (43.3 in) and 15 years, respectively. Heemstra and Randall (1993), in Froese and Pauly (2003), reported a maximum age of 25 years. Estimated size at maturity is 81.1 cm (32 in), and M is estimated at from 0.14 (Froese and Pauly 2003) to 0.15 (Potts *et al.* 1998a).

The speckled hind is thought to form spawning aggregations (G. Gilmore, Dynamac Corporation, personal communication). Spawning reportedly occurs from July to September (Heemstra and Randall 1993, in Froese and Pauly 2003; Appendix 4). Prey items include fishes, crustaceans, and squids (Bullock and Smith 1991; Heemstra and Randall 1993, in Froese and Pauly 2003).

2.4.5 Misty grouper, *Epinephelus mystacinus*

Misty grouper occur in the Western and Eastern Atlantic Ocean (Heemstra and Randall 1993, in Froese and Pauly 2003). In the Western Atlantic, it ranges from Bermuda and the Bahamas to Brazil (Robins and Ray 1986). The misty grouper is a solitary, bathydemersal species. Adults generally occur at depths from about 100 to 550 m (327 to 1,803 ft) (Robins 1967). Juveniles occur in shallower waters (e.g., 30 m (98 ft)).

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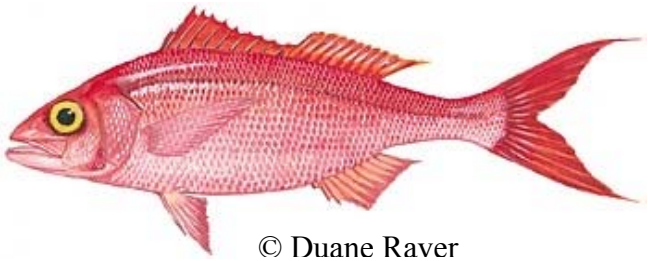
Little is known about the age, growth, and reproduction of this species. Maximum reported size is 160 cm (63 in) TL and 100 cm (39 in) TL for males and females, respectively. Maximum reported weight is 107 kg (236 lbs) (Heemstra and Randall 1993, in Froese and Pauly 2003). The estimated size at maturity is 81.1 cm (31.9 in), and M is 0.14 (Froese and Pauly 2003). This species feeds primarily on fishes, crustaceans, and squids (Heemstra and Randall 1993, in Froese and Pauly 2003).

2.4.6 Queen snapper, *Etelis oculatus*

The queen snapper occurs in the Western Atlantic, ranging from Bermuda and North Carolina to Brazil, including the Gulf of Mexico and Caribbean Sea. It is commonly found near oceanic islands, and is particularly abundant in the Bahamas and the Antilles. This species is bathydemersal species (Allen 1985 in Froese and Pauly 2003) and moves offshore to deep-water reefs and rocky ledges as it grows and matures (SAFMC 1999). Allen (1985, in Froese and Pauly 2002) indicates it is primarily found over rocky bottom habitat, in depths of 100 to 450 m (327 to 1,475 ft). Thompson and Munro (1974a) report it was caught on mud slopes of the south Jamaica shelf at a depth of 460 m (1,508 ft) (Thompson and Munro 1974a). Maximum reported size is 100 cm TL (39 inches, male). Maximum reported weight is 5,300 g (11.7 lbs) (Allen 1985, in Froese and Pauly 2003). Size at



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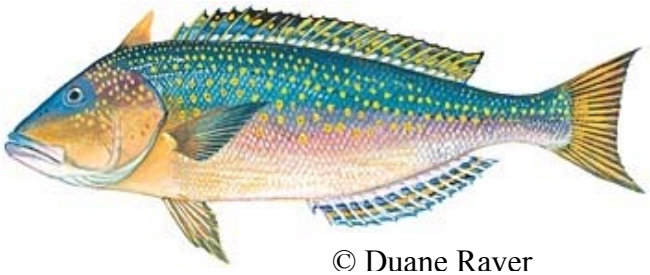
maturity and age at first maturity are estimated as 53.6 cm TL (21 inches) and 1 year, respectively. Spawning is reported to occur during April and May off St. Lucia (Murray *et al*. 1998). Approximate life span is 4.7 years; natural mortality rate, 0.76 (Froese and Pauly 2003). Primary prey items include small fishes and squids (Allen 1985 in Froese and Pauly 2003).

2.5 Deep Water Grouper, Tilefish, and Snapper Unit 2B

2.5.1 Tilefish, *Lopholatilus chamaeleonticeps*



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Tilefish is distributed throughout the Western Atlantic, occurring as far north as Nova Scotia, to southern Florida, and in the eastern Gulf of Mexico (Robins and Ray 1986). According to Dooley (1978), in Froese and Pauly (2002), the tilefish occurs at depths of 80-540 m (263-1,772 ft). Robins and Ray (1986) report the depth range of this fish as 82-275 m (270-900 ft). It is most commonly found at about 200 m (656 ft), usually over mud or sand bottom but, occasionally, over rough bottom (Dooley 1978).

Maximum reported size is 125 cm (50 in) TL and 30 kg (66 lbs) (Dooley 1978; Robins and Ray 1986 in Froese and Pauly 2003). Maximum reported age is 40 years (Palmer *et al*. 2004). Radiocarbon aging indicate that tilefish may live for at least 50 years (Harris, South Carolina Department of Natural Resources, personal communication). A recent SEDAR assessment estimated M at 0.07 (SEDAR 4 2004). Palmer *et al.* (2004) reported that this species spawns off the southeast coast of the United States from March through late July, with a peak in April (Appendix 4). Grimes *et al.* (1988) indicated that peak spawning occurs from May through September in waters north of Cape Canaveral. Tilefish primarily prey upon shrimp and crabs, but also eat fishes, squid, bivalves, and holothurians (Dooley 1978).

2.5.2 Blueline tilefish, *Caulolatilus microps*

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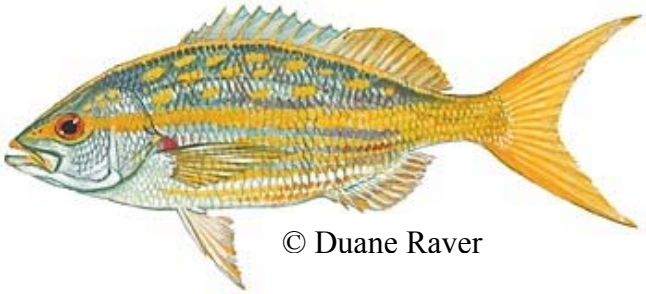
Blueline tilefish occurs in the Western Atlantic Ocean, North Carolina to southern Florida and Mexico, including the northern (and probably eastern) Gulf of Mexico (Dooley 1978). Blueline tilefish are found along the outer continental shelf, shelf break, and upper slope on irregular bottom with ledges or crevices, and around boulders or rubble piles in depths of 30-236 m (98-774 ft) and temperatures ranging from 15 to 23° C (59-73.4º F) (Ross 1978; Ross and Huntsman 1982; Robins and Ray 1986 in Froese and Pauly 2003; Parker and Mays 1998).

Maximum reported size is 90 cm (35.7 in) TL and 7 kg (15 lbs) (Dooley 1978). Maximum reported age is 42 years. The SEDAR group estimated M is between 0.04 and 0.17 (SEDAR 4 2004). Spawning occurs at night, from February to October, with a peak in May at depths of 48-232 m (157-761 ft) (Harris and Wyanski In Review; Appendix 4). This species feeds primarily on benthic invertebrates and fishes (Dooley 1978, in Froese and Pauly 2003).

2.6 Shallow Water Snapper, Tilefish, and Wrasse Unit 3

2.6.1 Yellowtail snapper, *Ocyurus chrysurus*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Yellowtail snapper occurs in the Western Atlantic, ranging from Massachusetts to southeastern Brazil, including the Gulf of Mexico and Caribbean Sea, but is most common in the Bahamas, off south Florida, and throughout the Caribbean. Most U.S. landings are from the Florida Keys and southeastern Florida. The yellowtail snapper inhabits waters as deep as 180 m (590 ft), and usually is found well above the bottom (Allen 1985 in Froese and Pauly 2003). Muller *et al*. (2003) state that adults typically inhabit sandy areas near offshore reefs at depths ranging from 10 to 70 m (33-230 ft). Thompson and Munro (1974a) indicate that this species is most abundant at depths of 20-40 m (66-131 ft) near the edges of shelves and banks off Jamaica. Juveniles are usually found over back reefs and seagrass beds (Thompson and Munro 1974a; Muller *et al*. (2003)). Yellowtail snapper exhibits schooling behavior (Thompson and Munro 1974a).

Maximum reported size is 86.3 cm (34.2 in) TL (male) and 4.1 kg (9.1 lbs) (Allen 1985 in Froese and Pauly 2003). Maximum age is 17 years (Manooch and Drennon 1987). M is estimated at 0.20 with a range of 0.15-0.25 (Muller *et al*. (2003)). There is a truncation in the size and age structure of yellowtail snapper near human population centers.

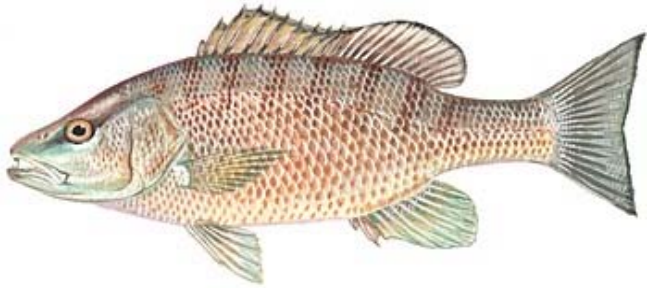
Yellowtail snapper have separate sexes throughout their lifetime (i.e., they are gonochoristic). Figuerola *et al.* (1997) estimated size at 50% maturity as 22.4 cm (8.9 in) FL (males) and 24.8 cm (9.8 in) FL (females), based on fishery independent and dependent data collected off Puerto Rico.

Spawning occurs over a protracted period and peaks at different times in different areas. In southeast Florida, spawning occurs during spring and summer, while it may occur year-round in the Bahamas and Caribbean (Grimes 1987). Figuerola *et al*. (1997) reported that, in the U.S. Caribbean, spawning occurs during February to October, with a peak from April to July. Erdman (1976) reported that 80% of adult yellowtail snapper captured off San Juan spawn during March through May. Spawning occurs in offshore waters (Figuerola *et al*. 1997; Thompson and Munro 1974a) and during the new moon (Figuerola *et al*. 1997). Large spawning aggregations are reported to occur seasonally off Cuba, the Turks and Caicos, and USVI. A large spawning aggregation occurs during May-July at Riley's Hump near the Dry Tortugas off Key West, Florida (Muller *et al*. (2003); Appendix 4).

Yellowtail snapper are nocturnal predators. Juveniles feed primarily on plankton (Allen 1985 in Froese and Pauly 2003; Thompson and Munro 1974a). Adults eat a combination of planktonic (Allen 1985 in Froese and Pauly 2003), pelagic (Thompson and Munro 1974a), and benthic organisms, including fishes, crustaceans, worms, gastropods, and cephalopods (Allen 1985 in Froese and Pauly 2003). Bortone and Williams (1986) stated that both juveniles and adults feed on fish, shrimp, and crabs.

2.6.2 Gray (mangrove) snapper, *Lutjanus griseus*

Gray snapper occur in the Western Atlantic from Massachusetts to Brazil, including the Gulf of Mexico and Caribbean Sea. Most gray snapper landed in the U.S. South Atlantic are caught in Florida. This species occupies a variety of habitats during its life history (Burton 2001). It occurs at depths of 5-180 m (16-591 ft), in coral reefs, rocky areas, estuaries, mangrove areas, and in the lower reaches of rivers (especially the young). Gray snapper often forms large aggregations (Allen 1985 in Froese and Pauly 2003).



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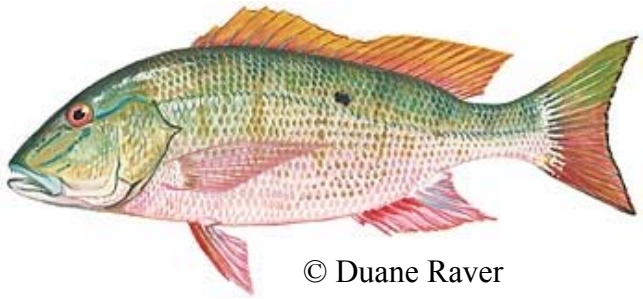
Maximum reported size is 89.0 cm (35.2 in) TL (male) and 20.0 kg (44.4 lbs) (Allen 1985 in Froese and Pauly 2003). Burton (2001) reported a maximum age of 24 year for gray snapper. M is estimated at 0.30 (Ault *et al*. 1998).

Gray snapper are gonochorists. Length and age at first maturity is estimated as 23.0 cm (9.1 in) FL and 2 years for females (Stark 1971) and 22.0 cm (8.7 in) for males. Allen (1985) indicates that spawning occurs during summer near the time of the full moon. This species spawns during July and August in the Florida Keys (Thompson and Munro 1974a). In the northeastern Caribbean, individuals in spawning condition have been observed in May, August, and September (Erdman 1976). Off Cuba, gray snapper spawn during June through October with a peak in July (García-Cagide *et al*. 1994). In Key West, FL, female gray snapper spawn from June to September with a peak in July (Domeier *et al*. 1996; Appendix 4).

The gray snapper feeds mainly at night on small fishes, shrimps, crabs, gastropods, cephalopods, and some planktonic items (Allen 1985 in Froese and Pauly 2003). The stomachs of 18 juveniles collected off the south coast of Jamaica contained 60% by volume of larval fish and 40% crabs and shrimp (Thompson and Munro 1974a). Sierra *et al*. (1994) indicated that gray snapper feed on fish, mollusks, and benthic crustaceans.

2.6.3 Mutton snapper, *Lutjanus analis*

Mutton snapper are found in the Western Atlantic from Massachusetts to southeastern Brazil, including the Caribbean Sea and the Gulf of Mexico. It is most abundant around the Antilles, the Bahamas, and off southern Florida. According to Allen (1985), in Froese and Pauly (2003), mutton snapper can be found in both brackish and marine waters at depths of 25-95 m (82-312 ft). This species is captured on mud slopes off the southeast coast of Jamaica at depths of 100-120 m (328-656 ft) (Thompson and Munro 1974a). Juveniles generally occur closer to shore, over sandy, vegetated (usually *Thalassia*) bottom habitats, while large adults are commonly found offshore among rocks and coral habitat (Allen 1985 in Froese and Pauly 2003).



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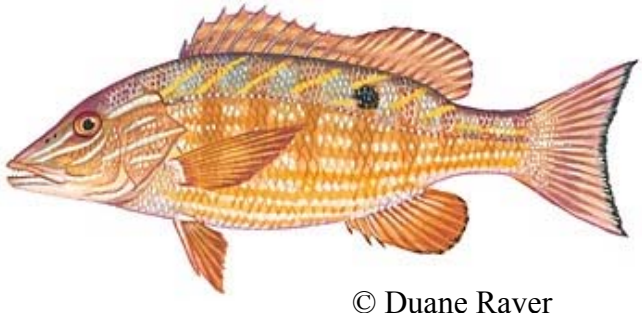
Allen (1985), in Froese and Pauly (2003), reported a maximum size of 94.0 cm (37.2 in) TL (male) and 15.6 kg (34.6 lbs). The largest male and female observed in a study conducted in Puerto Rico between February 2000 and May 2001 measured 70.0 cm (27.8 in) FL and 69 cm

(27.3 in) FL, respectively (Figuerola *et al.* 1997). Burton (2002) reported a maximum age of 29 years for mutton snapper. M is estimated as 0.21 (Ault *et al*. 1998).

Mutton snapper are gonochorists (separate sexes). Size at 50% maturity is 33.0 cm (13.1 in) FL and 41.4 cm (16.4 in) FL for males and females, respectively, off Puerto Rico (Figuerola and Torrez Ruiz 2001). All males and females are probably mature by 43.1 cm (17.1 in) FL and 45.0 cm (17.8 in) FL, respectively. Spawning occurs in aggregations (Figuerola *et al.* 1997). Individuals have been observed in spawning condition in the U.S. Caribbean from February through July (Erdman 1976). Some spawning occurs during February to June off Puerto Rico, but spawning peaks during the week following the full moon in April and May. Spawning aggregations are known to occur north of St. Thomas, USVI, and south of St. Croix, USVI, in March, April, and May (Rielinger 1999; Appendix 4). This species feeds on fishes, shrimps, crabs, cephalopods, and gastropods (Allen 1985 in Froese and Pauly 2003).

2.6.4 Lane snapper, *Lutjanus synagris*

Lane snapper occur in the Western Atlantic, ranging from North Carolina and Bermuda to southeastern Brazil, including the Gulf of Mexico and Caribbean Sea. It is most common near the Antilles, on the Campeche Bank, off Panama, and off the northern coast of South America. This species occurs over all bottom types, but is usually encountered near coral reefs and on vegetated sandy areas, in turbid as well as clear water, at depths of 10-400 m (33-1,311 ft) (Allen 1985 in Froese and Pauly 2003). Larvae and juveniles can be found in sea grass beds and bays in the eastern Gulf of Mexico (Froese and Pauly 2003).



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Maximum reported size is 60.0 cm (23.8 in) TL (male) and 3.5 kg (7.8 lbs) (Allen 1985 in Froese and Pauly 2003). The world record is 8.3 lbs from Mississippi (Andy Strelcheck, Pers. Com.). Luckhurst *et al.* (2000) a maximum age of 19 years for lane snapper caught off Bermuda. In the northern Gulf of Mexico, the maximum reported age of lane snapper is 17 years (Johnson *et al.* 1995). Estimates of M ranged from 0.11 to 0.24 (Johnson *et al.* 1995).

Figuerola *et al.* (1997) estimated size at 50% maturity as 14.7 cm (5.8 in) FL (males) and 18.5 cm (7.3 in) FL (females) in the U.S. Caribbean. Mean size at maturity of lane snapper collected off Jamaica was 26.8 cm (10.6 in) and 22.1 cm (8.8 in) in males and females respectively. Lane snapper first become sexually mature at age 1 (Luckhurst *et al.* 2000).

This fish often forms large aggregations, especially during the spawning season (Allen 1985 in Froese and Pauly 2003). Reproduction occurs over a protracted period, with some degree of reproductive activity occurring all year (Figuerola *et al*. 1997). Most spawning occurs from March to September in the U.S. Caribbean (Erdman 1976; Figuerola *et al.* 1997) with peak spawning during April to July (Appendix 4). Spawning is believed to peak in June and July around the full moon off Jamaica (Figuerola *et al.* 1997). This species feeds at night on small fishes, benthic crabs, shrimps, worms, gastropods, and cephalopods (Allen 1985 in Froese and Pauly 2003).

2.6.5 Hogfish, *Lachnolaimus maximus*


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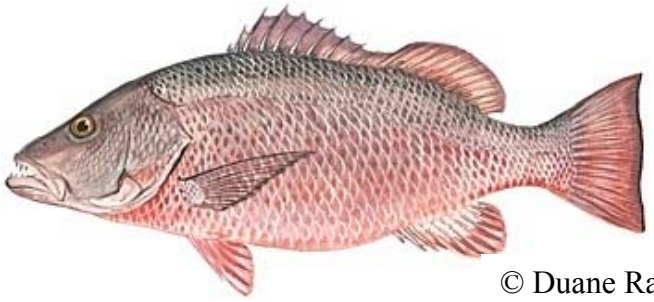
Hogfish occur in the Western Atlantic from Nova Scotia (Canada) to northern South America, including the Gulf of Mexico and Caribbean Sea (Robins and Ray 1986 in Froese and Pauly 2003). Hogfish are primarily found in warm subtropical and tropical waters (SEDAR 6-SAR2 2004). Froese and Pauly (2003) reported that hogfish is found at depths of 3-30 m (10-98 ft) over open bottom or coral reef. However, hogfish have occasionally been captured by the MARMAP program at depths ranging from 23 to 53 m (75 to 174 ft) and have been observed during submersible dives off South Carolina at depths of 52 m (171 ft) (McGovern, Pers. Com.). Hogfish exhibit sexual dimorphism. Large males have an elongate pig-like snout that is lacking in females and small males. Males also exhibit dark markings on top of the head and along the base of the medial fins, as well as a dark spot behind the pectoral fin.

Maximum reported size is 91.0 cm (36.0 in) TL (male) and 10.0 kg (22.2 lbs) (Robins and Ray 1986 in Froese and Pauly 2003). M is estimated as 0.13 (SEDAR6 - SAR2 2004). Maximum reported age in the eastern Gulf of Mexico is 23 years (McBride 2001) and 13 years in the Florida Keys (McBride 2001). Ault *et al.* (2003) and McBride and Murphy (2003) indicated hogfish were experiencing overfishing, and increasing the minimum size could increase yield.

Hogfish are protogynous (McBride *et al.* 2001). Spawning aggregations have been documented to occur in water deeper than 16 m (52 ft) off La Parguera, Puerto Rico from December through April (Rielinger 1999). García-Cagide *et al*. (1994) reported that hogfish spawn off Cuba during May through July. Colin (1982) found that peak spawning of hogfish off Puerto Rico is during December through April. Off the Florida Keys, Davis (1976) reports that spawning occurs from September to April with a February and March peak (Appendix 4). Hogfish primarily eat mollusks, but also feed on crabs and sea urchins (Robins and Ray 1986 in Froese and Pauly 2003).

2.6.6 Cubera snapper, *Lutjanus cyanopterus*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Cubera snapper occur in the Western Atlantic from Nova Scotia and Bermuda to Brazil. It also occurs throughout the Bahamas and Caribbean, including Antilles. It is rare north of Florida and in the Gulf of Mexico (Froese and Pauly 2003). Adults are found mainly around ledges over rocky bottoms or around reefs, at depths of 18-55 m (59-180 ft). Juveniles are reef-associated but also occur in brackish marine waters, and sometimes inhabit mangrove areas. Maximum reported sizes for cubera snapper are 160.0 cm (63.4 in) TL (male/unsexed) and 57.0 kg (126.5 lbs) (Froese and Pauly 2003). Appeldoorn *et al.* (1987)

estimated the maximum length as 102.0 cm (40.4 in) TL. Cubera snapper spawn during July-August off Cuba (García-Cagide *et al.* 1994; Appendix 4). Cubera snapper feed on fishes, crabs, and shrimp (Froese and Pauly 2003).

2.6.7 Sand tilefish, *Malacanthus plumieri*

Sand tilefish occur in the Western and Southeast Atlantic. In the Western Atlantic, the species ranges from North Carolina and Bermuda to Venezuela, Brazil, and to Rio de la Plata in Uruguay, including the Gulf of Mexico and Caribbean Sea. The sand tilefish occurs at depths of 10-153 m (33-502 ft), but is described as primarily a shallow-water benthic species. It generally occurs on sand and rubble bottoms, and is known to build mounds of rubble and shell fragments near reefs and grass beds. Maximum reported size is 70.0 cm (27.7 in) SL (male) and 1.1 kg (2.4 lbs) (Dooley 1978). There is little information on the life history of this species. Since blueline tilefish and other tilefish species are not hermaphroditic (Harris and Wyanski In Review; Palmer *et al.* 2004), it is likely that sand tilefish is also a gonochorist. Prey items include stomatopods, fishes, polychaete worms, chitons, sea urchins, sea stars, amphipods, and shrimps (Dooley 1978).

2.6.8 Dog snapper, *Lutjanus jocu*

Dog snapper occur in the Western and Eastern Atlantic. In the Western Atlantic, it occurs from Massachusetts to northern Brazil, including the Gulf of Mexico and Caribbean. The dog snapper is found at depths of 5-30 m (16-98 ft). Adults are common around rocky or coral reefs. Young are found in estuaries, and occasionally enter rivers (Allen 1985 in Froese and Pauly 2003).

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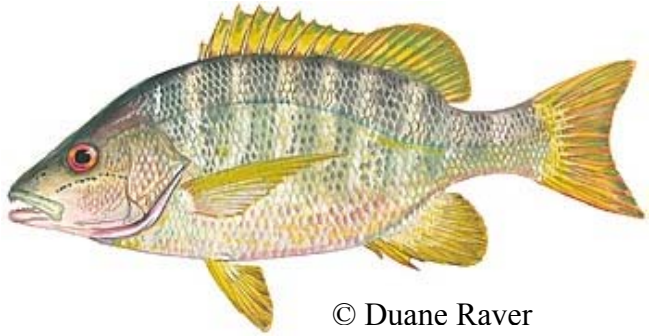
Maximum reported size is 128.0 cm (50.7 in) TL (male) and 28.6 kg (63.4 lbs) (Allen 1985 in Froese and Pauly 2003). Approximate life span is 29 years, and M is estimated at 0.33 (Ault *et al*. 1998). Dog snapper are gonochorists. The mean length at sexual maturity off Cuba is 43.0 cm (17.0 in) for females and 48.0 cm (19.0 in) FL for males (García-Cagide *et al.* 1994). Dog snapper are reported to spawn throughout the year off Cuba (García-Cagide *et al.* 1999). In the Caribbean, females in spawning condition have been collected during February-March, and in November (Thompson and Munro 1974a; Appendix 4). In the northeastern Caribbean, individuals in spawning condition have been observed in March (Erdman 1976). Spawning

aggregations have been observed on the outer fore reef of a promontory along the central province of the Belize barrier reef (Carter and Perrine 1994).

The dog snapper feeds mainly on fishes and benthic invertebrates, including shrimps, crabs, gastropods, and cephalopods (Allen 1985 in Froese and Pauly 2003). Sierra *et al.* (1994) indicate that 92% of the diet is fishes, 4% mollusks, and 4% benthic crustaceans.

2.6.9 Schoolmaster, *Lutjanus apodus*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Schoolmaster are found in the Western and Eastern Atlantic Ocean. In the Western Atlantic, it is found from Massachusetts to Trinidad and northern Brazil, including the Gulf of Mexico and Caribbean Sea. The schoolmaster snapper is found in shallow, clear, warm, coastal waters over coral reefs, from 2 to 63 m (7-207 ft) deep. Adults often seek shelter near elkhorn corals and gorgonians. Juveniles are encountered over sand bottoms with or without seagrass (*Thalassia*), and over muddy bottoms of lagoons or mangrove areas. Young sometimes enter brackish waters (Allen 1985 in Froese and Pauly 2003).

Allen (1985), in Froese and Pauly (2003), reported maximum sizes as 67.2 cm (26.6 in) TL and 75.0 cm (29.7 in) FL for males and females, respectively. The maximum reported weight is 10.8 kg (24.0 lbs) (Allen 1985 in Froese and Pauly 2003). Estimated M is 0.25 (Ault *et al*. 1998). Off Jamaica, the smallest mature female was 25.0 cm (9.9 in) long (García-Cagide *et al.* 1994).

The schoolmaster is a gonochorist. Ripe and/or recently spent fishes have been collected in nearshore and oceanic habitats off Jamaica in February-June and August-November (Thompson and Munro 1974a; Appendix 4). Erdman (1976) reports the occurrence of ripe males and females in September. Schoolmaster is reported to spawn during April-June off Cuba (García-Cagide *et al*. 1994).

Schoolmaster sometimes form resting aggregations during the day (Allen 1985 in Froese and Pauly 2003). Schools of this species observed over reefs off Florida dispersed at dusk in search of food (Thompson and Munro 1974a). Prey items include fishes, shrimps, crabs, worms, gastropods, and cephalopods (Allen 1985 in Froese and Pauly 2003).

2.6.10 Puddingwife, *Halichoeres radiatus*

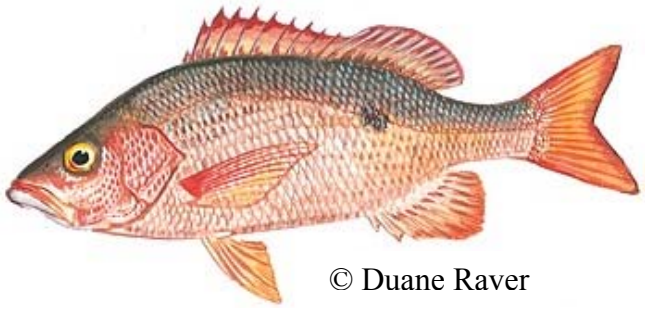
Puddingwife occur in the Western and Eastern Central Atlantic. In the Western Atlantic, they are found from North Carolina and Bermuda to Brazil, including the Gulf of Mexico (Robins and Ray 1986 in Froese and Pauly 2003) and Caribbean. Adults are found on shallow patch or seaward reefs as deep as 55 m. Juveniles usually occur in shallower coral reefs.

Maximum reported size is 51.0 cm (20.2 in) TL (male) (Robins and Ray 1986 in Froese

and Pauly 2003). In the northeastern Caribbean, individuals in spawning condition have been observed in March, April, and December (Erdman 1976; Appendix 4). Prey items include mollusks, sea urchins, crustaceans, and brittle stars (Robins and Ray 1986 in Froese and Pauly 2003).

2.6.11 Mahogany snapper, *Lutjanus mahogoni*

Mahogany snapper occur in the Western Atlantic from North Carolina to Venezuela, including the Gulf of Mexico and Caribbean Sea. This species is common in the Caribbean but is rare in US waters (Froese and Pauly 2003). The mahogany snapper occurs in nearshore water as deep as 100 m (328 ft). It is usually found in clear, shallow water over rocky bottoms near coral reefs but occurs less frequently in sandy areas or seagrass. It often forms large aggregations during the day (Allen 1985 in Froese and Pauly 2003) and has been observed to school with white grunt, *Haemulon plumieri*, at Grand Cayman (Thompson and Munro 1974a).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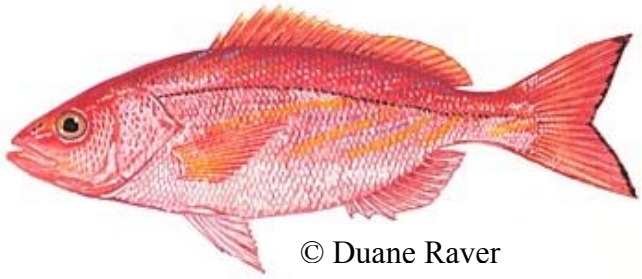
Maximum reported size is 48.0 cm (19.0 in) TL (male) and 1.3 kg (2.9 lbs)(Allen 1985 in Froese and Pauly 2003). M is estimated at 0.30 (Ault *et al*. 1998). Ripe females have been observed during August in the northeastern Caribbean (Erdman 1976). This fish feeds at night mainly on small fish, shrimps, crabs, and cephalopods (Allen 1985 in Froese and Pauly 2003).

2.7 Mid-Shelf Snapper Unit 4

2.7.1 Vermilion snapper, *Rhomboplites aurorubens*

Vermilion snapper occur in the Western Atlantic, from North Carolina to Rio de Janeiro. It is most abundant off the southeastern United States and in the Gulf of Campeche (Hood and Johnson 1999). The vermilion snapper is demersal, commonly found over rock, gravel, or sand bottoms near the edge of the continental and island shelves (Allen 1985, in Froese and Pauly 2003). It occurs at depths from 18 to 122 m (59 to 400 ft), but is most abundant at depths less than 76 m (250 ft). Individuals often form large schools. This fish is not believed to exhibit extensive long range or local movement (SEDAR2 2003b).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The maximum size of a male vermilion snapper, reported by Allen (1985), in Froese and Pauly (2003), was 60.0 cm (23.8 in) TL and 3.2 kg (7.1 lbs). Maximum reported age in the South Atlantic Bight was 14 years (Zhao *et al.* 1997; Potts *et al.* 1998b). SEDAR 2-SAR2 (2003) recommends that M be defined as 0.25/yr, with a range of 0.2-0.3/yr.

This species spawns in aggregations (Lindeman *et al.* 2000) from April through late September in the southeastern United States (Cuellar *et al.* 1996). Zhao *et al.* (1997) indicated

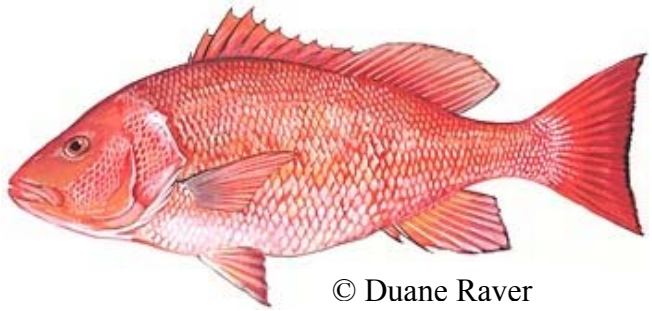
that most spawning in the South Atlantic Bight occurs from June through August (Appendix 4). Eggs and larvae are pelagic.

Vermilion snapper are gonochorists. All vermilion snapper are mature at 2 years of age and 20.0 cm (7.9 in) (SEDAR 2 2003b). Cuellar *et al.* (1996) collected vermilion snapper off the southeastern United States and found that all were mature. The smallest female was 16.5 cm (6.5 in) FL and the smallest male was 17.9 cm (7.1 in) FL (Cuellar *et al.* 1996). Zhao and McGovern (1997) reported that 100% of males that were collected after 1982 along the southeastern United States were mature at 14.0 cm (5.6 in) TL and age 1. All females collected after 1988 were mature at 18.0 cm (7.1 in) TL and age 1.

This species preys on fishes, shrimps, crabs, polychaetes, and other benthic invertebrates, as well as cephalopods and planktonic organisms (Allen 1985, in Froese and Pauly 2003). Sedberry and Cuellar (1993) reported that small crustaceans (especially copepods), sergestid decapods, barnacle larvae, stomatopods, and decapods dominated the diets of small (< 50 mm (2 in) SL) vermilion snapper off the Southeastern United States. Larger decapods, fishes, and cephalopods are more important in the diet of larger vermilion snapper.

2.7.2 Red snapper, *Lutjanus campechanus*

The red snapper is found from North Carolina to the Florida Keys, and throughout the Gulf of Mexico to the Yucatan (Robins and Ray 1986 in Froese and Pauly 2003). It can be found at depths from 10 to 190 m (33-623 ft). Adults usually occur over rocky bottoms. Juveniles inhabit shallow waters and are common over sandy or muddy bottom habitat (Allen 1985, in Froese and Pauly 2003).



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The maximum size reported for this species is 100 cm (39.7 in) TL (Allen 1985, and Robins and Ray 1986, in Froese and Pauly 2003) and 22.8 kg (50 lbs) (Allen 1985, in Froese and Pauly 2003). Maximum reported age in the Gulf of Mexico is 53 years (Goodyear 1995). For samples collected from North Carolina to eastern Florida, maximum reported age is 45 years (White and Palmer 2004). Potts and Brennan (2001) estimated M at 0.25.

Red snapper are gonochorists. In the U.S. South Atlantic Bight and in the Gulf of Mexico, Grimes (1987) reported that size at first maturity is 23.7 cm (9.3 in) FL. For red snapper collected along the Southeastern United States, White and Palmer (2004) found that the smallest mature male was 20.0 cm (7.9 in) TL, and the largest immature male was 37.8 cm (15 in) TL. 50% of males are mature at 22.3 cm (8.8 in) TL, while 50% of females are mature at 37.8 cm (15 in) TL. Males are present in 86% of age 1, 91% of age 2, 100% of age 3, 98% of age 4, and 100% of older age fish. Mature females are present in 0% of age 1, 53% of age 2, 92% of age 3, 96% of age 4, and 100% of older age individuals. Grimes (1987) found that the spawning season of this species varies with location, but in most cases occurs nearly year round. White and Palmer (2004) reported that the spawning season for female red snapper off the southeastern United States extends from May to October, peaking in July through September. Red snapper eat fishes, shrimps, crabs, worms, cephalopods, and some planktonic items (Froese and Pauly 2003; Szedlemayr and Lee 2004).

2.7.3 Silk snapper, *Lutjanus vivanus*

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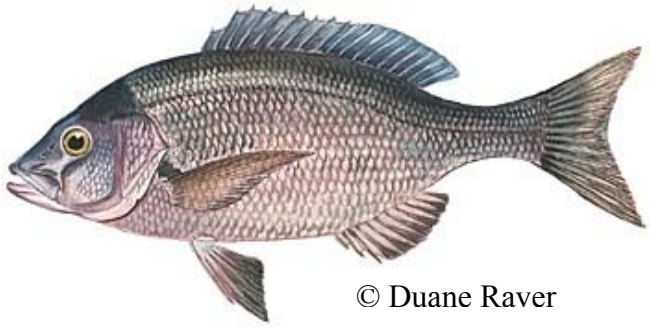
Silk snapper occur in the Western Atlantic, from North Carolina to Brazil, including the Bahamas and the northern Gulf of Mexico. It is commonly found along rocky ledges, in depths of 91-242 m (299-794 ft) (Robins and Ray 1986 in Froese and Pauly 2003). Adults are generally found further offshore than juveniles (SAFMC 1999), and usually ascend to shallow water at night (Allen 1985, in Froese and Pauly 2003). However, juveniles are sometimes observed on deep reefs (Robins and Ray 1986 in Froese and Pauly 2003). Silk snapper form moving aggregations of similar-sized individuals (Boardman and Weiler 1980).

Maximum reported size is 83.0 cm (32.9 in) TL and 8.3 kg (18.3 lb) (Allen 1985, in Froese and Pauly 2003). Size at maturity and age at first maturity are estimated at 43.4 cm (17.2 in) TL and 6.3 years, respectively (Froese and Pauly 2003). Silk snapper do not change sex. Spawning occurs in June, July, and August in waters off North and South Carolina (Grimes 1987; Appendix 4).

Silk snapper eat primarily fishes, shrimps, crabs, gastropods, cephalopods, tunicates, and some pelagic items, including urochordates (Allen 1985, in Froese and Pauly 2003).

2.7.4 Black snapper, *Apsilus dentatus*



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Black snapper occur in the Western Central Atlantic, off the Florida Keys, and in the western Gulf of Mexico and Caribbean Sea. A demersal species, the black snapper is primarily found over rocky bottom habitat, although juveniles are sometimes found near the surface (Allen 1985 in Froese and Pauly 2003). It moves offshore to deep-water reefs and rocky ledges as it matures (SAFMC 1999). Allen (1985), in Froese and Pauly (2003) reported the depth range as 100-300 m (328-984 ft). Off Jamaica, it is most abundant at depths of 60-100 m (197-328 ft) (Thompson and Munro 1974a).

Maximum reported size is 65.0 cm (25.7 in) TL (male) and 3.2 kg (7.1 lbs) (Allen 1985 in Froese and Pauly 2003). Observed maximum fork lengths are 56.0 cm (22.2 in) FL and 54.0 cm (21.4 in) FL for males and females, respectively (Thompson and Munro 1974a).

Black snapper have separate sexes throughout their lifetime. Size and age at maturity estimated in Froese and Pauly (2003) is 34.9 cm (13.8 in) TL and 1 year, respectively. Estimated mean size at maturity for fish collected off Jamaica is 43.0-45.0 cm (17.0-17.8 in) FL and 39.0-41.0 (15.4-16.2 in) cm FL for males and females, respectively (Thompson and Munro 1974a). Off Cuba the mean size at maturity is 44.0 cm (17.4 in) FL for males and 40.0 cm (15.8 in) FL for females (García-Cagide *et al.* 1994).

In the northeastern Caribbean, individuals in spawning condition have been observed from February through April and in September (Erdman 1976). Off Jamaica, the greatest

proportions of ripe fishes were found from January to April and from September to November (Thompson and Munro 1974a; Appendix 4).

Large catches occasionally obtained over a short period suggest a schooling habit for this species (Thompson and Munro 1974a). Prey includes fishes and benthic organisms, including cephalopods, tunicates (Allen 1985 in Froese and Pauly 2003), and crustaceans (Thompson and Munro 1974a).

2.7.5 Blackfin snapper, *Lutjanus buccanella*


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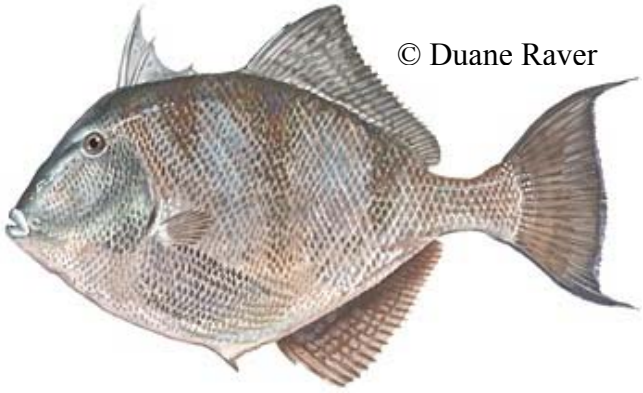
Blackfin snapper occur in the Western Atlantic, generally ranging from North Carolina, south throughout the Bahamas, and the northern Gulf of Mexico, to southeast Brazil (Robins and Ray 1986 in Froese and Pauly 2003). This is a demersal species. Adults occur in deep waters over sandy or rocky bottoms, and near drop-offs and ledges (Allen 1985, in Froese and Pauly 2003), ranging from 50-91 m (164-300 ft) depth (Robins and Ray 1986 in Froese and Pauly 2003). Juveniles occur in shallower waters, often associated with reefs in depths of 35-50 m (115-164 ft) (Allen 1985, in Froese and Pauly 2003).

Male blackfin snapper can reach sizes of 75.0 cm (29.8 in) and 14 kg (30.9 lbs). Blackfin snapper are gonochorists. Off Jamaica, the length at first maturity for males is 25.0-27.0 cm (9.9-10.7 in) FL and the mean length of females is 23.0-25.0 cm (9.1-9.9 in) FL (Thompson and Munro 1983). Allen (1985), in Froese and Pauly (2003) identified fishes as the primary prey item of blackfin snapper.

2.8 Triggerfish and Spadefish Unit 5

2.8.1 Gray triggerfish, *Balistes capriscus*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Gray triggerfish are found in the Eastern Atlantic from the Mediterranean to Moçamedes, Angola and in the Western Atlantic from Nova Scotia to Bermuda, the northern Gulf of Mexico, and to Argentina. The gray triggerfish is associated with live bottom and rocky outcrops from nearshore areas to depths of 100 m (328 ft). It also inhabits bays, harbors, and lagoons, and juveniles drift at the surface with *Sargassum*.

Maximum reported size is 60 cm (23.76 in) TL (male/unsexed) and 6.2 kg (13.8 lbs; Froese and Pauly 2003). Males are significantly larger than females (Moore 2001). The maximum age of gray triggerfish collected from North Carolina to eastern Florida was 10 years (Moore 2001). The maximum age of gray triggerfish collected from the Northeastern Gulf of

Mexico was 13 years (Johnson and Saloman 1984). Potts and Brennan (2001) estimated the natural mortality of gray triggerfish to be 0.30.

Gray triggerfish are gonochorists that exhibit nest-building and territorial reproductive behavior. Mature females from fishery-independent samples are found in 0% of age-0, 98 % of age-1 and age-2 fish, and 100% of fish older than age-3. Mature males from fishery-independent samples are present in 63% of age-1, 91% of age-2, 98% of age-3, 99% of age-4 and age-5, and 100% of older age fish. Females reach first maturity at 14.2 cm (5.6 in) FL, with an L_{50} of 15.8 cm (6.3 in) FL. Males first mature at 17.0 cm (6.7 in) FL, with a L_{50} of 18.0 cm (7.1 in) FL (Moore 2001).

Along the southeast United States, Moore (2001) determined that gray triggerfish spawn every 37 days, or 3-4 times per season. In contrast, Ingram (2001) estimated that gray triggerfish spawn every 3.7 days in the Gulf of Mexico. Off the southeast United States, female gray triggerfish are in spawning condition from April-August, with a peak of activity during June-July (Appendix 4). Male gray triggerfish are found in spawning condition throughout the year; however, there was a peak in activity during May-September (Moore 2001).

2.8.2 Atlantic spadefish, *Chaetodipterus faber*

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The Atlantic spadefish occurs in the Western Atlantic, from Massachusetts (USA) to southeastern Brazil, including the Gulf of Mexico (Robins and Ray 1986 in Froese and Pauly 2003) and Caribbean. It has also been introduced to waters surrounding Bermuda (Hayse 1987). Atlantic spadefish is found in depths of 3-35 m (10-115 ft), and is abundant in shallow coastal waters, from mangroves and sandy beaches, to wrecks and harbors. Juveniles are common in estuaries. Adults often occur in large schools of up to 500 individuals. Maximum reported size is 91.0 cm (36.0 in) TL (male) and 9.0 kg (19.9 lbs) (Robins and Ray 1986 in Froese and Pauly 2003). Hayse (1987) reported that Atlantic spadefish live for at least 8 years off South Carolina.

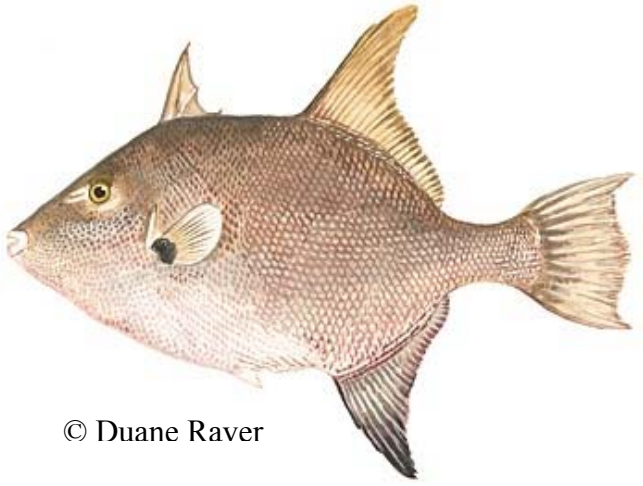
Atlantic spadefish are gonochorists (Hayes 1987). Histological examination of gonads indicates that 64% of age 0 males are sexually mature and all males age 1 and older are mature. All age 0 females are immature, while all females age 1 and older are mature (Hayse 1987). Atlantic spadefish are in spawning condition off South Carolina during May-September with peak spawning occurring during May (Hayse 1987; Appendix 4). In the northeastern Caribbean, individuals in spawning condition have been observed in May and September (Erdman 1976).

Atlantic spadefish feed on benthic invertebrates like crustaceans, mollusks, annelids, cnidarians, as well as on plankton (Robins and Ray 1986 in Froese and Pauly 2003). Hayse (1987) reported that cannonball jellyfish is the dominant food item in Atlantic spadefish collected off South Carolina. Hydroids, epifaunal amphipods, and sea anemones are observed in considerably lower volumes.

2.8.3 Ocean triggerfish, *Canthidermis sufflamen*

The ocean triggerfish occurs in both the Western and Eastern Atlantic. In the Western Atlantic, it ranges from Massachusetts (USA) to South America, including the Gulf of Mexico

and Caribbean. The ocean triggerfish is found at depths of 5-60 m (16-197 ft) (Robins and Ray 1986 in Froese and Pauly 2003), in mid-water or at the surface associated with *Sargassum* (Aiken 1983), near drop-offs of seaward reefs, and occasionally in shallow waters (Robins and Ray 1986 in Froese and Pauly 2003). This species is sometimes solitary, but also is known to form small groups in open water (Aiken 1983; Robins and Ray 1986 in Froese and Pauly 2003) of over 50 individuals. It is sometimes seen in association with the black durgon (Aiken 1983).



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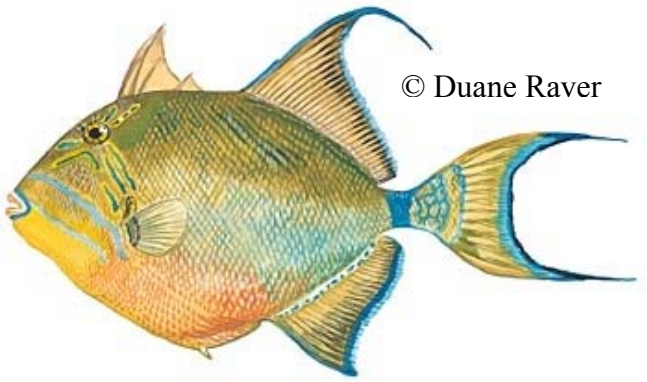
Maximum reported size is 65.0 cm (25.7 in) TL (male) and 6.1 kg (13.5 lbs) (Robins and Ray 1986 in Froese and Pauly 2003). Off Jamaica, spawning occurs during January, May, August, September, and December, with a peak in September (Aiken 1983). In the northeastern Caribbean, individuals in spawning condition have been observed in April (Erdman 1976; Appendix 4).

This species feeds primarily on large zooplankton (Robins and Ray 1986 in Froese and Pauly 2003), but also has been observed to consume benthic invertebrates (Aiken 1983).

2.8.4 Queen triggerfish, *Balistes vetula*

The queen triggerfish occurs in both the Eastern and Western Atlantic. In the Western Atlantic, its range extends from Massachusetts (USA) to southeastern Brazil, including the Gulf of Mexico and Caribbean (Robins and Ray 1986 in Froese and Pauly 2003). It is generally found over rocky or coral areas at depths of 2-275 m (7-902 ft). It also has been observed over sand and grassy areas (Robins and Ray 1986 in Froese and Pauly 2003). Juveniles tend to inhabit shallower waters, and then move into deeper water as they mature (Aiken 1983). This fish may school, but also has been observed alone and in small groups (Aiken 1983; Robins and Ray 1986 in Froese and Pauly 2003).



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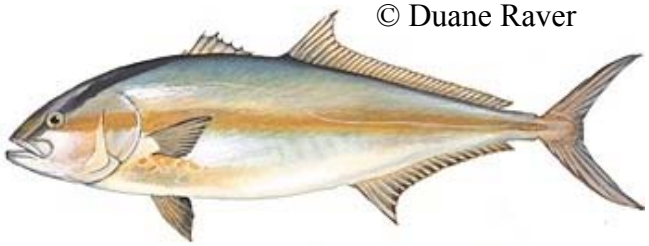
Maximum reported size is 60.0 cm (23.8 in) TL (male) and 5.4 kg (11.9 lbs) (Robins and Ray 1986 in Froese and Pauly 2003). Aiken (1983) estimated mean size at maturity as 26.5 cm (10.5 in) fork length (FL) and 23.5 cm (9.3 in) for males and females, respectively, collected in a Jamaican study. Aiken (1983) reported that peak spawning occurs during January to February and from August to October. In the northeastern Caribbean, spawning reportedly occurs during February through June (Erdman 1976). Froese and Pauly (2003) estimate that queen triggerfish live for 12.5 years. The queen triggerfish feeds primarily on benthic invertebrates, such as sea urchins (Robins and Ray 1986 in Froese and Pauly 2003).

2.9 Jack Unit 6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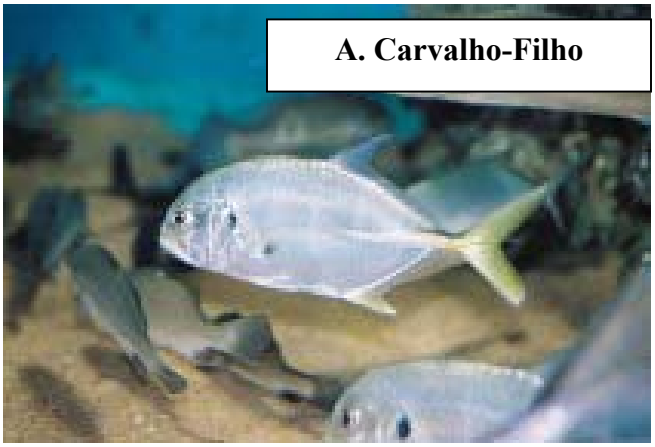
2.9.1 Greater amberjack, *Seriola dumerili*

The greater amberjack is a pelagic and epibenthic member of the family Carangidae (Manooch and Potts 1997a). This species occurs in the Indo-West Pacific, and in the Western and Eastern Atlantic Oceans. In the Western Atlantic, it occurs as far north as Nova Scotia, Canada, southward to Brazil, including the Gulf of Mexico (Paxton *et al.* 1989, in Froese and Pauly 2003; Manooch and Potts 1997a; Manooch and Potts 1997b). The greater amberjack is found at depths of 18-360 m (60-1,181 ft). It inhabits deep reefs, rocky outcrops or wrecks and, occasionally, coastal bays. Juveniles and adults occur singly or in schools in association with floating plants or debris in oceanic and offshore waters.

This species is the largest jack (Robins and Ray 1986 in Froese and Pauly 2003). Maximum reported size is 190 cm (75 in) and 80.6 kg (177.7 lbs) (Paxton *et al.* 1989, in Froese and Pauly 2003). Size at maturity and age at first maturity is estimated as 78.8 cm (31.3 in) TL and 2.3 years, respectively. Maximum reported age is 17 years (Manooch and Potts 1997a). The natural mortality rate is estimated to be 0.25 (Legault and Turner 1999).

Greater amberjack are gonochorists (separate sexes). Based on the occurrence of migratory nucleus oocytes and postovulatory follicles (POFs), spawning occurs from January through June, with peak spawning in April and May. Although fish in spawning condition were captured from North Carolina through the Florida Keys, spawning appears to occur primarily off south Florida and the Florida Keys (MARMAP unpublished data). Greater amberjack in spawning condition were sampled from a range of depths, although the bulk of samples were from the shelf break. Tagging data indicated that greater amberjack are capable of extensive movement that might be related to spawning activity. Greater amberjack tagged off South Carolina have been recaptured off Georgia, east Florida, Florida Keys, west Florida, Cancun Mexico, Cuba, and the Bahamas (MARMAP, unpublished data). Primary food items include fishes, such as bigeye scad, and invertebrates (Paxton *et al.* 1989, in Froese and Pauly 2003).

2.9.2 Crevalle jack, *Caranx hippos*

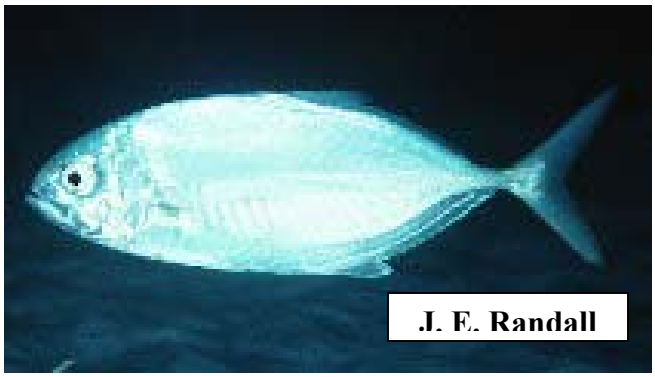

A. Carvalho-Filho

The crevalle jack occurs in the Western Atlantic Ocean, ranging as far north as Nova Scotia, southward to Uruguay, including the northern Gulf of Mexico (Robins and Ray 1986 in Froese and Pauly 2003).

This is a pelagic species, which is generally found over the continental shelf, although young are often found in brackish estuaries. The depth range is 1-350 m (3-1,148 ft) ((Smith-Vaniz *et al.* 1990, in Froese and Pauly 2003). The crevalle jack forms schools, although large individuals may be solitary (Smith-Vaniz *et al.* 1990, in Froese and Pauly 2003). Maximum reported size is 150.0 cm (59.4 in) TL and 9.0 kg (20.0 lbs) (Robins and Ray 1986 in Froese and Pauly 2003).

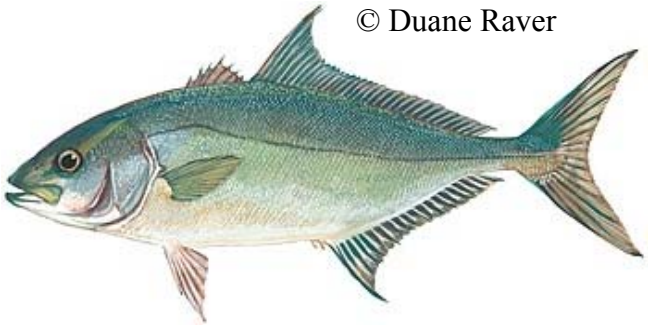
Maximum reported age from Florida is 19 years (Snelson 1992). Males become sexually mature by age 4 or 5 and females are sexually mature when they are 5-6 years old. Its diet is composed of smaller fish, shrimp and other invertebrates (Saloman and Naughton 1984; Smith-Vaniz *et al.* 1990, in Froese and Pauly 2003).

2.9.3 Blue runner, *Caranx crysos*



The blue runner occurs in the Eastern and Western Atlantic. In the Western Atlantic, it is found from Nova Scotia, Canada to Brazil, including the Gulf of Mexico and Caribbean. Blue runner is a pelagic species that occurs in water as deep as 100 m (328 ft), but generally stays close to the coast. Juveniles often occur in association with floating *Sargassum*. Maximum reported size is 70.0 cm (27.7 in) TL (male) and 5.1 kg (11.3 lbs) (Smith-Vaniz *et al*. 1990, in Froese and Pauly 2003). Maximum reported age is 11 years (Smith-Vaniz *et al.* 1990, in Froese and Pauly 2003). This species is believed to form spawning aggregations (Thompson and Munro 1974b). Thomas and Munro (1974b) indicate that blue runner spawn from February to September (Appendix 4). Erdman (1976) indicate that off La Parguera, spawning occurs mainly during March through May. Prey items include fishes, shrimps, and other invertebrates (Smith-Vaniz *et al*. 1990, in Froese and Pauly 2003).

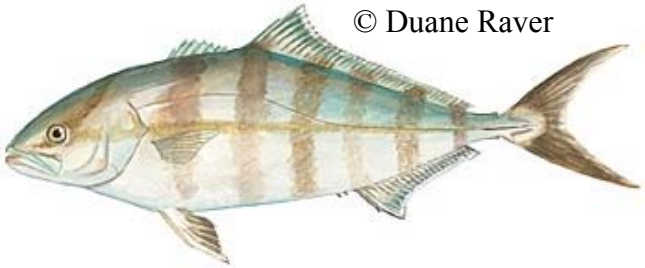
2.9.4 Almaco jack, *Seriola rivoliana*



The almaco jack occurs in the Indo-West Pacific, in the Eastern Pacific, and in the Western Atlantic, where it occurs from Massachusetts to northern Argentina. This species is thought to occur in the Eastern Atlantic as well, but the extent of its distribution there is not well established (Myers 1991, in Froese and Pauly 2003). A benthopelagic species, the almaco jack inhabits outer reef slopes and offshore banks, generally at depths from 15-160 m (49-525 ft). It has been observed to occur in small groups. Juveniles are often seen around floating objects (Myers 1991, in Froese and Pauly 2003).

Maximum reported size is 160.0 cm (63.4 in) FL (male) and 59.9 kg (132.1 lbs) (Myers 1991, in Froese and Pauly 2003). Size at maturity is estimated as 81.1 cm (32 in) FL (Froese and Pauly 2003). Fishes serve as its primary prey but invertebrates also make up a portion of its diet (Myers 1991, in Froese and Pauly 2003).

2.9.5 Banded rudderfish, *Seriola zonata*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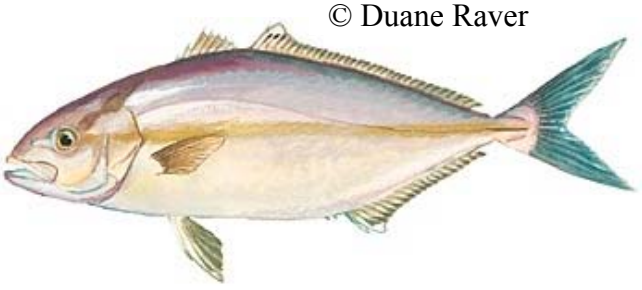
Banded rudderfish are found in the Western Atlantic from Nova Scotia, Canada to Santos, Brazil, including the Gulf of Mexico and the Caribbean Sea. They are absent from Bahamas and most islands (Froese and Pauly 2003). Adults are pelagic or epibenthic and confined to coastal waters over the continental shelf. Maximum reported size is 75.0 cm (29.7 in) TL (male/unsexed) and 5.2 kg (11.5 lbs). Banded rudderfish feed on shrimp and fishes.

2.9.6 Bar jack, *Caranx ruber*


Robert A. Patzner, Austria

The bar jack occurs in the Western Atlantic from New Jersey (USA) to southern Brazil, including the Gulf of Mexico and throughout the Caribbean Sea. It is commonly found in clear insular areas or coral reef habitats off mainland coasts, from depths of 3-35 m (10-115 ft). Juveniles frequent areas with *Sargassum* (Berry and Smith-Vaniz 1978, in Froese and Pauly 2003) and appear to be common in shallow water (0-15 m; 0-49 ft) reef habitats, but probably move to the outer margins of the shelf at or before maturity (Thompson and Munro 1974b). Bar jacks are sometimes solitary, but usually forms schools, possibly associated with spawning events (Berry and Smith-Vaniz 1978, in Froese and Pauly 2003). Maximum reported size is 69.0 cm (27.3 in) TL and 8.2 kg (18.2 lbs) (Berry and Smith-Vaniz 1978, in Froese and Pauly 2003). The minimum size of maturity for both males and females off Jamaica is 22.0-23.9 cm (8.7-9.5 in) FL (Thompson and Munro 1974b). The mean length at maturity is 24.0 cm (9.5 in) TL for both sexes, and most fish are probably mature by 26.0-27.0 cm (10.3-10.7 in) FL. Spawning occurs during all year with peak spawning during April and October (Thompson and Munro 1974b; Appendix 4). Peak spawning off Cuba occurs during April and July (García-Cagide *et al.* 1994). Prey items include fishes, shrimps, and other invertebrates (Berry and Smith-Vaniz 1978 in Froese and Pauly 2003).

2.9.7 Lesser amberjack, *Seriola fasciata*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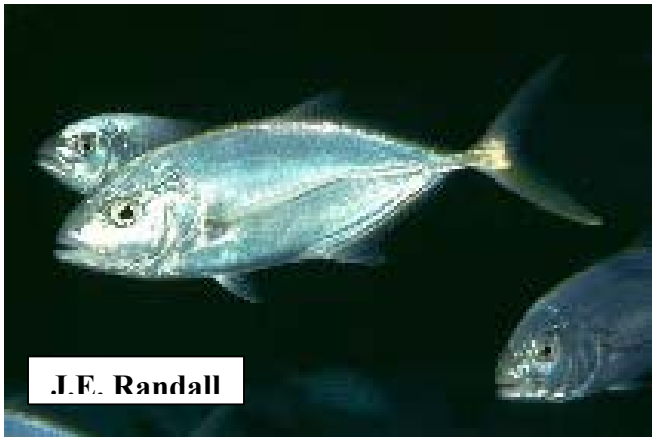
The lesser amberjack occurs in the Eastern and Western Atlantic Oceans. In the Western Atlantic, it is found from Massachusetts to Brazil (Robins and Ray 1986 in Froese and Pauly 2003). This is a benthopelagic species, primarily found in depths of 55-130 m (180-427 ft) (Smith-Vaniz *et al.* 1990, in Froese and Pauly 2003). Maximum reported size is 68 cm (27 in) FL (Claro 1994, in Froese and Pauly 2003). It feeds on squids and fishes (Smith-Vaniz *et al.* 1990,

in Froese and Pauly 2003).

2.9.8 Yellow jack, *Caranx bartholomaei*

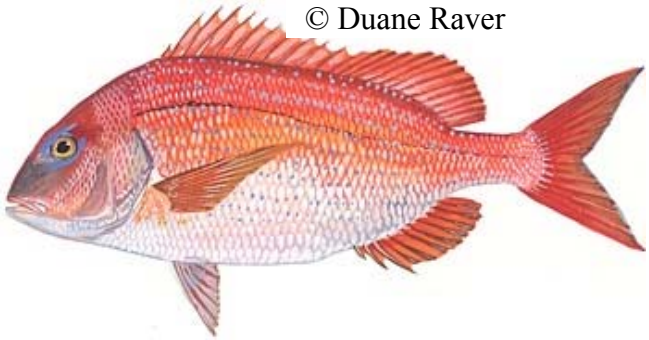


The yellow jack occurs in both the Western and Eastern Atlantic Oceans. In the Western Atlantic, its range extends from Massachusetts (USA) to Brazil, including the Gulf of Mexico and Caribbean Sea. It is usually found in offshore reef and open marine water habitat to depths of 50 m (164 ft). Yellow jack is solitary, but also has been observed to occur in small groups. Juveniles are often found near the shore on seagrass beds (Cervigón 1993 in Froese and Pauly 2003), and probably move to the outer margins of the shelf at or before maturity (Thompson and Munro 1974b). They often occur in association with jellyfish or floating *Sargassum* (Cervigón 1993 in Froese and Pauly 2003).

Maximum reported size is 100.0 cm (39.6 in) TL (male) and 14 kg (31.1 lbs) (Cervigón 1993 in Froese and Pauly 2003). According to Cervigón (1993), in Froese and Pauly (2003), yellow jack spawns offshore during February to October (Appendix 4). Thompson and Munro (1974b) reported that fish in spawning condition have been collected in November off Jamaica. This species feeds on small fishes (Cervigón 1993 in Froese and Pauly 2003).

2.10 Grunt and Porgy Unit 7A

2.10.1 Red porgy, *Pagrus pagrus*



The red porgy occurs in both the Eastern and Western Atlantic Oceans. In the Western Atlantic, it ranges from New York to Argentina, including the northern Gulf of Mexico. Adults are found in deep water near the continental shelf, over rock, rubble or sand bottoms, to depths as great as 280 m (918 ft). Red porgy are most commonly captured at depths of 25-90 m (82-295 ft). Young occur in water as shallow as 18 m (59 ft) (Robins and Ray 1986 in Froese and Pauly 2003), and are sometimes observed over seagrass beds (Bauchot and Hureau 1990, in Froese and Pauly 2003).

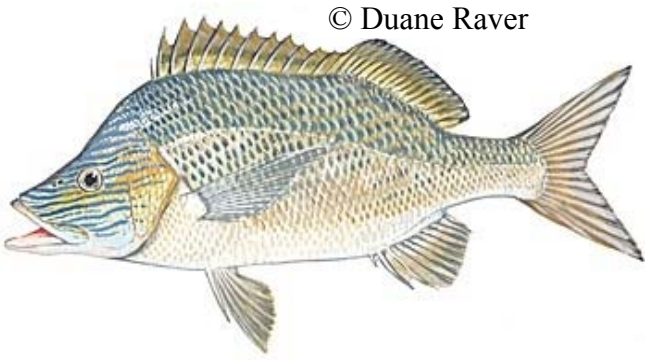
Maximum reported size is 91.0 cm (36.0 in) (Robins and Ray 1986 in Froese and Pauly 2003) and 7.7 kg (17.1 lbs) (Bauchot and Hureau 1990, in Froese and Pauly 2003). Maximum reported age of red porgy in the South Atlantic is 18 years (Potts and Manooch 2002). Maximum reported length is 73.3 cm (28.9 in) in the South Atlantic (Potts and Manooch 2002). Based on histological examination of reproductive tissue, it has been determined that red porgy spawn from December through May off the southeastern United States, with a peak in January and February (Harris and McGovern 1997; Daniel 2003; Appendix 4). Manooch (1976) examined red porgy ovaries macroscopically and stated that peak spawning of red porgy was

during March-April.

Based on data collected off the southeast United States from 1995-2000, females first mature at 20.1-22.4 cm (8.0-8.9 in) TL, and at age 0. Size and age at 50% maturity is 28.9 cm (11.5 in) TL and 1.5 years, respectively. Red porgy are protogynous. At 35.1-40.0 cm (13.9-15.9 in) TL, 72% of all individuals collected during 1995-2000 were male; by age 9, 100% of all individuals were males. Researchers observed a much greater percentage of males in smaller size classes during recent years, than during the early 1980s (Daniel 2003). This species feeds on crustaceans, fishes, and mollusks (Bauchot and Hureau 1990, in Froese and Pauly 2003).

2.11 Grunt and Porgy Unit 7B

2.11.1 White grunt, *Haemulon plumieri*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The white grunt is a demersal fish distributed in coastal waters of the Atlantic Ocean from the Chesapeake Bay to southeastern Brazil, including the Bahamas, West Indies, eastern Gulf of Mexico, and the Central American coast (Potts and Manooch 2001). It has also been introduced in Bermuda (Fischer 1978; Darcy 1983; Sadovy and Severin 1992; Bohlke and Chaplin 1993). The white grunt is found in tropical and subtropical waters (Johnson 1978; Miller and Richards 1979; Darcy 1983). It inhabits nearshore sponge-coral ("live-bottom") habitats or offshore rocky outcrop habitats on the continental shelf along the southeastern coast of the United States and the Gulf of Mexico (Powles and Barans 1980; Darcy 1983) in depths ranging from 18-55 m (59-180 ft) (Huntsman 1976).

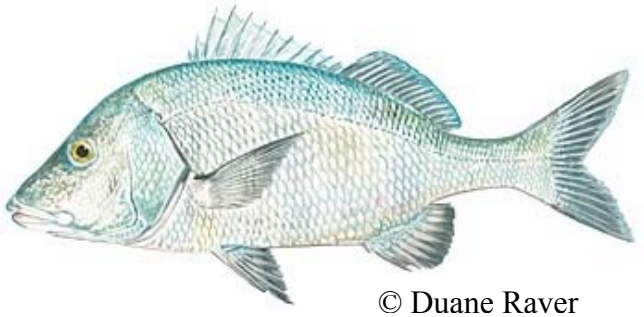
Maximum reported size is 53.0 cm (21.0 in) TL (male/unsexed) and 4.4 kg (9.8 lbs). White grunt occurring off North and South Carolina live for at least 27 years (Padgett 1997). Potts and Brennan (2001) estimate natural mortality for white grunt at 0.25.

Males are significantly larger than females. In fishery-independent samples, mature females are present in 50% of age 1 females, 88% of age 2 females, 99% of age 3 females, and 100% of older age females. Mature males from fishery-independent samples were present in 0% of age 1 males, 73% of age 2 males, 95% of age 3 males, and 100% of older age males. Females mature at 16.9-24.1 cm (6.7-9.5 in) TL (L_{50} = 16.7 cm (6.6 in) TL) and males mature at 17.3-27.7 cm (6.9-11.0) TL (L_{50} of 18.6 cm (7.4 in) TL). Off the southeastern United States, females are in spawning condition from March-September with a peak during May and June (Padgett 1997). Males are in spawning condition throughout the year with most activity occurring from March-June (Appendix 4). Padgett (1997) indicated that the sex ratio of white grunt taken with fishery-dependent and fishery-independent gear was skewed towards females. White grunt feed on mollusks, polychaetes, fishes, benthic crustaceans, stomatopods, echinoderms, and amphipods (Bowman *et al.* 2000).

2.11.2 Porkfish, *Anisotremus virginicus*

The porkfish occurs in the Western Atlantic from Florida (USA) to Brazil, including the Gulf of Mexico and Caribbean Sea. It inhabits reef and rocky bottom habitats at depths of 2-20 m (7-65 ft). Maximum reported size is 40.6 cm (16.1 in) TL (male) and 0.93 kg (2.1 lbs) Robins and Ray 1986 in Froese and Pauly 2003). Estimated natural mortality rate is 0.43 (Ault *et al*. 1998). Peak spawning occurs during January and April offshore of Jamaica (Munro *et al.* 1973; Gaut and Munro 1983; Appendix 4). In the northeastern Caribbean, individuals in spawning condition have been collected during April, July, October, and December (Erdman 1976). This species feeds at night on mollusks, echinoderms, annelids, and crustaceans. Juveniles pick parasites from the bodies of larger fishes (Robins and Ray 1986 in Froese and Pauly 2003).

2.11.3 Margate, *Haemulon album*



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Margate occurs in the Western Atlantic from the Florida Keys (USA) to Brazil, including the Caribbean Sea. Margate are found in pairs or larger schools, over seagrass beds, sand flats, coral reefs, and wrecks in depths of 20-60 m (66-197 ft). Maximum reported size is 79.0 cm (31.3 in) TL (male) and 7.1 kg (2.1 lbs) (Cervigón 1993 in Froese and Pauly 2003). Estimated natural mortality rate is 0.37 (Ault *et al*. 1998). García-Cagide *et al.* (1994) indicate that the mean size at maturity off Jamaica is 24.0 cm (9.5 in) FL. Peak spawning occurs during January and April off Jamaica, with a minor peak in September-November. In the northeastern Caribbean, individuals in spawning condition have been observed in February, March, April, and September (Erdman 1976). Margate off Cuba are in spawning condition throughout the year with a peak during March and April (García-Cagide *et al.* 1994; Appendix 4). This fish feeds on benthic invertebrates, and has been observed to eat subsurface invertebrates such as peanut worms and heart urchins (Cervigón 1993 in Froese and Pauly 2003).

2.11.4 Black margate, *Anisotremus surinamensis*

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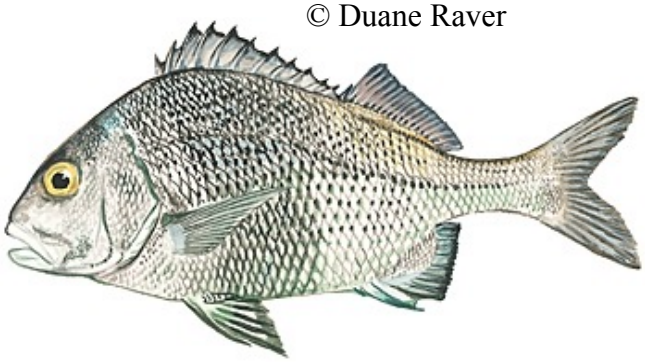
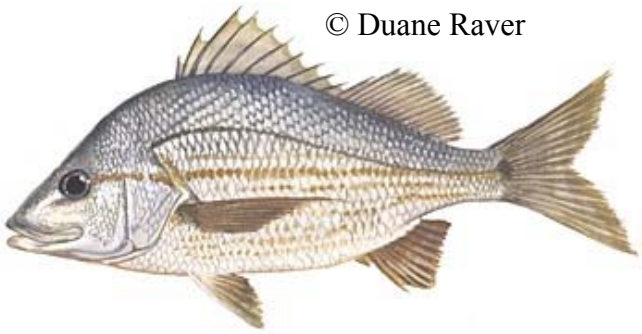


Black margate is found in the Western Atlantic from Florida, Bahamas, Gulf of Mexico Caribbean, and south American coast (Froese and Pauly 2003). It inhabits larger patch reefs and sloping rocky bottoms at depths of 3-20 m (10-66 ft). It attains sizes as large as 76.0 cm (30.1 in) TL and 5.8 kg (12.8

lbs). Spawning occurs May-July off Cuba (García-Cagide *et al.* 1994; Appendix 4). Black margate feeds on echinoderms, gastropods, crabs, shrimp, prawns, fishes, and benthic invertebrates.

2.11.5 Tomtate, *Haemulon aurolineatum*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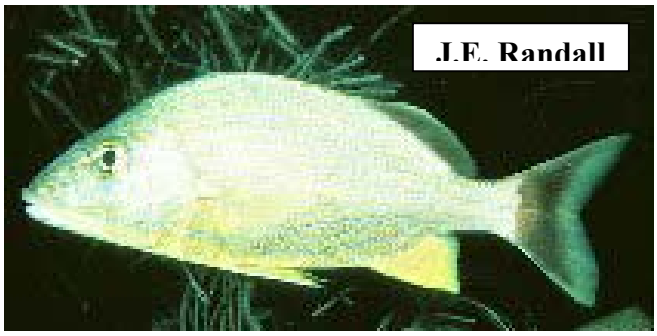
The tomtate occurs in the Western Atlantic from Massachusetts (USA) to Brazil, including the Gulf of Mexico and Caribbean Sea (Robins and Ray 1986 in Froese and Pauly 2003). The tomtate inhabits seagrass beds, sand flats, patch reefs (Robins and Ray 1986 in Froese and Pauly 2003), rocky outcrops, and even muddy bottom habitat, to depths of 55 m (180 ft) (Manooch and Barans 1982; unpublished MARMAP data). Maximum reported length is 25.0 cm (9.9 in) TL (male) (Robins and Ray 1986 in Froese and Pauly 2003). Maximum reported age is 9 years along the Southeastern United States (Manooch and Barans 1982). Estimated natural mortality rate is 0.33 (Ault *et al*. 1998).

Peak spawning occurs during January and April off Jamaica (Munro *et al.* 1973; Gaut and Munro 1983). In the northeastern Caribbean, individuals in spawning condition have been observed from January through May, and in July and August (Erdman 1976). Off the southeast Atlantic, tomtate are summer spawners (MARMAP unpublished data; Appendix 4).

Prey items include small crustaceans, mollusks, other benthic invertebrates, plankton, and algae (Robins and Ray 1986 in Froese and Pauly 2003). In the Southeast Atlantic, polychaetes and amphipods are the most important component of the diet (Sedberry 1985). Decapods are also frequently consumed, but make up a small percentage of the volume or number of prey items. Pelecypods are the most abundant prey and cephalochordates make up a large portion of the food volume.

2.11.6 Bluestriped grunt, *Haemulon sciurus*

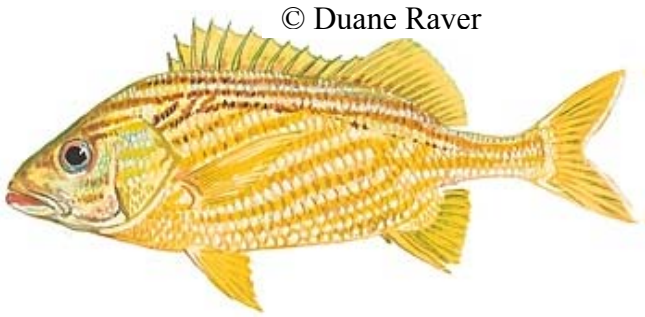


The bluestriped grunt occurs in the Western Atlantic from Florida (USA) to Brazil, including the Gulf of Mexico and Caribbean. It is found in small groups over coral and rocky reefs to depth of 30 m (98.4 ft). Juveniles are abundant in seagrass (*Thalassia*) beds. Maximum reported size is 46.0 cm (18.2 in) TL (male) and 0.75 kg (1.7 lbs) (Froese and Pauly 2003).

Few fish are mature at sizes 18.0 cm (7.1 in) FL and that full maturity is probably at about 22.0 cm (8.7 in) FL (Munro *et al.* 1973; Gaut and Munro 1983). Peak spawning off Jamaica occurs during January-April, with a minor peak in September-November (Appendix 4). In the northeastern Caribbean, individuals in spawning condition have been observed during January and March (Erdman 1976). Off Cuba, bluestriped grunt are reported to be in spawning condition during October through April with a peak during December and January (García-

Cagide *et al*. 1994). The bluestriped grunt feeds on crustaceans, bivalves and, occasionally, on small fishes (Froese and Pauly 2003).

2.11.7 French grunt, *Haemulon flavolineatum*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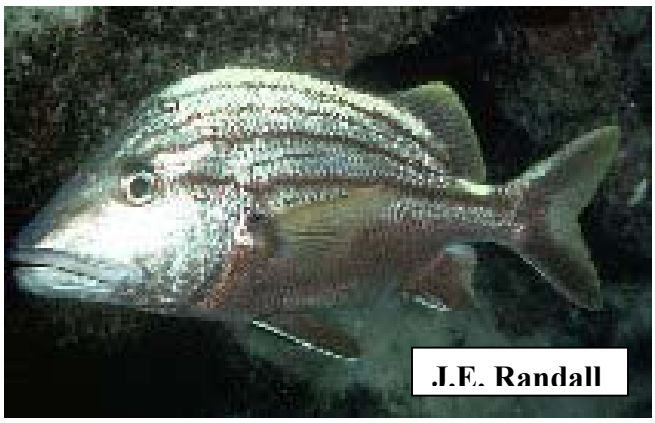
The French grunt occurs in the Western Atlantic from Bermuda, South Carolina (USA), northern Gulf of Mexico, Caribbean, and Brazil. It occurs in large schools on rocky and coral reefs to depths of 60 m (197 ft). Juveniles are abundant in nearshore seagrass beds. Maximum reported size is 30.0 cm (11.9 in) TL (male). (Robins and Ray 1986 in Froese and Pauly 2003).

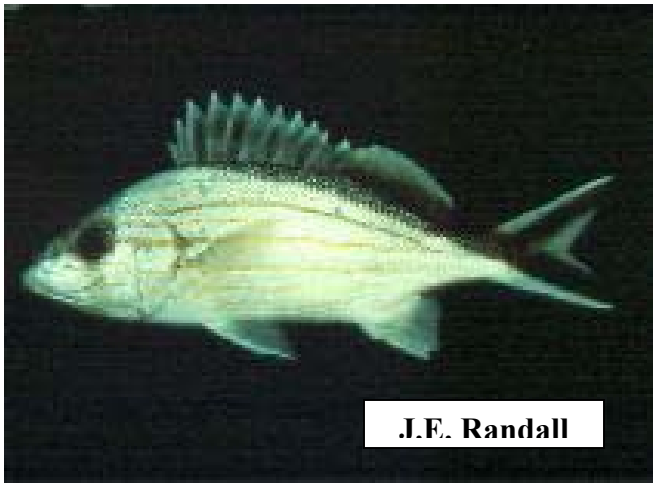
French grunt become sexually mature at lengths of 12.0 cm (4.8 in) FL or less (Munro *et al.* 1973; Gaut and Munro 1983). Spawning probably occurs throughout the year off Jamaica (Appendix 4). In the northeastern Caribbean, individuals in spawning condition have been observed in March and September (Erdman 1976). Small crustaceans are the primary prey (Robins and Ray 1986 in Froese and Pauly 2003).

2.11.8 Spanish grunt, *Haemulon macrostomum*



Spanish grunt is found in the Western Atlantic from southern Florida and the Antilles to Brazil. This reef-associated species occurs in dense schools at depths of 5-25 m (16-82 ft) (Froese and Pauly 2003). The maximum size reported is 43.0 cm (17.0 in) TL (male/unsexed) and 0.85 kg (1.9 lbs). Spawning occurs during May and June off Cuba (García-Cagide *et al*. 1994; Appendix 4). Spanish grunt feeds on benthic crustaceans and echinoderms (Froese and Pauly 2003).

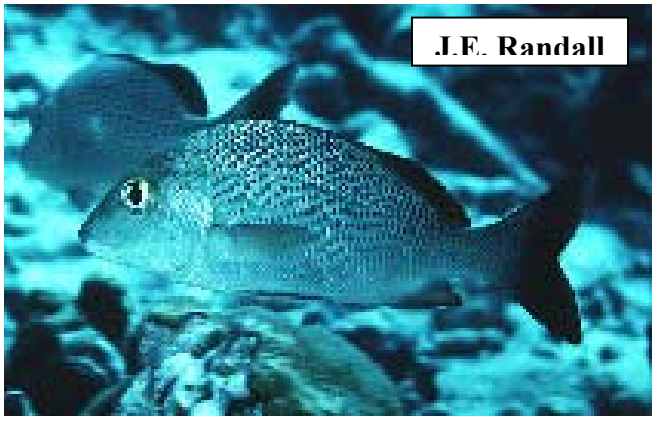
2.11.9 Cottonwick, *Haemulon melanurum*



Cottonwick is found in the Western Atlantic from Bermuda, southeastern Florida, and the Bahamas to Brazil. It is also reported from Yucatan, Mexico (Froese and Pauly 2003). This reef-associated species occurs at depths ranging from 3-50 m (10-164 ft). Maximum reported size is 33.0 cm (13.1 in) TL (male/unsexed) and 0.55 kg (1.2 lbs). The length at 50% maturity is 19.0 cm (7.5 in) FL off Jamaica

(Billings and Munro 1974). Cottonwick feeds on benthic crustaceans and other benthic invertebrates.

2.11.10 Sailors choice, *Haemulon parra*

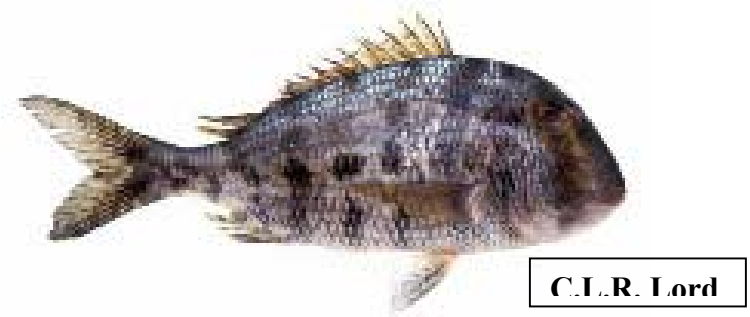


The sailors choice is a reef-associated species that occurs in the Western Atlantic including the Bahamas, Florida, northern Gulf of Mexico, throughout the Caribbean Sea, and Central and South American coasts (Froese and Pauly 2003). They inhabit shallow coastal reefs, with young occurring on seagrass beds at depths of 3-30 m (10-98 ft). Adults occur in schools in relatively open areas and the species is rare around oceanic islands. It attains a maximum size of 41.2 cm (16.3 in) TL. Sailors choice feeds on annelids, benthic crustaceans, and echinoderms (Sierra *et al.* 1994).

2.11.11 Smallmouth grunt, *Haemulon chrysargyreum*

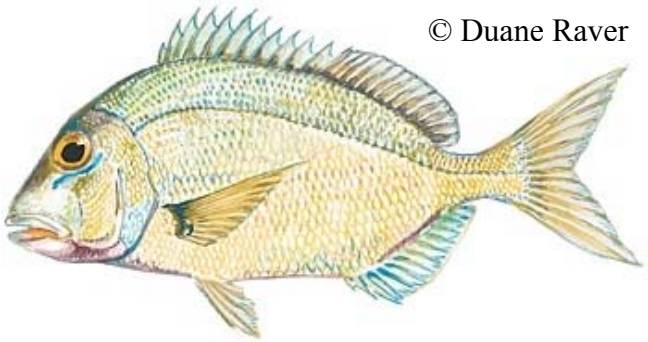
The smallmouth grunt is a reef-associated species that occurs in the Western Atlantic in southern Florida, Bahamas, and Yucatan, Mexico to Brazil at depths of 0 - 25 m. They are of minor commercial importance and is more commonly used as bait and in aquariums. It inhabits exposed rocky areas and coral reefs often near elkhorn and staghorn corals. Smallmouth grunt commonly found in schools and juveniles are encountered in *Thalassia* beds. Adults are observed in coral reefs during the day but enters open waters at night to feed primarily on mainly on plankton, but also on small crustaceans and mollusks (Froese and Pauly 2003).

2.11.12 Grass porgy, *Calamus arctifrons*



Grass porgy occur in the Western Central Atlantic from southern Florida to Louisiana. It is also found in the eastern Gulf of Mexico (Froese and Pauly 2003). Grass porgy occurs in sea grass beds from near shore to depths of at least 22 m (72 ft). Small individuals have been known to form small aggregations. Maximum reported size is 25.0 cm (9.9 in) TL. Diet includes benthic invertebrates.

2.11.13 Jolthead porgy, *Calamus bajonado*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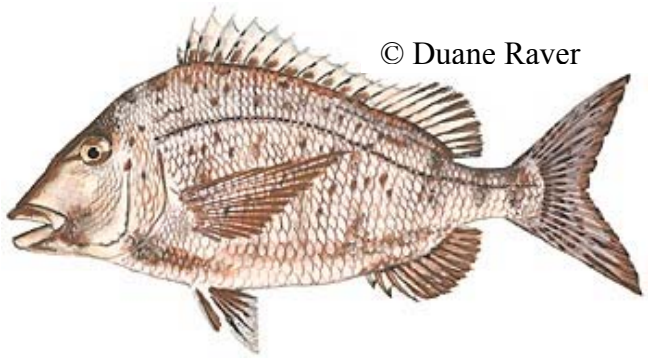
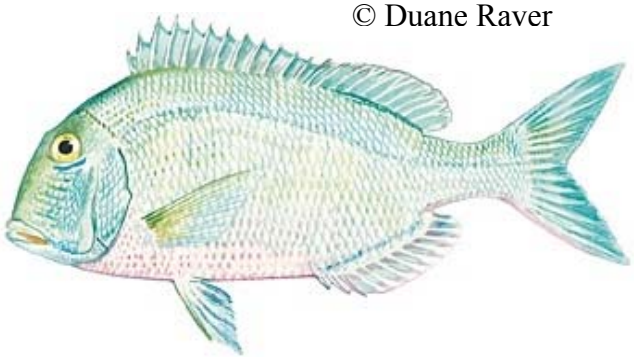
Jolthead porgy occur in the Western Atlantic from Rhode Island and Bermuda, southward to Brazil, including the northern Gulf of Mexico (Robins and Ray 1986 in Froese and Pauly 2003). This species inhabits coastal waters from 3 to more than 200 m (10–656 ft) in depth. It can be found on vegetated sand bottoms, but occurs more frequently on coral and hard bottom. Large adults are usually solitary. Maximum reported size is 76.0 cm (30.1 in) FL (male) and 10.6 kg (23.4 lbs) (Robins and Ray 1986 in Froese and Pauly 2003). Crabs and mollusks constitute its primary prey items (Robins and Ray 1986 in Froese and Pauly 2003).

2.11.14 Saucereye porgy, *Calamus calamus*


© Duane Raver

Saucereye porgy are a reef-associated species that occurs from North Carolina, and Bermuda to Brazil at depths of 1-75 m (3-246 ft). Adults are frequently found in coral areas, while the young prefer seagrass (e.g. *Thalassia*) and sandy bottoms. Maximum reported size is 56.0 cm (22.2 in) TL (male/unsexed) and 0.68 kg (1.5 lbs). The diet of saucereye porgy includes polychaetes, echinoderms, mollusks, crabs, gastropods, and other benthic crustaceans (Randall 1967).

2.11.15 Whitebone porgy, *Calamus leucosteus*

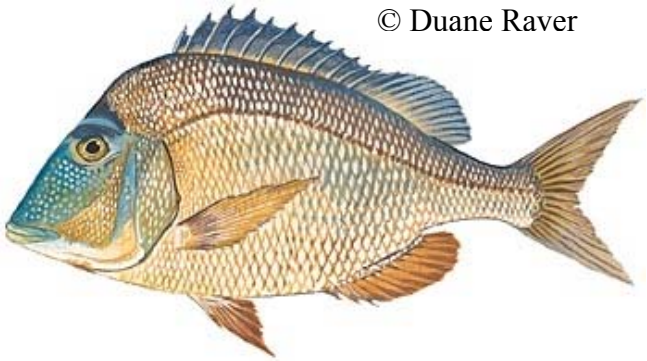

© Duane Raver

Whitebone porgy are found in the Western Atlantic from North Carolina to southern Florida in the USA and the entire Gulf of Mexico (Waltz *et al.* 1982; Froese and Pauly 2003). They are most frequently encountered in or near sponge-coral habitats at depths of 10-100 m (33-328 ft). Off the Southeastern United States, maximum reported size is 41.0 cm (16.2 in) and maximum reported age is12 years (Waltz *et al.*1982).

Whitebone porgy are protogynous and approximately 60% of the females undergo sex reversal (Waltz *et al.* 1982). Spawning occurs during April-August off the Southeastern United

States with peak during May (Waltz *et al.* 1982; Appendix 4). Off the Southeastern United States, whitebone porgy feed mainly on small hard-shelled species of gastropods, pagurid decapods, and sipunculids (Sedberry 1989). Polychaetes, pelecypods, barnacles, and fishes are also eaten. Larger individuals consume fishes and echinoderms.

2.11.16 Knobbed porgy, *Calamus nodosus*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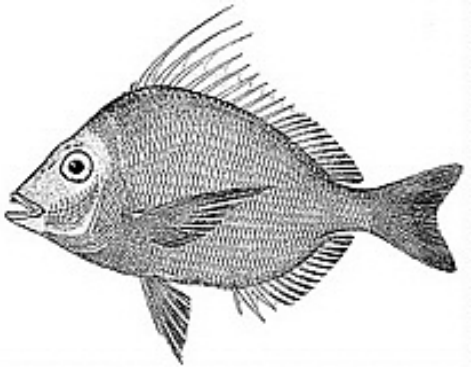
Knobbed porgy occur in the Western Atlantic Ocean from North Carolina to Southern Florida, and throughout the Gulf of Mexico (Robins and Ray 1986 in Froese and Pauly 2003). This fish is a demersal species, and typically occurs over hard bottom habitat at depths from 7-90 m (23-295 ft) (Robins and Ray 1986 in Froese and Pauly 2003). Maximum reported size is 54.4 cm (21.4 in) TL (male/unsexed) (Horvath *et al.* 1990) and 2.63 kg (5.8 lb) (Froese and Pauly 2003).

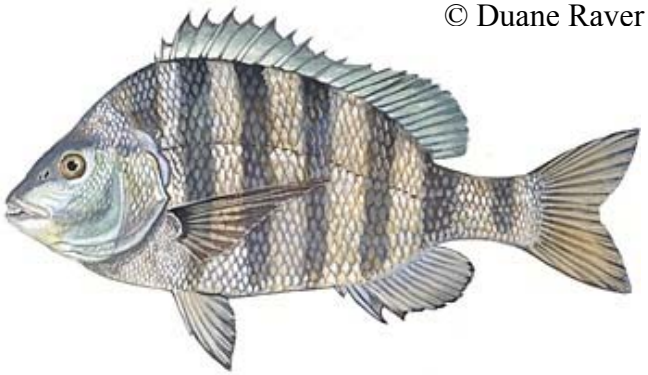
Maximum reported age is 21 years off the southeastern United States (Sharp 2001). Few immature fish were sampled by Sharp (2001). Length and age at which 100% of sampled fish are mature is 6 years and 29.8 cm (11.8 in) FL, respectively. Male to female sex ratios increased with increasing length and age, and histological evidence of protogyny was found. Females changed sex at 26.5-37.7 cm (10.5-15.0 in) FL and 5-20 years, during any time of year. Females spawned during March-July with a peak during April and May, with an estimated spawning frequency of 1.46 days (Appendix 4).

2.11.17 Longspine porgy, *Stenotomus caprinus*



The longspine porgy is found on mud bottom from North Carolina to Georgia in the USA and in the Gulf of Mexico from northern Florida to Yucatan, Mexico at depths of 5-185 m (16-607 ft) (Froese and Pauly 2003). Maximum reported size is 30.0 cm (11.9 in) TL. Maximum age is reported to be 3 years. Their diet includes polychaetes, crabs, other benthic invertebrates, shrimps, prawns, fishes, stomatopods, and amphipods (Sheridan and Trimm 1983).

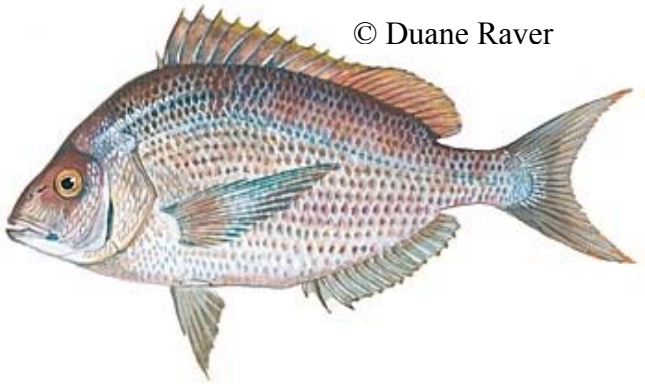
2.11.18 Sheepshead, *Archosargus probatocephalus*


© Duane Raver

The sheepshead is a reef-associated species that occurs to depths as great as 15 m (49 ft) from Nova Scotia, Canada and northern Gulf of Mexico to Brazil. Sheepshead have been observed to depths as great as 24 m (80 ft) in the Gulf of Mexico (Andy Strelcheck, pers.com.). It is absent in the Bahamas, West Indies, Bermuda, and

Grenada (Froese and Pauly 2003). Sheepshead inhabits bays and estuaries. It freely enters brackish waters and is sometimes found in freshwater. Sheepshead are commonly found around pilings. Maximum reported size is 91.0 cm (36.0 in) TL (male/unsexed) and 9.6 kg (21.3 lbs) and maximum reported age is 20 years (Schwartz 1990). Sheepshead feeds on crabs, other benthic crustaceans, and mollusks (Lieske and Myers 1994).

2.11.19 Scup, *Stenotomus chrysops*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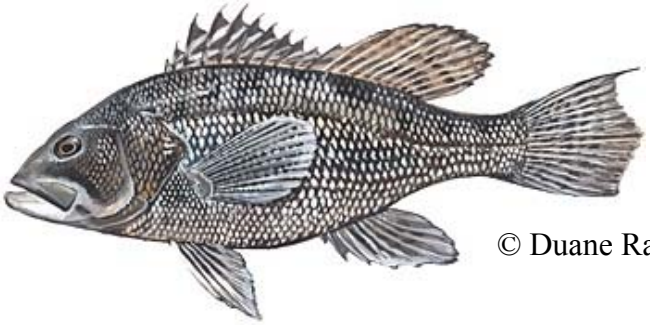
Scup occur in the Western Atlantic from Nova Scotia in Canada to Florida. Maximum reported size is 46.0 cm (18.2 in) TL (male/unsexed) and 2.1 kg (4.6 lbs). Length at 50% maturity is 15.5 cm (6.1 in) TL (O'Brien *et al.* 1993). Spawning is reported to occur during June off North Carolina (Appendix 4). Scup feeds on squid, polychaetes, amphipods, and other benthic invertebrates.

2.12 Sea Bass Unit 8

2.12.1 Black sea bass, *Centropristis striata*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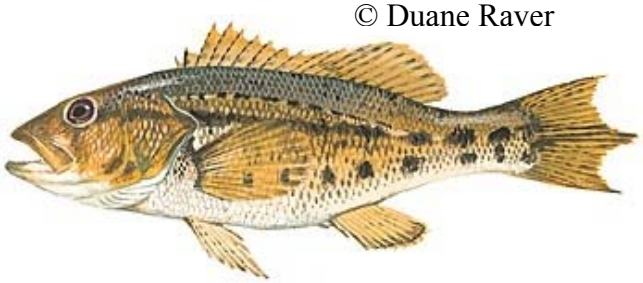
Black sea bass occur in the Western Atlantic, from Maine to northeastern Florida, and in the eastern Gulf of Mexico. It can be found in extreme south Florida during cold winters (Robins and Ray 1986 in Froese and Pauly 2003). Separate populations were reported to exist to the north and south of Cape Hatteras, North Carolina (Wenner *et al.* 1986). However, genetic similarities suggest that this is one stock (McGovern *et al.* 2002b). This species is common around rock jetties and on rocky bottoms in shallow water (Robins and Ray 1986 in Froese and Pauly 2003) at depths from 2-120 m (7-394 ft). Most adults occur at depths from 20-60 m (66-197 ft) (Vaughan *et al.* 1995).

Maximum reported size is 66.0 cm (26.1 in) TL and 3.6 kg (7.9 lbs) (McGovern *et al.* 2002b). Maximum reported age is 10 years (SEDAR 2 2003a). Natural mortality is estimated to be 0.30 (SEDAR 2-SAR1 2003). The minimum size and age of maturity for females studied off the southeastern U.S. coast is 10.0 cm (3.6 in) SL and age 0. All females are mature by 18.0 cm (7.1 in) SL and age 3 (McGovern *et al.* 2002b). Wenner *et al.* (1986) reported that spawning occurs from March through May in the South Atlantic Bight. McGovern *et al.* (2002b) indicated that black sea bass females are in spawning condition during March-July, with a peak during March through May (McGovern *et al.* 2002b; Appendix 4). Some spawning also occurs during September and November. Spawning takes place in the evening (McGovern *et al.* 2002b). Black sea bass change sex from female to male (protogyny). McGovern *et al.* (2002b) noted that the size at maturity and the size at transition of black sea bass was smaller in the 1990s than

during the early 1980s. Black sea bass appear to compensate for the loss of larger males by changing sex at smaller sizes and younger ages.

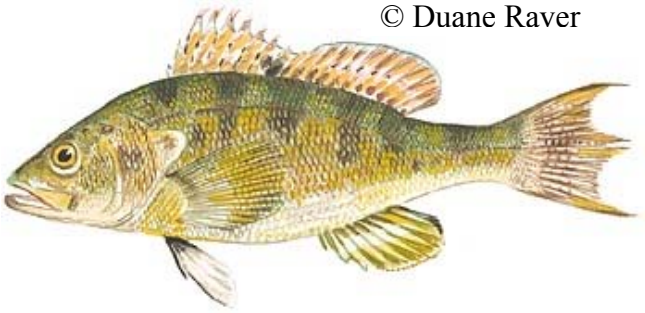
In the eastern Gulf of Mexico and off North Carolina, females dominate the first 5-year classes. Individuals over the age of 5 are more commonly males. Black sea bass live for at least 10 years. The diet of this species is generally composed of shrimp, crab, and fish (Sedberry 1988). Sedberry (1988) indicated that black sea bass consume primarily amphipods, decapods, and fishes off the Southeastern United States. Smaller black sea bass ate more small crustaceans and larger individuals fed more on decapods and fishes.

2.12.2 Bank sea bass, *Centropristis ocyurus*


© Duane Raver

Bank sea bass occurs in the Western Atlantic, ranging from North Carolina to northeastern Florida (Cape Canaveral), and throughout the Gulf of Mexico, including the Florida Keys (Robins and Ray 1986 in Froese and Pauly 2003). It prefers hard bottoms and depths of about 55 m (180 ft) (Robins and Ray 1986 in Froese and Pauly 2003). Maximum reported size is 30 cm (11.9 in) (Robins and Ray 1986 in Froese and Pauly 2003).

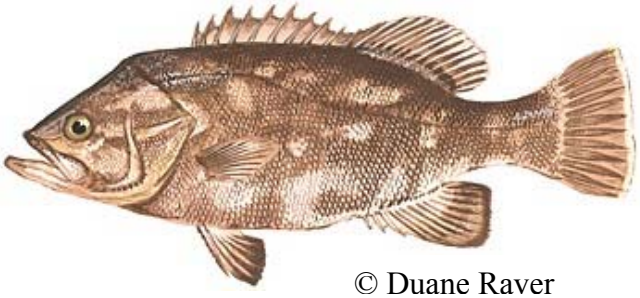
2.12.3 Rock sea bass, *Centropristis philadelphica*


© Duane Raver

Rock sea bass occurs in the Western Atlantic from North Carolina to Palm Beach, Florida as well as the northern Gulf of Mexico (Froese and Pauly 2003). It prefers hard bottom, rocks, jetties, and ledges. Maximum reported size is 30.0 cm (11.9 in).

2.13 Wreckfish Unit 8

2.13.1 Wreckfish, *Polyprion americanus*


© Duane Raver

The wreckfish *Polyprion americanus* is a large grouper-like fish that has a global anti-tropical distribution, but it was rarely captured in the western North Atlantic until the late 1980s, when a bottom hook-and-line fishery that targets wreckfish developed on the Blake Plateau (Vaughan *et al*. 2001). Wreckfish occur in the Eastern and Western Atlantic Ocean, on the Mid-Atlantic Ridge, on Atlantic islands and seamounts, and in the Mediterranean Sea, southern Indian Ocean, and southwestern Pacific Ocean (Heemstra 1986; Sedberry *et al*. 1994; Sedberry 1995). In the western Atlantic, they occur from Grand Banks (44º 50' N) off Newfoundland (Scott and Scott 1988) to the Valdes Peninsula (43º 30' S) in Argentina (Menni *et al*. 1981). Genetic evidence

suggests that the stock encompasses the entire North Atlantic (Sedberry *et al*. 1996). Active adult migration is also possible as the frequent occurrence of European fishhooks in western North Atlantic wreckfish suggests migration across great distances (Sedberry *et al*. 2001).

Wreckfish have supported substantial fisheries in the eastern North Atlantic, Mediterranean, Bermuda, and the western South Atlantic, but concentrations of wreckfish adequate to support a fishery off the southeastern United States were not discovered until 1987. The fishery off the southeastern United States occurs over a complex bottom feature that has over 100 m of topographic relief, known as the Charleston Bump, that is located 130-160 km southeast of Charleston, South Carolina, at 31°30'N and 79°00'W on the Blake Plateau (Sedberry *et al*. 2001). Fishing occurs at water depths of 450-600 m. Primary fishing grounds comprise an area of approximately 175-260 km^2, characterized by a rocky ridge and trough feature with a slope greater than 15° (Sedberry *et al*. 1994; Sedberry *et al* 1999; Sedberry *et al* 2001).

Adults are demersal and attain lengths of 200 cm TL (79 inches TL, Heemstra 1986) and 100 kg (221 lbs; Roberts 1986). Wreckfish landed in the southeastern United States average 15 kg (33 lbs) and 100 cm TL (39 inches TL) (Sedberry *et al*. 1994). Juvenile wreckfish (< 60 cm TL) are pelagic, and often associate with floating debris, which accounts for their common name. The absence of small pelagic and demersal wreckfish on the Blake Plateau has led to speculation that young wreckfish drift for an extended period, up to four years, in surface currents until reaching the eastern Atlantic, or perhaps that they make a complete circuit of the North Atlantic (Sedberry *et al*. 2001).

Vaughan *et al*. (2001) reported maximum ages of 35 years, however, off Brazil ages as great as 76 years have been reported for wreckfish (Peres and Haimovici 2004). In a recent MARMAP report, mature gonads were present in 60% of females at 751-800 mm, 57% at 801-850 mm, and 100% at larger sizes. The smallest mature female was 692 mm, and immature females were 576-831 mm. The estimate of L_{50} was 790 mm (gompit model; 95% CI = 733-820). Mature gonads were present in 40% of males at 651-800 mm and 100% at larger sizes. The smallest mature male was 661 mm, and immature males were 518-883 mm. L_{50} was not estimated because transition to maturity was abrupt.

Wreckfish spawn from December through May, with a peak during February and March. The highest percentages of ripe males occurred during December through May, which corresponded with the female spawning season (Fig. 4); however, males in spawning condition were collected throughout the year. The male spawning peak was also during February and March.

3 HABITAT

3.1 Inshore/Estuarine Habitat

Snapper grouper species utilize both pelagic (open ocean) and benthic (bottom) habitats during their life cycle. Free-swimming larval stages live in the water column and feed on zooplankton. Juveniles and adults are typically bottom dwellers 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 the Council's Habitat Plan, Sections 3.2.1, and 3.2.2. However, juveniles of some species, such as mutton snapper, gray snapper, dog snapper, lane snapper, yellowtail snapper, goliath grouper, red grouper, gag, snowy grouper, yellowfin grouper, Atlantic spadefish, and hogfish may occur in inshore seagrass beds, mangrove estuaries, lagoons, oyster reefs, and bay systems. In many species, various combinations of these habitats may be utilized during daily feeding migrations or seasonal shifts in cross-shelf distributions.

3.2 Offshore Habitat

The principal snapper grouper fishing areas are located in live bottom and shelf-edge habitats; depths range from 54 to 90 feet or greater for live-bottom habitats, 180 to 360 feet for the shelf-edge habitat, and 360 to 600 feet for the lower-shelf habitat. 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. The SEAMAP Bottom Mapping Project using a variety of data sources has mapped the extent and distribution of productive snapper grouper habitat on the continental shelf north of Cape Canaveral. Current data suggest that from 3% to 30% of the shelf is suitable bottom. These hard, live-bottom habitats may be low relief areas supporting sparse to moderate growth of immobile 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 immobile 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 miles 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. Generally, the outcroppings are composed of eroded limestone and carbonate sandstone and exhibit vertical relief ranging from less than ½ meter to over 10 meters. Ledge systems formed by rock outcrops and piles of irregularly sized boulders are common. It has been estimated that 24% (9,443 square kilometers) of the area between the 27 and 101 meter depth contours from Cape Hatteras to Cape Canaveral is reef habitat. Although the area of bottom between 100 and 300 meter 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 can be used as a proxy for the distribution of the species in the snapper grouper complex. These maps are available over the Council's Internet Mapping System under "GIS Data" on the ecosystem homepage (www.safmc.net).

Additional information on use of offshore fish habitat by snapper grouper species has been obtained through the Marine Resources Monitoring, Assessment, and Prediction Program (MARMAP). This fishery-independent survey program has been collecting data in the South Atlantic Bight region since 1973. The program began as a larval fish and groundfish survey of shelf and upper slope waters from Cape Fear to Cape Canaveral. However, since 1978, efforts of the South Carolina MARMAP program have concentrated on fishery-independent assessments of reef fish abundance and life history. The spatial distribution of sampling effort has varied considerably by gear type. Maps portraying the distribution of offshore species were created with this temporal and spatial variability in fishing effort in mind (see the Council's Habitat Plan). Maps of the distribution of snapper grouper species by gear type based on MARMAP data can be generated through the Council's Internet Mapping System under "GIS Data" on the ecosystem homepage (www.safmc.net)

3.3 Spawning Habitats of Snapper Grouper Species

Along with habitat settlement patterns, spawning locations are a key demographic attribute of reef fish species. Protection of spawning habitats is an unquestionably logical component of managing essential fish habitat. Specific information on the spawning sites and component habitats for many snapper grouper species has been provided by the MARMAP Program (Sedberry et al. In Press). Information on spawning seasonality of many reef species is provided in Section 2 and Appendix 4. Several seasonal patterns are present: a) spawning is concentrated over one or two winter months (as in many groupers); b) spawning occurs at low levels year-round with one or two peaks in warmer months; and c) spawning occurs year-round with more than two significant peaks. In addition, spawning can occur in pairs or in various types of aggregations. Many species of groupers and snappers can form sizeable spawning aggregations. However, this may not be the case among all species in the snapper grouper management unit. In fact, some species that spawn in aggregations may also pair-spawn under certain conditions.

Species in the snapper grouper complex may form spawning aggregations in the same spawning locales for decades. One explanation for the choice of spawning sites has to do with the avoidance of egg predation. This assumes that the upward rush culminating the spawning act takes place at structural features positioned in such a manner that eggs will be immediately carried offshore and away from predators on the reef. However, this hypothesis suffers from limited and sometimes contradictory experimental evaluation.

Spawning sites within Council's jurisdiction have been identified for many grouper and snapper species (Sedberry et al. In Press) and available information for other species suggests that shelf edge environments of moderate to high structural relief are sites of spawning for many species, perhaps throughout the entire South Atlantic region. In addition, shallow areas may also be spawning sites for some snapper grouper species such as goliath grouper. As new information becomes available, maps of all documented spawning areas will be created. In addition to pinpointing existing spawning information, this approach will allow the assessment of the spawning value of similar habitat types within Council's jurisdiction

4 CURRENT FEDERAL REGULATIONS

4.1 Current commercial regulations

See Appendix 1.

4.2 Current Recreational Regulations

See Appendix 2.

5 LANDINGS

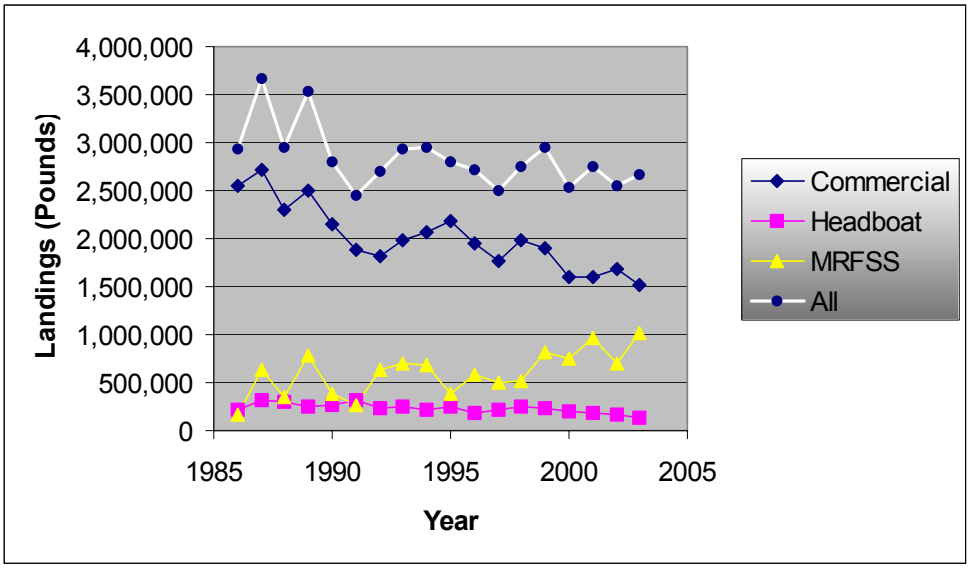
Landings from 1986-2002 for species in the Snapper Grouper FMU are provided in Appendix 3. For red porgy, black sea bass, vermilion snapper, and yellowtail snapper landings are from recent stock assessments (SEDAR 1 2002; SEDAR 2 2003a; SEDAR 2 2003b; Muller *et al*. (2003)). Sources of data in Appendix 3 for other species included the Accumulated Landings System (ALS) for commercial data, the Marine Recreational Fisheries Statistical Survey (MRFSS), and the NMFS headboat survey.

The headboat survey, using a vessel trip logbook, collects information on the total number and weight of fish harvested. The headboat survey has historically collected only information on harvested fish, though programs to generate estimates of discards were implemented two years ago. Fish are sampled for length and weight measurements, during dockside sampling effort by port agents, and these data are used to produce the harvest weight estimates. It should be noted that any discussion of MRFSS data for the South Atlantic does not include the Florida Keys since this geographic region is operationally included in the Gulf of Mexico portion of the survey. The methodology used for the MRFSS survey is described at the following web site: http://www.st.nmfs.gov/st1/recreational/overview/overview.html.

5.1 Shallow Water Grouper Unit 1A

Species included in Shallow Water Grouper Unit 1A are shown in Table 1. Landings have been fairly stable since the mid 1990s. During 1999-2002, landings (commercial and recreational) in Shallow Water Grouper Unit 1A were dominated by gag (46%), red grouper (24%), scamp (18%), and black grouper (9%). The remaining species (rock hind, red hind, graysby, yellowfin grouper, coney, yellowmouth grouper, and tiger grouper comprised 3% of the landings (Appendix 3). Commercial catches dominated landings (60%) for the major species (gag, red grouper, scamp, and black grouper). Commercial catches declined from 1,900,524 lbs in 1999 to about 1,594,420 lbs in 2000 (Figure 5-1). Catch levels were similar during 2001-2003. The decline in landings after 1999 may have been the result of the March-April spawning season closure and the increase in the minimum size from 20 to 24 inches TL in 1999.

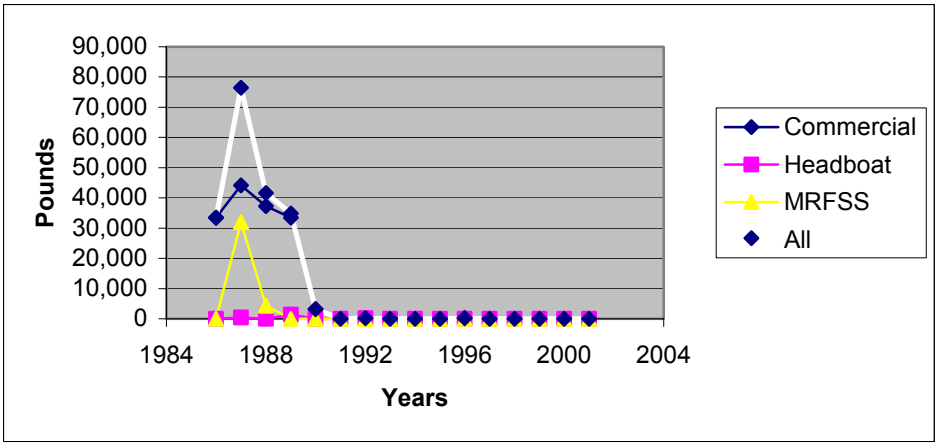
Figure 5-1. Landings - Shallow Water Grouper Unit 1A



5.2 Shallow Water Grouper Unit 1B

Shallow Water Grouper Unit 1B includes only Goliath Grouper. In 1990, there was a total prohibition of harvest or possession of goliath grouper in the EEZ (Figure 5-2, Appendix 3).

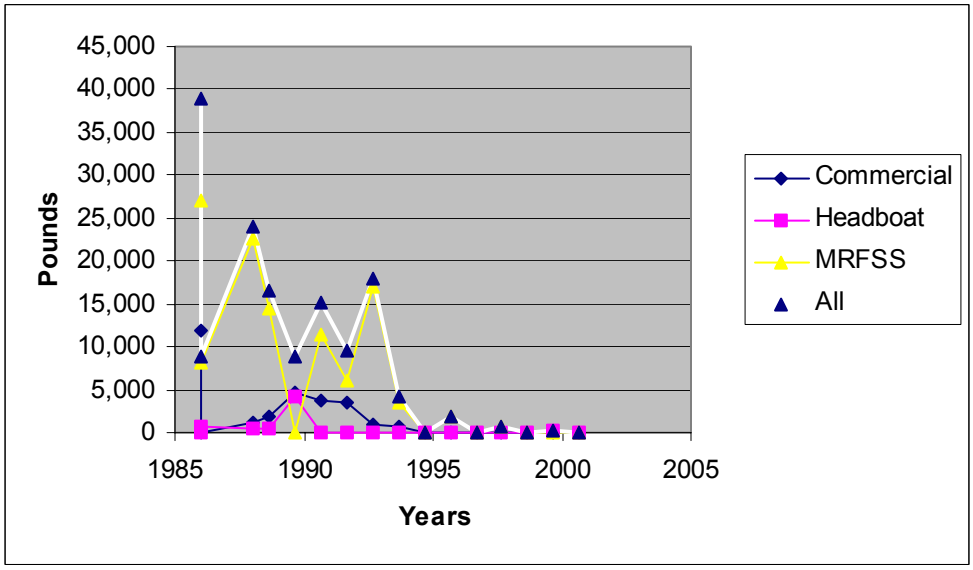
Figure 5-2. Landings - Shallow Water Grouper Unit 1B.



5.3 Shallow Water Grouper Unit 1C

Shallow Water Grouper Unit 1C includes only Nassau Grouper. Retention of Nassau grouper has been prohibited since 1992 (Figure 5-3, Appendix 3).

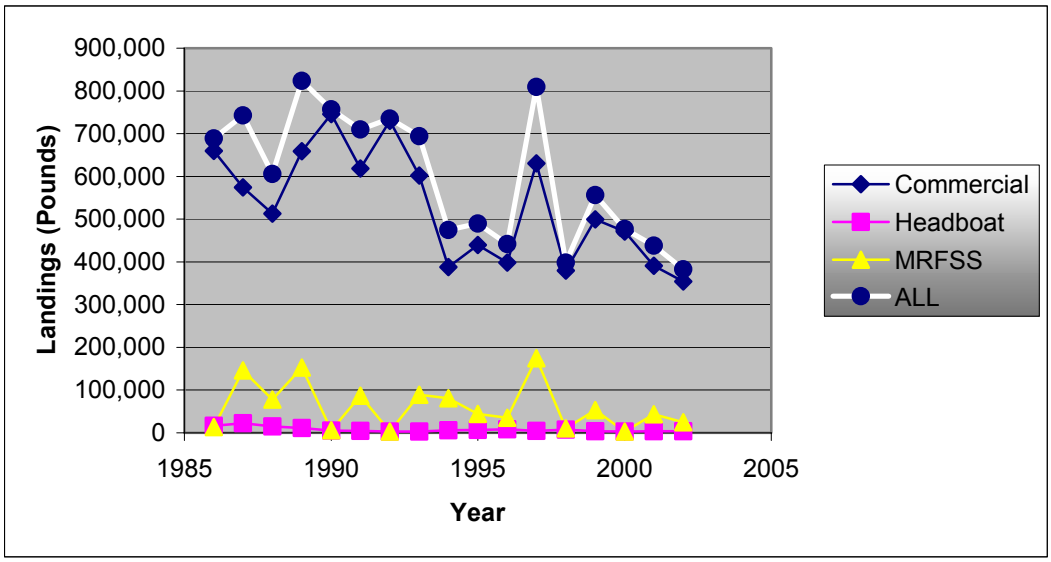
Figure 5-3. Landings - Shallow Water Grouper Unit 1C.



5.4 Deep Water Grouper, Tilefish, and Snapper Unit 2A

Deep Water Grouper, Tilefish, and Snapper Unit 2A includes snowy grouper, yellowedge grouper, warsaw grouper, speckled hind, misty grouper, and queen snapper (Table 1). Snowy grouper, yellowedge grouper, and warsaw grouper dominate landings in this unit (87%, 6.5%, and 4.5%, respectively). During 1999-2002, commercial catches dominated the harvest of snowy grouper (95%) and yellowedge grouper (99%). In contrast, landings of warsaw grouper and speckled hind were dominated by recreational harvest (79% and 51%, respectively; Appendix 3). Except for a spike during 1997, landings of species in the Deep Water Grouper, Tilefish, and Snapper Unit 2A have declined from 700,000 lbs in 1993 to 400,000 pounds in 2002 (Figure 5-4).

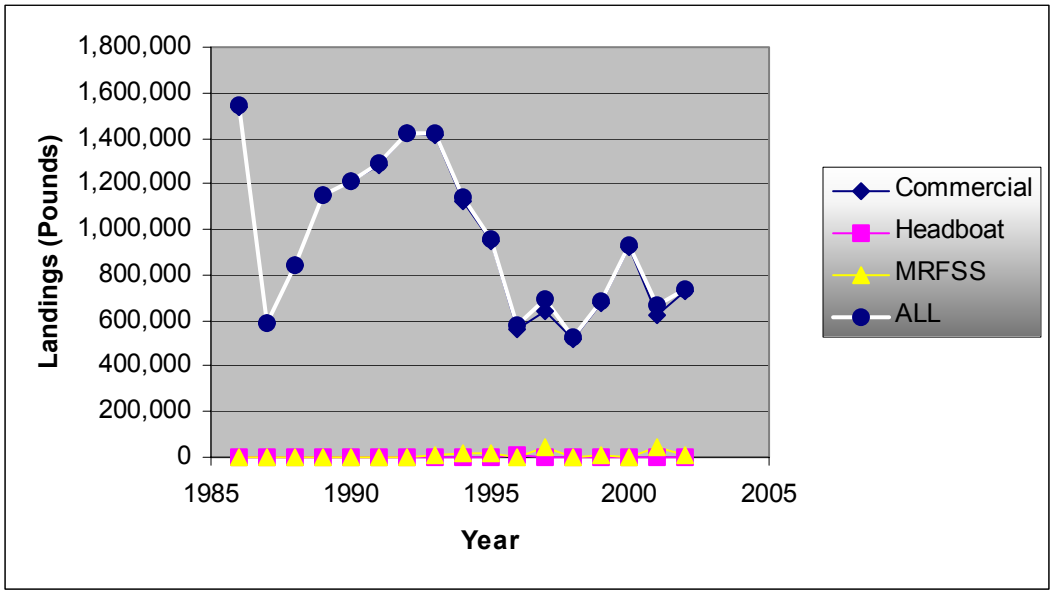
Figure 5-4. Landings - Deep Water Grouper, Tilefish, and Snapper Unit 2A.



5.5 Deep Water Grouper, Tilefish, and Snapper Unit 2B

The Deep Water Grouper, Tilefish, and Snapper Unit 2B includes tilefish (golden) and blueline tilefish (Table 1). During 1999-2002, tilefish comprised 77% of the landings (Appendix 3). There is very little recreational catch of species in this unit (2%). Tilefish and blueline tilefish landings declined from 1,400,000 lbs during 1993 to about 600,000 lbs after 1996 (Figure 5-5).

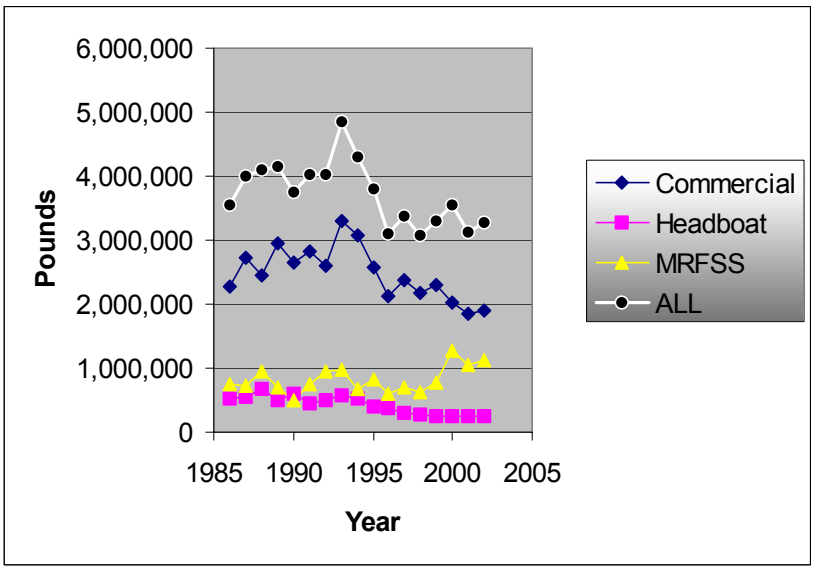
Figure 5-5. Landings - Deep Water Grouper, Tilefish, and Snapper Unit 2B.



5.6 Shallow Water Snapper, Tilefish, and Wrasse Unit 3

Species included in the Shallow Water Snapper, Tilefish, and Wrasse Unit are listed in Table 1. Yellowtail snapper, gray snapper, mutton snapper, lane snapper, and hogfish dominated landings during 1999-2002 (56%, 24%, 12%, 4%, and 3%, respectively). Catches of the remaining species in the unit made up 1% of the total landings. Landings for yellowtail snapper are from the stock assessment conducted by Muller *et al*. (2003) and include individuals that were caught from the Atlantic and Gulf of Mexico portions of south Florida (Appendix 3). Approximately 58% of the catch of the major species was commercial and 42% of the catch was recreational. Landings decreased from about 5,000,000 lbs in 1991 to 3,500,000 lbs in 1996 were they have remained fairly stable (Figure 5-6).

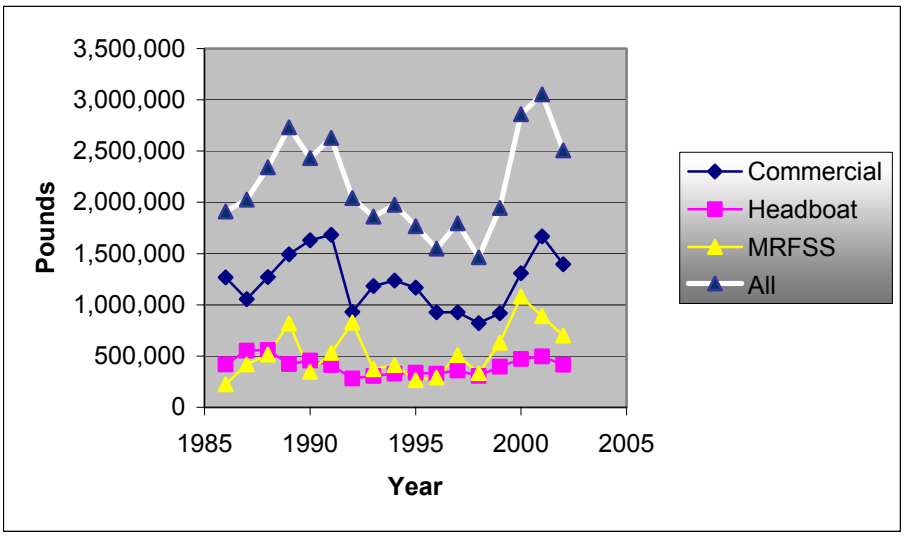
Figure 5-6. Landings - Shallow Water Snapper, Tilefish, and Wrasse Unit 3.



5.7 Mid-Shelf Snapper Unit 4

The Mid-Shelf Snapper Unit 4 includes vermilion snapper, red snapper, silk snapper, blackfin snapper, and black snapper (Table 1). Vermilion snapper and red snapper dominated landings during 1999-2002 (77% and 22% respectively; Appendix 3). Vermilion snapper landings in Appendix 3 are based on the recent SEDAR assessment (SEDAR 2003a). Commercial and recreational landings of vermilion snapper and red snapper were roughly equivalent during 1999-2002. Landings decreased from 2,600,000 lbs in 1991 to about 1,500,000 lbs in 1999. Commercial and recreational landings increased after 1999 (Figure 5-7).

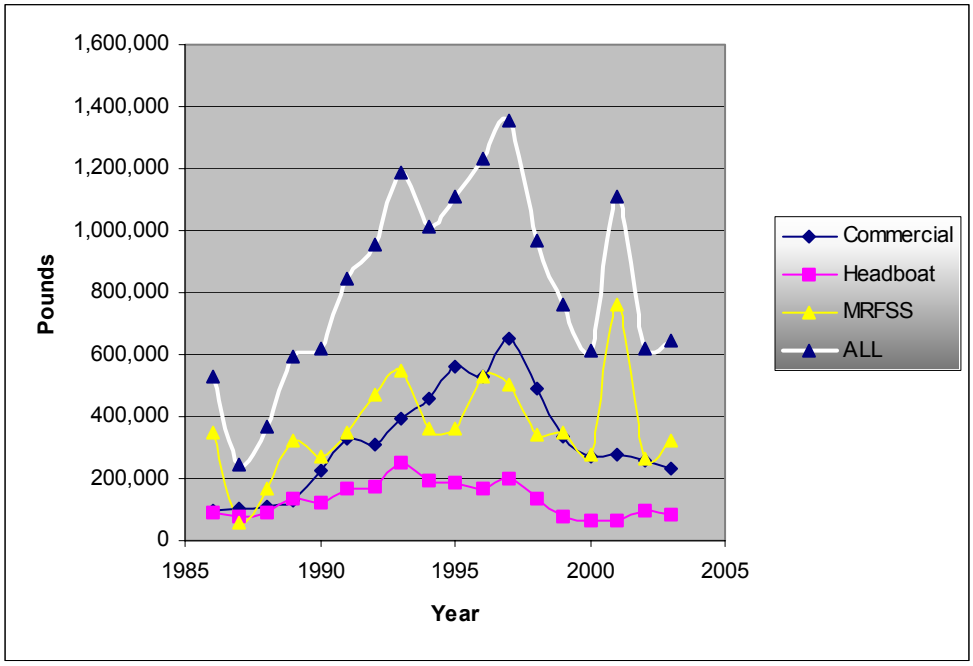
Figure 5-7. Landings – Mid-Shelf Snapper Unit 4.



5.8 Triggerfish and Spadefish Unit 5

The Triggerfish and Spadefish Unit 5 includes gray triggerfish, Atlantic spadefish, ocean triggerfish, and queen triggerfish (Table 1). Queen triggerfish has been recommended for removal from the FMU. Gray triggerfish (including unclassified triggerfish; 60%) and Atlantic spadefish (38%) dominated the landings in the unit during 1999-2002 (Appendix 3). Commercial fishermen took approximately 58% of the total landings of gray triggerfish and unclassified triggerfish during 1999-2002, while commercial fishermen took 16% of the total harvest of Atlantic spadefish during 1999-2002. Landings of species in the unit increased to almost 1,350,000 lbs in 1997, followed by a decline to 620,000 lbs in 2002 (Figure 5-8).

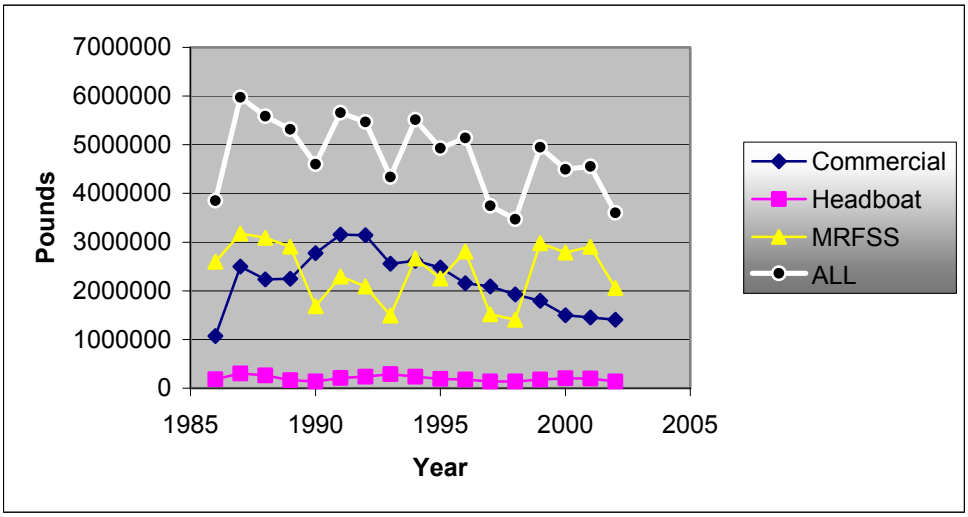
Figure 5-8. Landings - Triggerfish and Spadefish Unit 5.



5.9 Jack Unit 6

Species in Jack Unit 6 include greater amberjack, lesser amberjack, crevalle jack, blue runner, almaco jack, banded rudderfish, bar jack, and yellow jack (Table 1). Crevalle jack has been recommended for removal from the Snapper Grouper FMU. Greater amberjack (including unclassified jacks), blue runner, and almaco jacks dominate landings during 1999-2002 (77%, 13%, and 6%, respectively) when crevalle jack is removed from the FMU. Recreational catches dominated the landings for these species (65%) during 1999-2002. During that period, recreational landings increased and commercial landings decreased (Figure 5-9). There has been a decline in landings of species in the unit from 4,500,000 lbs in 1995 to 2,800,000 lbs in 2002.

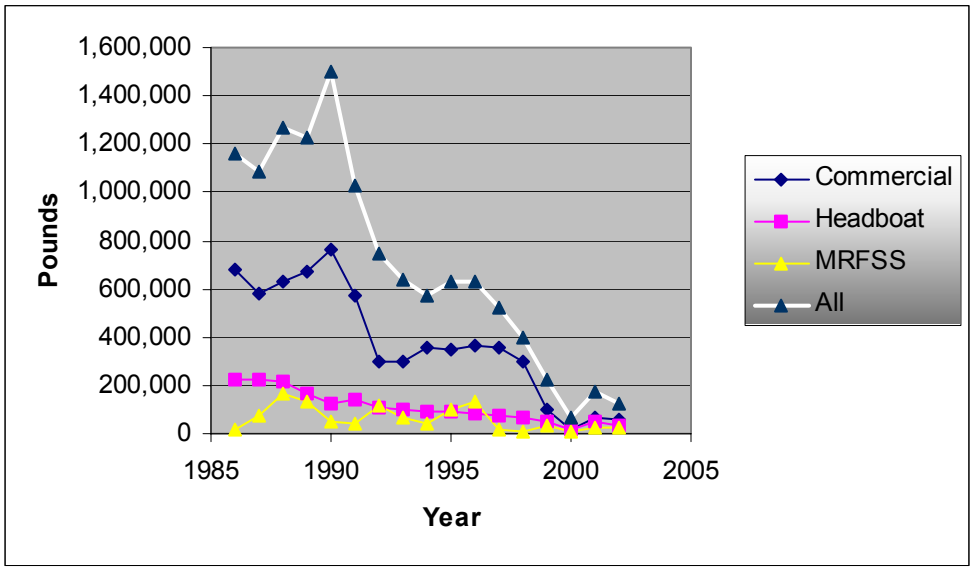
Figure 5-9. Landings - Jack Unit 6.



5.10 Grunt and Porgy Unit 7A

Red porgy is the only member of Grunt and Porgy Unit 7A (Table 1). Landings provided in Appendix 3 are based on the SEDAR stock assessment (SEDAR 1 2002). Landings decreased from 1,500,000 lbs in 1990 to 117,000 lbs in 2002 (Figure 5-10). Based on the SEDAR stock assessment, recreational landings comprised 56% of the total harvest during 1999-2002.

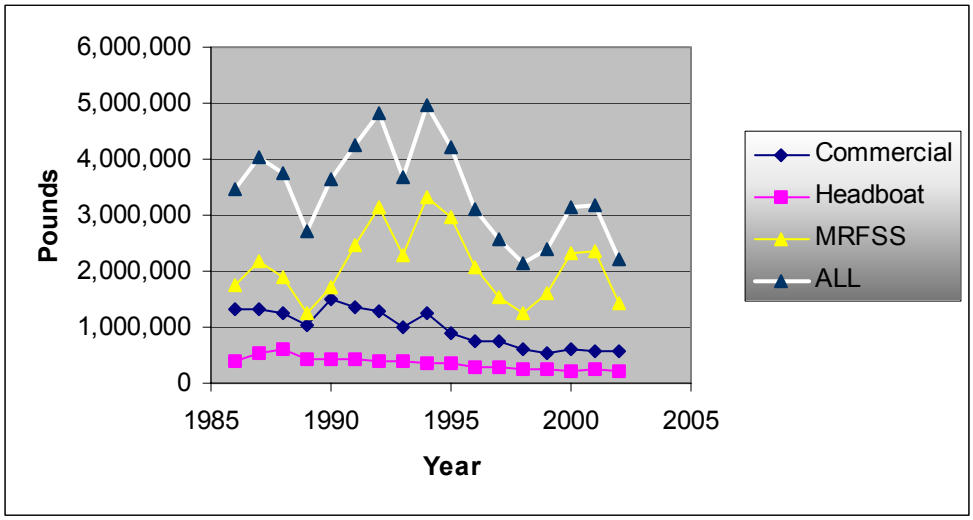
Figure 5-10. Landings - Grunt and Porgy Unit 7A.



5.11 Grunt and Porgy Unit 7B

Species included in Grunt and Porgy Unit 7B are listed in Table 1. Porkfish has been considered for removal from the unit. During 1999-2002, landings in the unit were dominated by sheepshead (67.1%), white grunt and unclassified grunts (20.3%), black margate (3.0%), knobbed porgy (2.4%), and tomtate (1.7%). Landings for these species were dominated by recreational harvest (79%). Since 1995, total landings in this unit have declined from 5,000,000 lbs in 1994 to 2,200,000 lbs in 2002 (Figure 5-11).

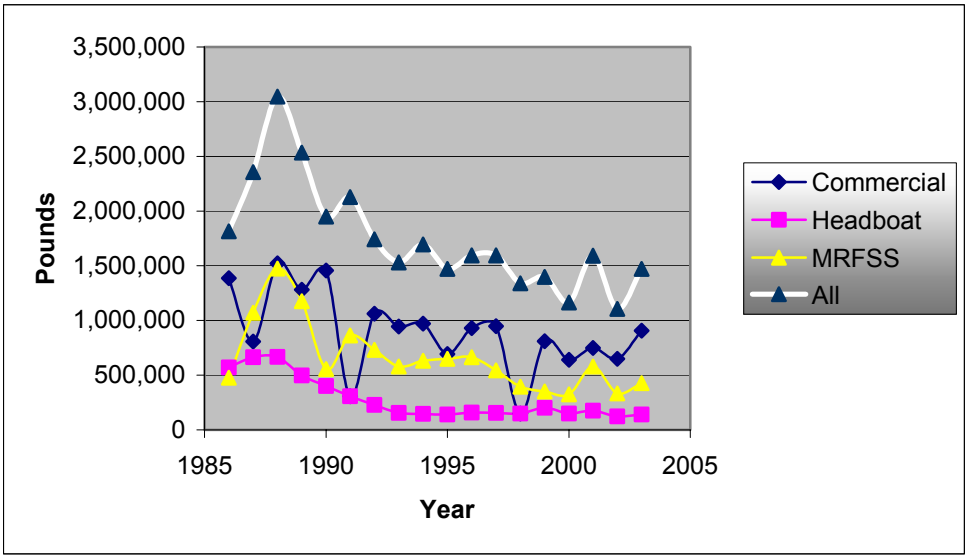
Figure 5-11. Landings - Grunt and Porgy Unit 7B.



5.12 Sea Bass Unit 8

Sea Bass Unit 8 includes black sea bass, bank sea bass, and rock sea bass (Table 1). Landings for black sea bass in Appendix 3 are from the recent SEDAR assessment (SEDAR 2 2003a). Black sea bass comprised 99.5% of the landings in this unit during 1999-2002. According to the assessment, recreational catch accounted for 54% of the total landings during that period. Landings decreased from about 3,000,000 lbs in 1988 to 1,100,000 lbs during 2002 (Figure 5-12).

Figure 5-12. Landings - Sea Bass Unit 8.



6 RECENT STATUS INFORMATION

6.1 Recent SEDAR Stock Assessments

As mentioned in Section 1.5, the Southeast, Data, Assessment, and Review process (SEDAR) process was initiated in 2002. Stocks in the Snapper Grouper FMU that have gone through the SEDAR process include red porgy, black sea bass, vermilion snapper, yellowtail snapper, hogfish, goliath grouper, snowy grouper, and tilefish. Brief summaries of these assessments are provided below as well as links to the assessments.

6.1.1 Red porgy

Red porgy was the subject of the first SEDAR assessment that updated previous assessments conducted by Vaughan *et al*. (1991), Huntsman *et al*. (1994), Vaughan (1999), and Vaughan and Prager (2002). Data for the assessment were assembled and reviewed at a data workshop during the week of March 11, 2002, in Charleston, SC. The assessment utilized commercial and recreational landings, as well as abundance indices and life history information from fishery-independent and fishery-dependent sources. Four abundance indices were developed: two indices derived from CPUE in the NMFS headboat survey (1976-1991; 1992-1998), and two derived from CPUE observed by the South Carolina MARMAP fishery-independent monitoring program ("Florida" trap index, 1983-1987; and chevron trap index, 1990-2001) (SEDAR 1 2002).

At the assessment workshop, age-structured and production models were applied to available data. Although the AW determined that the age-structured model provided the most definitive view of the population, both models provide a similar picture of the status of red porgy. SEDAR 1 (2002) indicated that, given the different assumptions used by each type of model and the lack of age structure in the production models, this degree of agreement increased confidence in the assessment results. It was concluded that the stock was overfished, but overfishing was not occurring (Table 6-1).

Table 6-1: Stock assessment parameters for red porgy.
Values are those recommended by SARC and SEFSC staff (SEDAR 1 2002).

Parameter	Value	Notes	Status
M	0.225		
F_{MSY}	0.19		
SSB_{MSY}	3,050	Metric Tons	
MSST	2,364	(1-M)*B_{MSY}; Metric Tons	
MSY	375	Metric Tons	
F_{2001}/F_{MSY}	0.45		Not Overfishing
SSB_{2001}/SSB_{MSY}	0.44		
SSB_{2001}/MSST	0.57		Overfished

The South Atlantic Council defined the rebuilding schedule for red porgy in Amendment 12 to the Snapper Grouper FMP. That schedule is 18 years, which is the maximum allowable rebuilding time frame based on the formula: T_{MIN} (10 years) + one generation time (8 years) (SAFMC 2000). The schedule began with the implementation of a no harvest emergency rule in September of 1999 (64 FR 48324), and ends December 31, 2017.

6.1.2 Black Sea Bass

6.1.2.1 2003 Assessment

At the second SEDAR (SEDAR 2 2003a), assessments were conducted on black sea bass and vermilion snapper, which updated a black sea bass assessment conducted by Vaughan *et al*. (1996) and a vermilion snapper assessment conducted by Manooch *et al*. (1998). Data for the SEDAR assessment were assembled and reviewed at a data workshop held during the week of October 7, 2002 in Charleston, SC. The assessment utilized commercial and recreational landings, as well as abundance indices and life history information from fishery-independent and fishery-dependent sources. Six abundance indices were developed by the data workshop. Two CPUE indices were used from the NMFS headboat survey (1978-2001) and the MRFSS recreational survey (1992-1998). Four indices were derived from CPUE observed by the South Carolina MARMAP fishery-independent monitoring program ("Florida" trap index, 1981-1987; blackfish trap index, 1981-1987; hook and line index, 1981-1987; and chevron trap index, 1990-2001) (SEDAR 2 2003a).

Age-structured and age-aggregated production models were applied to available data at the assessment workshop. The age-structured model was considered the primary model, as recommended by participants in the data workshop. The stock assessment indicated that black sea bass was overfished and overfishing was occurring (Table 6-2). Previously, the rebuilding

clock for black sea bass was restarted with the effective date of the regulations implementing the SFA Comprehensive Amendment on December 2, 1999. Black sea bass rebuilt to Bmsy within 10 years (December 2, 2009). The stock assessment indicated that black sea bass could not be rebuilt to SSBmsy in 10 years in the absence of fishing mortality (SEDAR 2 2003a). The maximum rebuilding time is 18 years based on the formula: T_{MIN} (11 years) + one generation time (7 years).

Table 6-2: Stock assessment parameters for black sea bass.
Note: M=0.3 and steep=free (SEDAR 2 2003a)

Parameter (Table 6-2	**Value**	**Notes**	**Status**
F_{2001}	1.04		
SSB_{2002}	1,755	As of January 1, 2002; Metric Tons	
F_{MSY}	0.2		
$F_{0.1}$	0.29		
F_{MAX}	0.83		
SSB_{MSY}	13,500	Metric Tons	
MSY	1,730	Metric Tons	
MSST	9,460	Metric Tons	
F_{2001}/F_{MSY}	5.22		Overfishing
SSB_{2002}/SSB_{MSY}	0.13		
SSB_{2002}/MSST	0.19		Overfished
Reduction Needed to End Overfishing	50-90%		
Rebuilding in Absence of Fishing	11 years	If F=0	

6.1.2.2 2005 Update

At the request of the SAFMC, the SEDAR panel convened to update the 2003 black sea bass stock assessment, using data through 2003, and to conduct stock projections based on possible management scenarios (SEDAR Update 1 2005). The assessment indicated that the

stock was overfished and overfishing was occurring (Table 6-3). However, the stock could be rebuilt to B_{MSY} in 5 years when F = 0.

Table 6-3: Stock assessment parameters from black sea bass update 1 (SEDAR Update 1 2005).

Parameter	Value	Notes	Status
F_{2003}	2.641		
SSB_{2004}	1,858	Metric Tons	
F_{MSY}	0.429	Fully selected fishing mortality rate	
E_{MSY}	0.100	Ages 1+	
SSB_{MSY}	6,812	Metric Tons	
MSY	1,260	Metric Tons	
MSST	4,768	Metric Tons	
F_{2003}/F_{MSY}	6.151		Overfishing
E_{2003}/E_{MSY}	1.617		
SSB_{2004}/ SSB_{MSY}	0.273		Overfished
$SSB_{2004}/ MSST$	0.390		
Reduction Needed to End Overfishing	62%		
Rebuilding in Absence of Fishing	5 years	F = 0	

6.1.3 Vermilion snapper

The vermilion snapper assessment utilized commercial and recreational landings, as well as abundance indices and life history information from fishery-independent and fishery-dependent sources. Four abundance indices were developed by the data workshop. One CPUE index was developed from the NMFS headboat survey, 1973-2001. Three indices were derived from CPUE observed by the South Carolina MARMAP fishery-independent monitoring program ("Florida" trap index, 1983-1987; hook and line index, 1983-1987; and chevron trap index, 1990-2001) (SEDAR 2 2003b).

A forward-projecting model of catch at length was formulated for this stock. Two other models (forward-projecting catch at age and age-aggregated production model) were applied but neither could provide estimates. The assessment was based on the catch-at-length model, which

was applied in a base run and eight sensitivity runs. The assessment indicated that the stock was undergoing overfishing but that there was a high level of uncertainty in the overfished condition as the stock recruitment relationship was poorly defined (Table 6-4).

Table 6-4: Stock assessment parameters for vermilion snapper (SEDAR 2 2003b).

Parameter	Value	Notes	Status
$F_{PROJECTED}$	0.60	Averaged over the last 3 years	
F_{2001}	0.64		
F_{MSY}	0.36		
F_{MAX}	0.375		
$F_{40\%}$	0.33		
E_{MSY}	5.06×10^{11}	Eggs; E=Egg Production (Analogous to spawner biomass)	
MSST	3.8×10^{11}		
MFMT	0.36/year	$= F_{MSY}$	
E_{2002}/E_{MSY}	0.66	Eggs; E=Egg Production (Analogous to spawner biomass)	
F_{2001}/F_{MSY}	1.78		Overfishing

6.1.4 Yellowtail snapper

The stock assessment on yellowtail snapper was conducted by the State of Florida but went through the SEDAR review process (Muller *et al*. 2003). Abundance indices were developed from MRFSS data and from commercial CPUE data. Two age-structured models (Fleet-Specific and Integrated Catch at Age) were formulated for the stock. The results from both models were very similar and neither model was recommended to represent the status of the stock. It was concluded that yellowtail snapper was not overfished and was not experiencing overfishing (Table 6-5).

Table 6-5: Stock assessment parameters for yellowtail snapper (Muller *et al*. 2003).

Parameter	ICA Model	Fleet-Specific Model	Notes	Status
F_{2001}	0.19	0.24		
F_{MSY}	0.33	0.33		
F_{OY}	0.21	0.21		
MSY	946	1,388	Metric Tons	
MSST	2,947	4,288	(1-M)*(B_{MSY}); Metric Tons	
MFMT	0.33	0.33	F_{MSY}	
F_{2001}/MFMT	0.6	0.7		Not Overfishing
SSB_{2001}/B_{MSST}	1.5	1.2		Not Overfished

6.1.5 Goliath Grouper

Goliath grouper was assessed at the sixth SEDAR workshop (SEDAR 6-SAR1 2004). The base model used in the assessment assumed that the fishing mortality rate was nearly zero in 1950, increased linearly through 1979, was relatively constant during 1980 to 1989, and dropped off to near zero in 1990 due to the fishing moratorium. Numerous sensitivity runs were conducted for the assessment. However, none of these runs resulted in significant departures from the base run, with the exception of one run that removed the Everglades National Park (ENP) index from the analysis.

SEDAR 6-SAR1 2004) recommended that the base run be used for managing the U.S. goliath grouper population. It was stressed that the results focused on the Ten Thousand Islands Area, a relatively small portion of the range of goliath grouper that is considered the center of abundance (SEDAR 6-SAR1 2004). The assessment indicated that goliath grouper remained overfished; however, it was not experiencing overfishing and the stock was rebuilding. The SSC and Review Workshop indicated that estimates of biomass and fishing mortality rates were not reliable and that the moratorium on fishing should remain in effect until better data became available to further assess the condition of the stock.

6.1.6 Hogfish

The hogfish assessment was conducted under contract to the State of Florida (SEDAR 6-SAR2 2004). It was reviewed by SEDAR because the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council manage hogfish. The SEDAR Review Panel did not find a solid basis for accepting the quantitative assessment and had further

reservations that, even if the problems with the assessment were corrected, the model was still limited in its geographic application to the Florida Keys.

6.1.7 Snowy Grouper

The data workshop convened in Charleston, SC during the week of November 3, 2003 to examine data from eight deep-water species for assessment purposes. The group determined that data were adequate to conduct assessments on snowy grouper and tilefish. Four indices were available for snowy grouper including a logbook index, headboat index, MARMAP trap index, and MARMAP short longline index. The assessment workshop chose not to use the logbook index for snowy grouper due to reasons listed below. Commercial and recreation landings as well as life history information from fishery-independent and fishery-dependent sources were used in the assessment.

A statistical catch-at-age model and a production model were used to assess the snowy grouper population (SEDAR 4 2004). The population was determined to be overfished and experiencing overfishing (Table 6-6). In the absence of fishing it was determined that it would take 13 years to rebuild the stock to SSBmsy. The maximum rebuilding time is 34 years based on the formula: T_{MIN} (13 years) + one generation time (21 years).

Table 6-6: Stock assessment parameters for snowy grouper (SEDAR 4 2004).

Parameter	Value	Notes	Status
E_{MSY}	0.037	Median estimate under current gear pattern $_M$. E=exploitation rate, the fraction of fish by number taking during one year of fishing. E=C/N, where C=catch in a fishing year and N=number of fish at beginning of year.	
$E_{30\%}$	0.046		
$E_{40\%}$	0.035		
B_{MSY}	2,481	Median value in metric tons	
SSB_{MSY}	2,116	Median value in metric tons	
MSST	1,587	0.75*SSB_{MSY} (metric tons)	
SSB_{2002}/ SSB_{virgin}	0.05		Overfished
E_{2002}/E_{MSY}	3.11		Overfishing
SSB_{2002}/ SSB_{MSY}	0.18	Median value	Reduction Needed
Reduction Needed	68%	Reduction in fishing pressure needed to end overfishing	
Rebuilding Projection	13 years	If no fishing, population will recover to SSB_{MSY} in 13 years based on 2002 data.	

6.1.8 Tilefish

There were two indices of abundance available for the tilefish stock assessment (SEDAR 4 2004). A fishery-independent index was developed from MARMAP horizontal longlines. A fishery-dependent index was developed from commercial logbook data during the data workshop. Commercial and recreation landings as well as life history information from fishery-independent and fishery-dependent sources were used in the assessment.

A statistical catch-at-age model and a production model were used to assess the tilefish population (SEDAR 4 2004). It was determined that this population was not overfished but overfishing was occurring (Table 6-7).

Table 6-7: Stock assessment parameters for tilefish (golden) (SEDAR 4 2004).

Parameter	Value	Notes	Status
E_{MSY}	0.035 per year	Median estimate using average E among three% fisheries for 1999-2002 and their respective selectivity patterns. E=exploitation rate, the fraction of fish by number taking during one year of fishing. E=C/N, where C=catch in a fishing year	
$E_{30\%}$	0.047	Based on ages 1+ Y %	
$E_{40\%}$	0.035	Based on ages 1+ Y %	
B_{MSY}	2,611.4	Median value in metric tons	
SSB_{MSY}	879.4	Median value in metric tons	
$MSST_{MSY}$	659.6	$0.75*SSB_{MSY}$ (metric tons) Based on ages 1+	
E_{2002}/E_{MSY}	1.55	Median value	Overfishing
SSB_{2002}/SSB_{MSY}	0.95	Median value	
SSB_{2002}/ MSST	1.27		Not Overfished
Reduction Needed	35%	Reduction in fishing pressure needed to end overfishing.	Reduction Needed
Rebuilding Projection	1 year	If no fishing, population will recover to SSB_{MSY} in 1 year based on 2002 data.	

6.2 MARMAP

6.2.1 Recent MARMAP Reports

For 33 years, the Marine Resources Research Institute (MRRI) at the South Carolina Department of Natural Resources (SCDNR), through the Marine Resources Monitoring, Assessment, and Prediction (MARMAP) program, has conducted fisheries-independent research on groundfish, reef fish, ichthyoplankton, and coastal pelagic fishes within the region between Cape Lookout, North Carolina, and Cape Canaveral, Florida. The overall mission of the program has been to determine distribution, relative abundance, and critical habitat of

economically and ecologically important fishes of the South Atlantic Bight (SAB), and to relate these features to environmental factors and exploitation activities.

Each year, MARMAP produces a report on trends in relative abundance of red porgy, vermilion snapper, black sea bass, white grunt, gray triggerfish, tilefish, and blueline tilefish that are monitored with standard gear types including traps and longline

6.2.1.1 MARMAP 2004 Status of Stocks Report

During 2004, 262 of 495 randomly stations from Cape Lookout, NC to Fort Pierce, FL were sampled with chevron traps (Harris and Machowski 2004 – available in Snapper Grouper SAFE report download). From 1993 to 1999, CPUE of black sea bass increased from 9.9 to 19.7 fish caught per hour. Since 1999, CPUE declined steadily to an all time low of 5.87 fish caught per hour in 2003, followed by an increase to 13.25 fish per hour in 2004. The mean length of black sea bass declined through 1988 followed by a gradual increase from 22.1 cm FL in 1988 to 23.5 cm FL in 2000 due to an increase in larger fish being caught. Although mean length declined slightly in 2001 and 2002, the mean length recorded for black sea bass in 2004 (24.7 cm TL) was larger than that recorded for 2003 (24.1 cm TL), which in turn, was the largest recorded since 1983.

CPUE of red porgy taken at depths > 25 m on the southeast continental shelf declined during 1983 through 1989 in Florida Traps (Figure 3a; (Harris and Machowski 2004 – available in Snapper Grouper SAFE report download)) and 1988 to 1997 in chevron traps. Since 1997, CPUE has increased from 0.94 to 2.27 fish caught per hour but declined in 2003 to the lowest value recorded since 1988 (0.84 fish per trap hour), followed by an increase in 2004 to 2.38 fish per trap hour. The mean length of red porgy declined through 1988 and then increased from an average of 24.3 cm FL in 1988 to 29.3 cm FL in 2001. Although the mean length in 2004 decreased to 28.5 cm FL, it appears to have been steady with some variability around 29 cm FL since 1999. The decline in mean length during 1995 was due to good recruitment of fish that were probably spawned during 1993. With the exception of 1995, recruitment appears to have been poor during the 1990's and 2000's. The length frequency of red porgy for 2004 suggests very few small (< 23 cm) fish were sampled, and the last year demonstrating good recruitment was 1996 (Figure 6; (Harris and Machowski 2004 – available in Snapper Grouper SAFE report download)).

The CPUE of vermilion snapper caught from 26 to 55 m declined during 1983-1987 in Florida traps and declined during 1988-1990 in chevron traps. There was a slight increase in CPUE during 1994-1996 from 5.8 to 6.2 fish caught per hour followed by a decrease to 2.2 fish caught per hour in 1999. Since 1999, CPUE has increased to 4.7 fish caught per hour although there was a sharp decrease in 2003 to 0.35 fish per trap hour, the lowest value recorded since 1988. The mean length of vermilion snapper showed a significant decrease from 1983 to 1992. The mean length increased from 21.2 cm FL in 1992 to 26.6 cm FL in 2000. Since 2000, the mean length of vermilion snapper sampled with chevron traps has decreased to 25.1 cm FL, but showed an increase again in 2003, but was followed by a decline in 2004. The mean length of vermilion snapper may also have stabilized with variability around 26 cm FL.

Gray triggerfish CPUE (26 to 55 m) increased from 0.1 fish caught per hour in 1988 to 2.4 fish caught per hour in 1996 followed by a decline to 0.51 in 1999. Since 1999, CPUE has increased to 1.3 fish caught per hour, declined sharply in 2003 to 0.07 fish per trap hour, and increased to 0.51 fish per trap hour in 2004. The CPUE of white grunt increased from 0.08 fish caught per hour in 1988 to 1.15 in 1992. Since 1992, the CPUE decreased, with some

fluctuation, to 0.15 fish caught per hour in 2000. The CPUE rose to 0.56 fish caught per hour in 2001, but decreased to 0.35 fish per trap hour in 2003, followed by an increase to the second highest recorded catch per unit of effort of 1.17 fish per hour in 2004. White grunt and gray triggerfish decreased in mean length from 1983 to 1990 when very few individuals were caught in trapping gear (Figures 8, 9; (Harris and Machowski 2004 – available in Snapper Grouper SAFE report download). In 2004, both white grunt and triggerfish showed a decrease in mean length compared to previous years, which may reflect the increase in smaller fish sampled this year.

6.2.1.2 Life History of Greater Amberjack

2,729 amberjack were sampled (MARMAP 2004a). Samples were collected from 24°N to 34°N, encompassing almost the entire range of greater amberjack off the southeastern United States. The vast majority of the samples were obtained by fishery-dependent sampling (n=2,695). The mean age of all fish aged was 3.98 years old (±1.66; range 0-13; Figure 4a, MARMAP 2004a), while the mean age of males was 3.87 (±1.61; range 0-13, n=583) and females was 4.01 (±1.68; range 0-13, n=816; Figure 4b, MARMAP 2004a). There were no significant differences between the mean ages of male and female greater amberjack, or between the age frequency distributions of male and female amberjack. Otolith weight was a reasonably precise predictor of age. Sexual dimorphism was evident in greater amberjack, albeit with females being larger at age than males.

2,537 gonad samples were obtained from the 2,729 fish sampled. Sex and reproductive stage was assigned to 2,517 of these. The overall male:female sex ratio for greater amberjack was 1:1.22, significantly different from a 1:1 ratio, although this appears to be a function of females dominating the larger size classes, where the sex ratio was significantly biased toward females. The smallest mature male was 267 mm FL and the youngest was age 0; the size at 50% maturity was 643 mm FL (age 0.5), and the largest immature male was 771 mm FL (age 3). All males were mature at 795 mm FL and age 3.5. The smallest mature female was 352 mm FL, and the youngest was age 0; the size at 50% maturity was 733 mm FL (age 1.4), and the largest immature female was 826 mm FL, and the oldest was age 4. All females were mature by 865 mm FL and age 4.2.

Based on the occurrence of migratory nucleus oocytes and postovulatory follicles (POFs), spawning occurred from January through June, with peak spawning in April and May. Although fish in spawning condition were captured from North Carolina through the Florida Keys, spawning appears to occur primarily off south Florida and the Florida Keys. Greater amberjack in spawning condition were sampled from a range of depths, although the bulk of samples were from the shelf break. With a spawning season of approximately 60 days off South Florida, an individual female could spawn approximately 12 times.

6.2.1.3 Reproductive Biology of Red Porgy

During 2003, Daniel (2003) completed a study of the reproductive biology of red porgy. Listed below is the abstract from the Master's thesis.

"Red porgy, *Pagrus pagrus*, is a protogynous sparid that is a popular commercial and recreational species found along the Atlantic coast of the southeastern United States. Red porgy were collected from September to July of 1997-2000 from commercial fishermen (hook and line; fishery-dependent) and from May to September of 1995-2000 by Marine Resources Monitoring

Assessment and Prediction (MARMAP) Program (chevron traps; fishery-independent). Additional samples (hook and line; fishery-independent) were collected in February 2000 and March 2001 aboard the R/V Lady Lisa, and data from all hook and line samples (fishery-dependent and fishery-independent) were pooled. Due to the lack of immature fish in hook and line samples, fishery-independent data collected by MARMAP were used for maturity analysis. Size at first maturity occurred at 201-224 mm TL, and age at first maturity occurred at age 0. Size at 50% maturity occurred at 289 mm TL while age at 50% maturity occurred at 1.5 y. The size at maturity was greater during 1995-2000 than during 1979-1981 and 1988-1994. The percentage of males increased as size and age class increased. By size range 351-400 mm TL, 72% of all individuals were males, and by age 9, 100% of all individuals were males. The percentage of males was greater in smaller size classes than during 1978-1981 or 1988-1994. When compared to samples from 1991-1994, mean FL for ages 1-2 had increased, indicating a possible increase of size at age. Specifically, for 1997-2000 mean FL was 237 mm at age 1 and 260 mm at age 2, and or 1991-1994 mean FL was 226 at age 1 and 252 at age 2. The sex ratios of both gear types were significantly different from 1:1. Hook and line samples (fishery-dependent and fishery-independent) exhibited an overall sex ration of 1:1.1 with females accounting for 53% whereas chevron traps (fishery-independent) exhibited an overall sex ratio of 1:0.8 with males accounting for 54%. In the fishery-independent samples, sex ratios were significantly different from 1:1 across the majority of size and age classes. Females dominated in the small and younger age classes whereas males dominated in the larger and older age classes. In addition, 39% of all females showed protogynous sex transition with active spermatogenic tissue exhibiting ventrolateral proliferation in a spent or resting ovary. Size at 50% transition was 377 mm TL, and age at 50% transition was 3.7 yr. The majority of transitionals were found in May-July. There was a much greater percentage of individuals undergoing sexual transition as juveniles than observed during 1977-1983. Spawning season began in mid-November and ended in mid-April, lasting 145 days. Total body weight was the best predictor of batch fecundity. Potential annual fecundity was indeterminate with estimates ranging from 440,944 to 4,061,512 for lengths 305-417 mm TL. In conclusion, the comparison of current life history traits with previous studies supports the SAFMC's (2002) conclusion that red porgy is an overfished population that is not currently undergoing overfishing. The population is showing signs of rebounding since size at maturity and mean size at age are increasing, however, the increased percentage of males at smaller sizes as well as much greater percentage of juvenile protogyny suggests that the population has not recovered."

6.2.1.4 Life History of Vermilion Snapper

In 2003, the MARMAP Project completed an analytical report that updated information on the life history of vermilion snapper (Loefer et al. 2004). The following is and excerpt from the analytical report.

"Observed mean lengths at age were calculated for the three time periods (1988-1990; 1991-1993; 1999-2001). Age classes two through nine had sufficient sample sizes for statistical comparison. None of these increment classes had significantly different variances (Brown-Forsythe, $P > 0.05$ in all cases), so means for each period were compared with the Tukey-Kramer HSD test for comparison of all pairs separately by age class (statistical test results not shown). Mean lengths at age for the1999-2001 group were significantly higher than both pre-regulatory groups for age classes two, three, and four (fig. 3). The postregulatory group was also

significantly higher than at least one of the pre-regulatory 9 groups for classes five, six, and eight. There were no significant differences between any time periods for age classes seven and nine.

Observed mean lengths at age for samples collected in 1999 from fishery independent and fishery dependent sources were compared. Age classes two through eight contained enough samples in both datasets for statistical comparison. Age class three was the only that demonstrated unequal variances between the treatments (Brown-Forsythe test, $n = 167$, $df = 1$, $P = 0.0479$). Age class three was therefore analyzed using the non-parametric Welch ANOVA. All other age classes were analyzed with one-way ANOVA ($P < 0.001$ in all cases). Fishery dependent specimens were significantly larger at every increment class analyzed. Fishery dependent samples also gave higher VBGE estimates of Linf and k.

Only six females out of 3,955 specimens examined from 1988 to 2001 were interpreted as immature. These six specimens ranged from 167 to 195 mm FL. The smallest mature female in the sample was 169 mm FL, and the smallest mature male was 187 mm FL. The small number of immature specimens in the sample ($n = 6$) prevented the calculation of size at 50% maturity estimates. Sex ratios were significantly different from a 1:1 ratio for all years from 1988-1993 and 1998-2001 (chi-square test), and have remained relatively constant since 1988 (fig. 10). Spawning seasonality did not vary substantially between the three periods, so the data were combined to give a more robust estimate of the spawning season. The data showed the highest percentage of spawning females in July, with the highest percentages of spent females in September, and resting females in April.

A comparison of VBGE parameter estimates from the three periods based on observed length at age data indicated the highest Linf the post-regulatory period (1999-2001). In addition, the von Bertalanffy growth curve for the 1999-2001 group indicated a larger size at age for all age groups in relation to either of the pre-regulatory periods. Observed mean lengths at age from the 1999-2001 period were also significantly higher that those of the two pre-regulatory groups for age classes two, three, and four.

Observed mean lengths at age for fishery dependent data from 1999 where higher than those from fishery independent data collected in 1999. The means for fishery dependent data were significantly higher at all age classes with a sufficient sample size for statistical testing. Estimates for Linf for the fishery dependent data was higher than that for the fishery dependent data, both overall and for every age class. Of the analyses previously discussed (mean back-calculated lengths at age, observed mean lengths at age, and von Bertalanffy parameter estimates based on observed data), all suggest increases in size at age in younger age classes in the 1999-2001 data. This may indicate an ongoing recovery of the stock since regulatory actions were first taken to protect this species in 1993.

Vermilion snapper mature rapidly, and the vast majority of individuals are mature before the first annual increment is formed (Zhao and McGovern 1997). Since this species matures at such a small size, very few immature specimens are exposed to most fishing gears, included those used for the collection of the data presented herein. This prevented calculation of L50 estimates from the current data. The percentage of females in spawning condition was at its highest in July, with high values also present in May and June. This is similar to results of previous studies (Cuellar, *et al.,* 1996; Hood and Johnson, 1998)."

6.2.1.5 Life History of Sand Perch

Fishery-independent and fishery-dependent sampling from May 2000 through July 2004 resulted in the capture of 1,132 sand perch (MARMAP 2004b). Of these, 979 sand perch were caught in fishery-independent sampling (MARMAP and SEAMAP), and ranged in length from 72 to 236 mm SL (mean 176.6 mm, standard error (SE) = 0.96). Sand perch collected from fishery-independent sampling were captured between depths of 6 to 47 m and the collection sites were between 27° 26'N and 34° 08'N, and between 75° 21'W and 81° 16'W.

Sex and reproductive stages were assigned to 1,109 specimens. Appearance of both male and female tissue, regardless of maturity, occurred in 950 of specimens, with both mature male and female tissue occurring in 856 specimens. The smallest mature female observed was 117 mm SL with mature male tissue first appearing in a specimen of 106 mm SL. The youngest age at maturity observed was 12 months for female tissue and 5 months for male tissue. Length at 50% maturity for female tissue was estimated as 129.3 mm SL (logistic model, 95% CI = 124.4 – 133.7 mm), and age at 50% maturity for female tissue as 13.6 months (logistic model, 95% CI = 12.3 – 14.5 months). Length at 50% maturity for male tissue was estimated as 122.8 mm SL (logistic model, 95% CI = 118.1 – 126.8 mm), and age at 50% maturity for male tissue as 12.2 months (logistic model, 95% CI = 9.8 – 13.4 months). Length at 100% maturity was 179 mm SL for female tissue and 173 mm SL for male tissue. Age at 100% maturity was 27 months for female tissue and 18 months for male tissue.

Developing or mature testicular tissue, indicating spawning condition of fish as males, was present throughout the year with no distinct peak but an increase in June and July (Fig. 4). Hydrated oocytes, migratory nuclear oocytes, or postovulatory follicles were present from March to January, approximately 337 days, indicating spawning condition of fish as females. No samples were collected from November and December. The only month sampled, which did not show female tissue in spawning condition, was February. There was a peak of spawning in May with the highest percentage of resting females in September and spent females in February (Fig. 5). The spawning frequency as a female was 2.98 days. Sand perch spawn as females an average of 113 times throughout the spawning season. Otoliths were obtained from 1,131 specimens. The age of fish ranged from 0 to 8 years old with a mean of 2.3 years.

6.2.1.6 Wreckfish reproductive biology

Otoliths and reproductive tissue were obtained during 1989-97 and 2000-02, primarily from specimens (n = 1617) landed in Charleston, South Carolina, by commercial fishermen that fished on a complex bottom feature of great topographic relief (100+ m) known as the Charleston Bump (Wyanski and Meister 2002). Specimens from the Azores (n = 38), Madeira (n = 5), Bermuda (n = 5), and the Bahamas (n = 1) were also sampled. The life history of wreckfish in the western North Atlantic has not been thoroughly described because, except for the Bermuda fishery, wreckfish were rarely encountered in this region prior to 1987. All reproductive tissue samples were processed histologically and potential annual fecundity was estimated for 98 specimens. The overall sex ratio for wreckfish was significantly different from 1:1 in samples from both periods, 1989-93 and 2000-02. Males were smaller than females in three data sets. Females were predominant in fishery-dependent samples from 1989-93 (median TL = 1005 mm), whereas males were predominant in fishery-independent samples from 1989-93 (median TL = 983 mm) and fishery-dependent samples from 2000-02 (median TL = 985 mm). Median TL was smaller in samples where males predominated. Mature gonads were present in 60% of females at 751-800 mm, 57% at 801-850 mm, and 100% at larger sizes. The estimate of L_{50} was

790 mm (gompit model; 95% CI = 733-820). Mature gonads were present in 40% of males at 651-800 mm and 100% at larger sizes. L_{50} was not estimated because transition to maturity was abrupt. Based on the presence of hydrated oocytes and POFs, female wreckfish spawned from December through May, with a peak during February and March. The relationships between total fecundity and total length, fork length, whole body weight, and ovary-free body weight were highly significant. Wreckfish have determinate fecundity, as early stages of yolked oocytes were absent at the beginning of the spawning season. Annual fecundity estimates, uncorrected for atresia, for wreckfish 933-1280 mm ranged from 1,397,500 to 4,114,200 stage-3 yolked oocytes.

6.2.2 Recent MARMAP Peer-Reviewed Publications

6.2.2.1 Red Snapper

During 2004, a paper was accepted for publication on the life history of red snapper taken along the southeast coast of the United States (White and Palmer 2004). The abstract from that publication is listed below.

"Otoliths and gonadal tissue were taken from red snapper collected from fishery-independent and fishery-dependent sources between Cape Lookout, North Carolina and Key West, Florida during 1979-2000. The mean size of red snapper from fishery-dependent samples was 594 mm TL and ranged from 70-976 mm TL. Fish sampled with fishery-independent gear had a significantly smaller mean TL (426 mm, range = 121-866 mm) than fishery-dependent samples. The mean size of red snapper was significantly smaller in the 1980s when compared to the 1990s, regardless of gear type. Mean marginal increment analysis showed that opaque zone formation is annual with deposition occurring from June through August. The age range for fishery-independent samples was 1-22 years with a mean age of 3.1 years, and 1-45 years with a mean age of 4.2 years for fishery-dependent samples. Von Bertalanffy growth curves revealed that red snapper from commercial catches approach asymptotic size at around age 10, however, no asymptote is apparent for those fish sampled with fishery-independent gear. The overall sex ratio for red snapper was not significantly different from the expected 1:1, regardless of gear type. The smallest mature female was 287 mm TL and the largest immature female was 435 mm TL, with an estimate of length at 50% maturity (L_{50}) of 378 mm TL. The smallest mature male was 200 mm TL and the largest immature male was 378 mm TL, with an L_{50} for males of 223 mm TL. Histological examination of the gonads indicated that female red snapper were in spawning condition from May through October, with a peak between June and September. The gonadosomatic index (GSI) for females ranged from a low of 0.35 in November & December to a high of 2.67 in June. Males were found to be in spawning condition throughout the year."

6.2.2.2 Tilefish

During 2004, a report on the age, growth, and reproduction of tilefish was submitted to the SEDAR 4 Data Workshop (Palmer *et al*. 2004).

6.2.2.3 Gag Tagging Study

During 2004, a manuscript was accepted for publication on tagging of gag (McGovern *et al*. 2005). Listed below if the abstract for that publication.

"During 1995-1999, 3,876 gag, *Mycteroperca microlepis* (Goode and Bean), were tagged off the southeastern United States from North Carolina to southern Florida, primarily from commercial fishing vessels. Prior to release, the swim bladder of tagged fish was deflated with a 16-gauge hypodermic needle. Approximately 11% of the tagged fishes were recaptured. Many gag (36%) moved less than 2 km, however, 23% of the recaptured gag moved greater than 185 km. Most of the gag that moved greater than 185 km were tagged off South Carolina and recaptured off Georgia, Florida, and in the Gulf of Mexico. Gag tagged at depths of 20-40 m showed the greatest degree of movement while gag tagged in deeper water appeared to be relatively sedentary. Recapture rate was greatest for gag tagged off southern Florida and gag tagged off Georgia and Florida were generally recaptured near the same area that they were tagged. Recapture rate declined with increasing depth of capture of tagged fish. Depth-related mortality of degassed fish was estimated to range from 14% at 15 m to 95% at 95 m. Recapture data from 1996-1997 for gag tagged in 1996 provided an estimate of fishing mortality = 0.27. The length of gag tagged was related to depth with significantly larger individuals occurring in water deeper than 35 m. It was estimated that 3.6% of the gag tagged during 1995-1999 were male. The mean length of gag tagged and depth of capture was greatest during the gag spawning season (February-April) suggesting that commercial fishermen may have targeted spawning aggregations."

6.2.2.4 Spawning locations for Atlantic Reef Fishes

During 2004, a manuscript was accepted for publication on reef fish spawning condition (Sedberry et al. In Press). Spawning condition was determined for 28 species of reef fish representing 11 families (Balistidae, Berycidae, Carangidae, Centrolophidae, Haemulidae, Lutjanidae, Malacanthidae, Polyprionidae, Scorpaenidae, Serranidae, Sparidae) collected off the Carolinas, Georgia, and east coast of Florida (including the Keys) in depths from 1 - 686 m. The presence of migratory-nucleus oocytes, hydrated oocytes, and/or postovulatory follicles was used to indicate imminent or very recent spawning, and locations of capture of fishes in spawning condition were mapped using GIS. Reproductive behavior was observed from submersible for a few species. Most fishes were collected from fishery-independent sampling, with time and location of collection accurately recorded. Some specimens were sampled from fishery landings, and time and location data were approximate. Samples came from all months and throughout the region, but sampling effort was not equally distributed and was concentrated from May through September and in the middle of the region (South Carolina and Georgia). In spite of some temporal and spatial sampling limitations, we determined that several species such as small serranids, haemulids, sparids, and lutjanids spawn over protracted periods and throughout the region. Other species such as *Helicolenus dactylopterus, Caulolatilus microps, Epinephelus niveatus, Lopholatilus chamaeleonticeps, Hyperoglyphe perciformis* and *Polyprion americanus* have specific habitat requirements and live and spawn in very restricted areas. Several species (*Mycteroperca microlepis, M. phenax*) appear to spawn at specific shelf-edge reef sites (50 - 100 m depth), and tagging indicated they may undertake migrations to those specific sites during the spawning season. Some of the shelf-edge sites are utilized by several species, including some with moderately protracted spawning seasons that peak during winter or summer months. These sites may be in nearly continuous use by spawning fishes year-round, and should be considered no-take MPAs, to protect spawning adults.

6.2.3 Recently Funded Studies on Reef Fishes

6.2.3.1 MARFIN Studies

6.2.3.1.1 2003 Report

6.2.3.1.2 2004 Report

6.2.3.2 CRP Studies on Reef Fishes 2004

7 MANAGEMENT MEASURE ANALYSES

7.1 Shallow Water Grouper Unit 1A

The South Atlantic Fishery Management Council (SAFMC) requested analyses for Shallow Water Grouper Unit 1A to determine what effect changes to the recreational bag limit and commercial spawning season closure will have on reducing harvest (Shallow Water Grouper Report). No reduction in harvest is necessary and the SAFMC has not specified a target harvest reduction for this unit. This report examines the effects of:

1) reducing the aggregate grouper bag limit from five to one,
2) reducing the aggregate bag limit for gag and black grouper from two to one,

Reducing the existing five grouper aggregate from 5 fish to 1 fish for the whole year would provide a 6.5% reduction in harvest. If the 1 fish bag limit were put into place for only March-April, a 1.1% reduction in harvest would be attained. Reducing the bag limit from 5 fish to 3 fish for 12 months would reduce harvest by 1.8%. If the 3 fish bag limit were restricted to 10 months, the reduction in harvest would be 1.5%. The combined reduction provided by a 1 fish bag limit during the March-April commercial closure and a 3 fish bag limit during the rest of the year would be 2.6%. Extending the March-April spawning season closure to all species in Shallow Water Grouper Unit 1A caught by recreational fishermen would reduce harvest in the recreational fishery by 15.7%.

7.2 Deep Water Grouper Unit 2A

Rebuilding projections based on the SEDAR 4 (2004) stock assessment were conducted by the SEFSC population dynamics team to determine the reduction in harvest needed to end overfishing and rebuild the stock to SSBmsy. In the absence of fishing, it would require 13 years (Tmin) for snowy grouper to rebuild to SSBmsy. Using a generation time of 21 years, the maximum allowable time (Tmax) to rebuild the snowy grouper to SSBmsy is Tmin + 1 generation time (34 years). Based on a start time of 2006, the stock would rebuild to SSBmsy in 2040 under Tmax.

Two rebuilding projections were computed, a constant fishing mortality and a constant catch. Under the constant fishing mortality rebuilding projection a reduction of 68% will be needed to end overfishing and rebuild the stock to SSBmsy by 2040. The constant catch scenario is not considered here since it allows overfishing to continue for 12 years while the stock rebuilds.

Snowy grouper spawn during April through September off the southeast coast of the United States (Wyanski *et al*. 2000). An April-September closure would provide a 60.5% reduction in commercial harvest and a May-August closure would provide a 44.1% reduction in harvest. A trip limit of 115 lbs whole weight (97 lbs gutted weight) would reduce harvest by 70%. A May through August spawning season closure would provide a 44% reduction in commercial harvest. To obtain the harvest reduction to end overfishing, an additional 27% reduction in harvest would be provided by a trip limit of 700 lbs whole weight (Snowy Grouper Report).

7.3 Deep Water Grouper Unit 2B

Analyses in SEDAR 4 (2004) indicate tilefish is not overfished; however, a 35% reduction in harvest is needed to end overfishing. The Council has selected several different management alternatives to end overfishing including a seasonal closure, trip limit, combination of a seasonal closure/trip limit, and an annual quota.

Off the southeast coast of the United State, tilefish spawn during March through July with peak spawning in April (Palmer *et al*. 2004). A May through August closure would reduce harvest by 39%. Based on data from 1999-2003, a trip limit of 1,600 to 1,700 lbs whole weight would reduce harvest by 35% (Tilefish Report).

7.4 Mid-Shelf Snapper Unit 4

The South Atlantic Fishery Management Council requested that a variety of options be examined to provide up to a 31% reduction in catch of vermilion snapper (Vermilion Snapper Report). This report examines the effects of:

1) a commercial trip limit that would provide a 10, 20, and 31% reduction in catch,
2) a commercial size limit,
3) a recreational bag limit,
4) a recreational size limit,
5) a spawning season closure, and
6) various combinations of the first five measures.

Management measures that are currently in place for species in Mid-Shelf Snapper Unit 4 include an aggregate bag limit of 10 snapper (not including vermilion snapper) with a maximum of 2 red snapper, a 10 fish bag limit for vermilion snapper outside the 10 snapper aggregate, an 11-inch TL minimum size for vermilion snapper caught by recreational fishermen, a 12-inch TL minimum size for vermilion snapper taken by commercial fishermen, a 20-inch TL minimum size for red snapper (commercial and recreational), and a 12-inch TL minimum size (commercial and recreational) for black snapper, blackfin snapper, and silk snapper.

Mid-Shelf Snapper Unit 4 includes vermilion snapper, silk snapper, red snapper, black snapper, and blackfin snapper. The Council indicated proposed management measures would apply to only vermilion snapper, with the exception of the spawning season closure, which would apply to all species in Mid Shelf Snapper Unit 4. Data from 1999-2003 were used to determine the required reductions. A wide range (0-40%) of release mortality rates was considered. The SEDAR data workshop for vermilion snapper recommended 25% release mortality for recreational fisheries, and 40% release mortality for the commercial fishery (SEDAR 2003a).

7.4.1 Recreational Fishery

In the recreational fishery (private/charterboat (MRFSS) and headboat combined), a bag limit of 2 fish per person would be needed to achieve at least a 31% reduction (38% reduction) if release mortality is 25% (Table 7-1). An increase in the minimum size from 11 to 13 inches TL would be necessary to achieve greater than a 31% reduction, regardless of the release mortality. When size and bag limits are combined, a 32% reduction in harvest could be attained with a 12 inch TL minimum size and a 6 fish bag limit with a release mortality rate of 25%. These would provide at least a 31% reduction in recreational harvest of vermilion snapper for different release mortality rates.

Table 7-1. Vermilion snapper recreational management measures.

Management	25% release mortality
Bag limit (Table 3)	3 fish limit (33%)
Size limit (Table 6)	13 inch limit (43%)
Bag/size limit (Table 7)	6 fish/12 in (32%)
June-July Closure (Table 12)	26%

7.4.2 Commercial Fishery

In the commercial fishery, a trip limit of 800 lbs would provide a 31% reduction if the current size limit is retained and there is no spawning season closure (Table 7-2). An increase in the size limit from 12 to 14 inches TL would be required to obtain at least a 31% reduction if release mortality is 25%. However, if release mortality were assumed to be 40%, then a 15-inch TL minimum size would be needed.

A combination of a 1,200 lb trip limit and a 13-inch TL minimum size would provide a 32% reduction in harvest if release mortality is 25%, whereas, a 1,100 lbs trip limit and a 13 inch TL minimum size would be needed to provide a 31% reduction if release mortality is 40% (Table 7-2).

A three-month spawning season closure (from June through August) would provide a 28% reduction in harvest. A four-month closure from May through August would provide a 37% reduction. If release mortality is assumed as 40%, a reduction of 31% can be achieved with the combination of a two-month closure and a 13-inch TL minimum size (Table 7-2). A 32% reduction could be achieved through a two-month spawning season closure and a 1,500 lb trip limit, or a three-month spawning season closure and a 3,750 lbs trip limit.

Table 7-2. Vermilion snapper commercial management measures.
These would provide at least a 31% reduction in commercial harvest of vermilion snapper for different release mortality rates.

Release Mortality	40%
Size limit (Table 9)	15 inches (34%)
Size/trip limit (31%; Table 10)	13 inches; 1,100 lbs
Size limit/spawning season closure (Table 13)	13 inches: June-July or July-Aug closure (31%)
Trip Limit (Table 8)	800 pounds (31%)
Spawning season closure (Table 11)	May-August (37%)
Spawning season closure/trip limit combination (Table 14)	June-July or July-August closure and 1,500 lbs (31%)

7.5 Triggerfish and Spadefish Unit 5

The South Atlantic Fishery Management Council requested several options be examined to reduce harvest of species in the Triggerfish and Spadefish Unit 5 (Triggerfish Report). This report examines the effects of:

1) a recreational size limit;

2) a commercial size limit;
3) a bag limit; and
4) combinations of size and bag limits.

This unit includes gray triggerfish, ocean triggerfish, and Atlantic spadefish. A wide range (0-40%) of release mortality rates was considered. Given that a 6% return rate was obtained for gray triggerfish in the MARMAP tagging program, release mortality might be fairly low. Release mortality of Atlantic spadefish is also probably low, since most individuals are caught in shallow water. Queen triggerfish is being considered for removal from the unit and data are not available for ocean triggerfish.

7.5.1 Gray Triggerfish

When private/charterboat (MRFSS) and Headboat data are combined for gray triggerfish, an 12 inch TL minimum size would provide at least a 7% reduction if release mortality is 40% or less (Table 7-3). The mean size of gray triggerfish caught by commercial fishermen during 1999-2003 was 15.8 inches TL. A minimum size of 13 inches TL would be required to obtain a 7% decrease in the commercial harvest of gray triggerfish with release mortality up to 30% (Table 7-4).

Table 7-3. Gray triggerfish recreational fishing mortality by size.
Estimate (percent) of combined headboat and MRFSS fishing mortality of gray triggerfish under various size limits, using data from 1999-2003.

Release Mortality	10 inches	11 inches	12 inches	13 inches
0.00	0.7	4.2	12.6	26.4
0.10	0.6	3.8	11.4	23.7
0.15	0.6	3.6	10.7	22.4
0.20	0.5	3.4	10.1	21.1
0.30	0.5	3.0	8.8	18.5
0.40	0.4	2.5	7.6	15.8

Table 7-4. Gray triggerfish commercial fishing mortality by size.
Estimate (percent) of commercial fishing mortality of gray triggerfish under various size limits, using data from 1999-2003.

Release Mortality	11 inches	12 inches	13 inches	14 inches
0.00	1.6	4.8	10.4	23.9
0.10	1.4	4.3	9.3	21.5
0.15	1.3	4.1	8.8	20.3
0.20	1.3	3.8	8.3	19.1
0.30	1.1	3.3	7.3	16.7
0.40	0.9	2.9	6.2	14.3

7.5.2 Atlantic spadefish

A 7% reduction in Atlantic spadefish recreational harvest would be achieved with a 7-inch size limit and a bag limit of 7 fish, if release mortality were 15% or 20% (Table 7-5).

Table 7-5. Effects of bag and size limits on Atlantic spadefish recreational harvest.
Percent reductions in recreational harvest under different combinations of bag and size limits.
Release mortality =15%.

Min Size	limit 7	6 fish	5 fish	4 fish	3 fish	2 fish	1 fish
7 inches	7.3	9.3	11.6	15.1	20.7	28.1	39.4
8 inches	20.9	22.6	24.5	27.5	32.3	38.6	48.3
9 inches	34.4	35.9	37.5	40.0	43.9	49.2	57.1
10 inches	41.0	42.3	43.7	46.0	49.5	54.2	61.4

The average size of Atlantic spadefish caught by commercial fishermen during 1999-2003 was 9.7 inches TL. A 7-inch TL minimum size would provide greater than a 7% reduction in harvest in the commercial fishery (Table 7-6).

Table 7-6. Effects of size limits on Atlantic spadefish commercial harvest.
Estimate (percent) of fishing mortality of Atlantic spadefish for the commercial fishery under various size limits, using data from 1999-2003.

Release Mortality	6 inches	7 inches	8 inches	9 inches	10 inches
0	0.0	19.2	44.7	54.6	62.7
0.1	0.0	17.3	40.2	49.2	55.7
0.15	0.0	16.4	38.0	46.4	55.5
0.2	0.0	15.4	35.7	43.7	48.6
0.3	0.0	13.5	31.3	38.2	41.6
0.4	0.0	11.5	26.8	32.8	34.6

7.6 Grunt and Porgy Unit 7A

In December 2003, the Council adopted a constant F rebuilding strategy (including discards) that was provided by the Southeast Fisheries Science Center, which would allow directed catches to be increased to an average of 280,722 lbs whole weight during 2005-2007 (Red Porgy Report). This represents a 109% increase over average landings (Accumulative Landings System, MRFSS, Headboat) during 2001-2003. The Council requested analyses to determine

1) the allowable increase in the commercial trip limit (in numbers rather than weight),
2) a reduction in the length of the spawning season closure, and
3) the allowable increase in the recreational bag limit.

Currently, the commercial trip limit for red porgy is 50 lbs, the commercial fishery is closed from January through April, and the recreational bag limit is one fish per person per day. The average landings (ALS, headboat, and MRFSS) of red porgy from commercial and recreational fishermen during 2000-2003 were 134,046 pounds whole weight. The allowable catch from the rebuilding projection is 280,722 pounds whole weight. Commercial catch during

2000-2003 represented 47% of the total. Therefore, the allowable commercial catch is 131,811 pounds whole weight (126,741 pounds gutted weight), which is a 109% increase over the current harvest.

To determine the increase in the commercial trip limit, it was assumed that if reported landings were less than 50 lbs then landings were retained and not changed. If reported landings were greater than 50 pounds, but less than or equal to the new trip limit, then landings were set equal to the new trip limit. If landings exceeded the new trip limit then landings were retained and not changed. Landings were retained and not adjusted for trips reporting landings during January through April. Based on these assumptions, it is estimated that a trip limit of 220 pounds or 120 fish would increase the commercial harvest by 109%.

7.7 Grunt and Porgy Unit 7B (Grunt and Porgy Report)

Grunt and Porgy Unit 7B includes white grunt, porkfish, margate, black margate, tomtate, bluestriped grunt, French grunt, Spanish grunt, smallmouth grunt, cottonwick, sailor's choice, grass porgy, jolthead porgy, saucereye porgy, whitebone porgy, knobbed porgy, longspine porgy, scup, and sheepshead. The grunts (Family Haemulidae) and porgies (Family Sparidae) are grouped together due to ecological similarities in habitat and food preferences. An assessment of white grunt by SEDAR is scheduled for 2008. The Council identified white grunt as the indicator species for this unit, because it is the species with the best data to make an informed judgment on status. Sheepshead dominated landings in this group (67%) during 1999-2003 followed by white grunt and unclassified grunts (19.8%).

Based on information from Potts and Brennan (2001), white grunt would not be considered to be undergoing overfishing, or overfished. However, based on data from NMFS (1999) white grunt would be experiencing overfishing.

The Council requested several management options be explored to reduce harvest of species in this unit. The Council indicated that management measures apply to all species for which data are available. The Council also charged that management measures should consider regional differences in length. Preliminary analyses indicated that there were regional differences in the lengths of white grunt and knobbed porgy, with smaller individuals landed off Florida than off Georgia, South Carolina, and North Carolina. Management measures considered by the Council to reduce in harvest included:

1) a commercial size limit for white grunt, and sheepshead;
2) a recreational size limit for white grunt, and sheepshead; and
3) a recreational bag limit for sheepshead and the white grunt, knobbed porgy, and black margate aggregate.

This report describes the effect of these management measures on the reduction in harvest of white grunt and other species in Grunt and Porgy Unit 7B.

7.8 Sea Bass Unit 8

The most recent assessment update of black sea bass in the South Atlantic indicated that the stock is undergoing overfishing and is overfished. The South Atlantic Fishery Management Council (Council) requested a variety of management options be examined to end overfishing and rebuild the stock to Bmsy.

The following options were considered in this report:

1) a commercial pot limit;

2) a commercial size limit;
3) recreational size and bag limits;
4) increasing the minimum mesh size for sea bass pots;
5) commercial trip limits; and a
6) commercial black sea bass pot seasonal closure.
7) annual commercial quota

Harvest reductions were based on data from 2000-2003. Data from 1999 were not used, because the size limit for black sea bass was increased in February 1999. The SEDAR assessment workshop recommended 15% release mortality for black sea bass, with a range of 10-20%. A wide range (0-20%) of release mortality rates was considered in this report.

Assuming a 15% release mortality rate, a recreational size limit of 11 inches would provide a reduction of 23% and a 12-inch size limit would provide a reduction of 45%. A 10 fish bag limit and a 12 inch minimum size would provide a 46% reduction. An 11-inch size limit used in conjunction with 2-inch mesh in the pots would provide a 22.5% reduction. The report also provides estimates of reduction obtained through trip limits, pot limits, and bringing in traps each day (Black Sea Bass Report).

8 SOCIO-ECONOMIC INFORMATION

8.1 Short-Term Economic Effects of Proposed 13B Management Measures

Waters and Perusso (2005) prepared a report entitled "Short-Term Economic Effects of Management Alternatives Proposed for the Commercial Fishery in Snapper-Grouper Amendment 13B". The "Introduction" section of this report appears below.

Introduction

This report presents the results of a simulation model developed to analyze the short-term economic effects of management alternatives proposed in Amendment 13B for the commercial snapper-grouper fishery in U.S. south Atlantic waters from North Carolina through the Florida Keys. The model uses logbook trip reports that were submitted by fishermen between 2001 and 2003 to simulate the short-term economic effects of proposed management alternatives on catches of species in 10 management sub-units within the snapper-grouper fishery, including shallow water groupers, deep water groupers, tilefishes, shallow water snappers, mid-shelf snappers, triggerfishes and spadefish, jacks, red porgy, grunts and other porgies, and sea basses. The simulated fishing incomes net of trip costs for specific combinations of management alternatives were compared to historical averages for 2001-2003 to estimate the expected short-term economic effects of the proposed alternatives for commercial fishermen.

8.2 Trip-Level Cost Function Estimation for the S. Atlantic Snapper Grouper Fishery

Perusso and Waters (2005) prepared a report entitled "Trip-Level Cost Function Estimation for the South Atlantic Snapper-Grouper Commercial Fishery". The "Introduction" and "Conclusions and Future Work" sections of this report appear below.

Introduction

This report documents the data and methodology that were used to specify and estimate trip-level cost equations from a sample of south Atlantic snapper-grouper (SASG) commercial trips in 2002-03. Estimated parameters were subsequently used in a simulation model to predict trip costs for each trip in the SASG logbook database from 2001-03. The model was then employed to analyze the short-term effects of management alternatives proposed in Amendment 13B for the commercial snapper grouper fishery in U.S. South Atlantic waters from North Carolina through the Florida Keys.

Conclusions and Future Work

Cost functions were estimated using ordinary least squares for five different gear categories (i.e., vertical lines, longlines, traps, diving, and other gears) using reported trip-level costs from an economic add-on survey to the south Atlantic snapper-grouper logbook program. Although spatial differences exist within gear categories, area stratifications were not employed as model utility was inversely related to finer spatial resolutions. Specification procedures led to a logarithmic transformation to correct for heteroscedasticity while maintaining a relatively parsimonious model. The estimated equations will be used in a simulation model to predict the economic effects associated with regulations proposed in Amendment 13B of the south Atlantic snapper-grouper fishery management plan.

In general, each model fit the data reasonably well. The R^2 sample statistic ranged from 0.49 to 0.79 suggesting that quite a bit of sample variation in trip costs can be explained by the specified cost equations. Global F tests for each gear category indicated that models were useful

for predicting trip costs. Individual parameter estimates were significant at relatively high levels after adjusting for inflated Type I errors. All but one estimate (total pounds in the other gears model) was positive supporting the contention that increases in effort levels increase trip costs. Only one parameter estimate (days in the diving model) had to be restricted to one in order to produce reasonable cost estimates. Initial runs in the simulation model suggested that the model is useful for predicting trip costs outside of the original sample.

Although the results of the cost function estimation were relatively successful, the analysis could be improved. Most importantly, the data set is longitudinal in nature as a panel of vessels is tracked during the fishing year. Controlling for individual vessel effects could have a significant impact on estimated parameters. Since many vessels in the general logbook population were not sampled for economic information, a random effects panel data model would need to be employed.

8.3 Ethnographic Evaluation of A Coastal Southeastern U.S. Fishing Community

Dr. Kathi Kitner of the South Atlantic Fishery Management Council prepared a final report in 2001 entitled "Ethnographic Social Network Tracing US Bureau of the Census, National Marine Fisheries Service, South Atlantic Fishery Management Council" (Kitner 2001). The executive summary from that report appears below.

Executive Summary

The following is a description of anthropological field research carried out to determine the degree of residential mobility among a small work community of fishermen, their co-workers and family in the coastal southeastern United States. Fieldwork took place from March through September 2000 and was contracted by the U.S. Bureau of the Census in a joint MOU with the National Marine Fisheries Service. The key questions to be addressed were:

1) What interactions in social networks influence and explain or determine the duration of individuals' stays in domiciles (in households, institutions, or other places where people sleep) and their residential mobility?
2) How well do Census Bureau categories fit with the socially represented characteristics people use to form interacting social networks?

There are many social variables that might be measured that would predict how mobile a population might be. In this particular study, the indicators that point to mobility are less easily measured in a quantifiable manner. The characteristics of their specific mobility are more given to qualitative description. This observation does not preclude ever measuring such variables, rather it points to the necessity of doing a study such as this one but in a longer timeframe, allowing for more regular participant observation and for the researcher to build deeper rapport in the community. However, as an experimental methodology for the Census Bureau, this study can clearly show how this particular population (and others like it) is not easily enumerated by standard Census methods.

A majority of the social network participants can be characterized as socially and economically marginal, and exhibiting high frequencies of both illegal drug and alcohol use, high divorce rates, past involvement in illegal activities and often a history of jail time, weak familial ties, and weak social ties. Such characteristics are seen to push an individual to lead a less stable life overall and to experience a high rate of personal mobility.

None of the above-mentioned quality of life variable can be measured easily by traditional Census Bureau categories. These variables are difficult to measure even with more in-depth and qualitative methods and among less suspicious, more accessible populations. Perhaps knowing which groupers of people are more likely to exhibit mobile lifestyles may help the Census Bureau in the future predict how best to enumerate such groups in future efforts.

8.4 Cost-Earnings Data Collection Program for South Atlantic Fisheries

The South Atlantic Fishery Management Council is currently developing a survey to collect information from commercial fishing boats to better gauge the economic health of specific commercial fisheries in the South Atlantic region. A fact sheet with answers to Frequently Asked Questions about the data collection program is available at the following link (Frequently Asked Questions).

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10 USEFUL DEFINITIONS

Advisory Panel (AP) - A group of people appointed by a fisheries management agency to review information and give advice. Members are usually not scientists, but most are familiar with the fishing industry or a particular fishery.

Allowable Biological Catch (ABC) - The range of allowable catch for a species or species group. It is set each year by a scientific group created by the management agency. The agency then takes the ABC estimate and sets the annual total allowable catch (TAC).

Angler - A person catching fish with no intent to sell. This includes people releasing the catch.

Bag Limit - The number and/or size of a species or group of species that a person can legally take in a day or trip. This may or may not be the same as a possession limit.

Biomass - The total weight or volume of a species or group of species in a given area.

Bycatch - The harvest of fish other than the species for which the fishing gear was set. Also often called incidental catch. Some bycatch is kept for sale. Also called **incidental catch.**

Catch - The total number or poundage of fish captured from an area over some period of time. This includes fish that were caught but released or discarded instead of being landed. The catch may take place in an area different from where the fish are landed. Note: Catch, harvest, and landings are different terms with different definitions.

Catch Curve - A breakdown of different age groups of fish, showing the decrease in numbers of fish caught as the fish become older and less numerous or less available. Catch curves are often used to estimate total mortality.

Catch per unit effort (CPUE) – An index showing the ratio of a catch of fish, in numbers or in weight, and a standard measure of the fishing effort expended to catch them.

Charter Boat - A boat available for hire, normally by a group of people for a short period of time. Anglers usually hire a charter boat.

Cohort - A group of fish spawned during a given period, usually within a year.

Commercial Fishery - A term related to the whole process of catching and marketing fish for sale. It refers to and includes fisheries resources, fishermen, and related businesses directly or indirectly involved in harvesting, processing, or sales.

Control Rule - A pre-agreed plan for adjusting management actions depending on the condition of the stock.

Council - Indicates a regional fishery management group. The Fishery Conservation and Management Act of 1976 as amended created the regional councils. For example, the South

Atlantic Fishery Management Council develops fishery policies designed to manage those species most often found in South Atlantic federal waters.

Directed Fishery - Fishing that is directed at a certain species or group of species. This applies to both commercial and recreational fishing.

Effort - The amount of time and fishing power used to harvest fish.

Environmental Impact Statement (EIS) - An analysis of the expected impacts of a fishery management plan (or some other proposed action) on the environment.

Exclusive Economic Zone (EEZ) - All waters from the seaward boundary of coastal states out to 200 natural miles. This was formerly called the Fishery Conservation Zone.

Fishery - All the activities involved in catching a species of fish or group of species.

Fishery-Dependent Data - Data collected on a fish or fishery from sport fishermen, commercial fishermen, and seafood dealers.

Fishery-Independent Data - Data collected on a fish or fishery by scientists who catch the fish themselves, rather than depending on fishermen and seafood dealers.

Fishery Management Plan (FMP) - A plan to achieve specified management goals for a fishery. It includes data, analyses, and management measures for a fishery.

Fishing Mortality (F) - A measure of the rate of removal of fish from a population by fishing. Fishing mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of fish dying in one year. Instantaneous is that percentage of fish dying at any one time.

F_{MAX} - The level of fishing mortality (rate of removal by fishing) that produces the greatest yield from the fishery.

F_{MSY} - The level of fishing mortality (rate of removal by fishing) that produces the maximum sustainable yield from the fishery.

$F_{0.1}$ - The level of fishing mortality (rate of removal by fishing) that produces a rate of growth equal to 10% of the highest rate of growth. Often used as a 'warning' reference point.

Growth - Usually an individual fish's increase in length or weight with time. Also may refer to the increase in numbers of fish in a population with time.

Growth Overfishing - When fishing pressure on smaller fish is too heavy to allow the fishery to produce its maximum poundage. Growth overfishing, by itself, does not affect the ability of a population to replace itself.

Harvest - The total number or poundage of fish caught and kept from an area over a period of time. Note that landings, catch and harvest are different.

Head Boat - A fishing boat that takes recreational fishermen out for a fee per person. Different from a charter boat in that people on a head boat pay individual fees, as opposed to renting the boat.

ITQ - See individual transferable quota.

Incidental Catch - see bycatch.

Indicator Species - In Snapper-Grouper Amendment 13B, the one species within a unit for which the status is best understood.

Individual Transferable Quota (ITQ)- A form of limited entry that gives private property rights to fishermen by assigning a fixed share of the catch to each fisherman.

Intrinsic Rate of Increase - The change in the amount of harvestable stock.

Juvenile - A young fish that has not reached sexual maturity.

Landings - The number or poundage of fish unloaded at a dock by commercial fishermen or brought to shore by recreational fishermen for personal use. Landings are reported at the points at which fish are brought to shore. Note that landings, catch and harvest define different things.

Limited Entry - A program that changes a common property resource like fish into private property for individual fishermen. License limitation and the individual transferable quota (ITQ) are two forms of limited entry.

M - see natural mortality.

MRFSS - See marine recreational fishery statistics survey.

MSFCMA - See Magnuson-Stevens fishery conservation and management act.

MSST - See minimum stock size threshold.

MSY - See maximum sustainable yield.

MSY Control Rule - A harvest strategy that, if implemented, would be expected to result in a long-term average catch approximating MSY. It serves two important purposes: (1) it constitutes the maximum fishing mortality threshold (MFMT), above which overfishing is considered to be occurring; and (2) it determines the minimum stock size threshold (MSST), below which the stock is considered overfished.

MSY Stock Size - The long-term average size of the stock or stock complex, measured in terms of spawning biomass or other appropriate units, that would be achieved under an MSY control rule in which the fishing mortality rate is constant.

Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA)- The federal law that created the regional councils and is the federal government's basis for fisheries management in the EEZ. Named after the chief sponsors, Senator Warren Magnuson of Washington and Senator Ted Stevens of Alaska.

Marine Recreational Fishery Statistics Survey (MRFSS) - An annual survey by the National Marine Fisheries Service (NMFS) to estimate the number, catch, and effort of recreational fishermen.

Maximum Fishing Mortality Threshold (MFMT) - Status determination criteria for determining if overfishing is occurring. If the actual fishing mortality rate exceeds MFMT for a period of one year or more, overfishing is occurring.

Maximum Sustainable Yield (MSY) - The largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions.

Minimum Stock Size Threshold (MSST) - The greater of (a) ½Bmsy, or (b) the minimum stock size at which rebuilding to Bmsy will occur within 10 years of fishing at the MFMT. MSST should be measured in terms of spawning biomass or other appropriate measures of productive capacity. If the actual size of the stock or stock complex in a given year falls below this threshold, the stock or stock complex is considered overfished.

Model - In fisheries science, a description of something that cannot be directly observed. Often a set of equations and data used to make estimates.

NMFS - See national marine fisheries service.

National Marine Fisheries Service (NMFS) - A federal agency - with scientists, research vessels, and a data collection system - responsible for managing the nation's saltwater fishes. It oversees the actions of the Councils under the Magnuson-Stevens Fishery Conservation and Management Act.

Natural Mortality (M) - A measurement of the rate of removal of fish from a population from natural causes. Natural mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of fish dying in one year. Instantaneous is the percentage of fish dying at any one time.

OY - See **optimal yield.**

Optimal Yield (OY) - The harvest level for a species that achieves the greatest overall benefits, including economic, social, and biological considerations. Optimum yield is different from

maximum sustainable yield in that MSY considers only the biology of the species. The term includes both commercial and sport yields.

Overfishing - Fishing at a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis. Defined as a situation when the current rate of fishing ($F_{current}$) is greater than that maximum fishing mortality threshold (MFMT) for 1 year or more.

Overfished - The status of a population after overfishing has occurred, when the capacity of a fishery to produce the maximum sustainable yield on a continuing basis is jeopardized. An overfished stock is one whose size is sufficiently small that a change in management practices is required in order to achieve an appropriate level and rate of rebuilding. Defined as a situation when the current level of biomass ($B_{current}$) is less than that the minimum stock size threshold (MSST).

Population - Fish of the same species inhabiting a specified area.

Population Dynamics - The study of fish populations and how fishing mortality, growth, recruitment, and natural mortality affect them.

Possession Limit - The number and/or size of a species or group of species that a person can legally have at any one time. Refers to commercial and recreational fishermen.

Predator - A species that feeds on other species. The species being eaten is the prey.

Prey - A species being fed upon by other species. The species eating the other is the predator.

Quota - The maximum number of fish that can be legally landed in a time period. It can apply to the total fishery or an individual fisherman's share under an ITQ system.

RIR - See **regulatory impact review.**

Rebuilding Plan - A plan designed to recover stocks to the Bmsy level in the shortest possible time period in the absence of fishing mortality. This time period is variously 10 years, a stock-specific T_{MIN}, or T_{MIN} + one generation time (stock specific).

Recreational Fishery - Harvesting fish for personal use, fun, and challenge. Recreational fishing does not include sale of catch. The term refers to and includes the fishery resources, fishermen, and businesses providing needed goods and services.

Recruit - An individual fish that has moved into a certain class, such as the spawning class or fishing-size class.

Recruitment - A measure of the number of fish that enter a class during some time period, such as the spawning class or fishing-size class.

Recruitment Overfishing - When fishing pressure is too heavy to allow a fish population to replace itself.

Regulatory Impact Review (RIR) - The part of a federal fishery management plan that describes impacts resulting from the plan.

SPR - See spawning potential ratio.

SSBR - See spawning stock biomass per recruit.

Slot Limit - Allows a harvester to keep fish under a minimum size and over a maximum size, but not those in between the minimum and maximum. Can also refer to size limits that allow a harvester to keep only fish that fall between a minimum and maximum size.

Socioeconomics - A word used to identify the importance of factors other than biology in fishery management decisions.

Spawning Potential Ratio (SPR) - The number of eggs that could be produced by an average recruit in a fished stock, divided by the number of eggs that could be produced by an average recruit in an unfished stock. SPR can also be expressed as the spawning stock biomass per recruit (SSBR) of a fished stock divided by the SSBR of the stock before it was fished.

Spawning Stock Biomass - The total weight of the fish in a stock that are old enough to spawn.

Spawning Stock Biomass Per Recruit (SSBR) - The spawning stock biomass divided by the number of recruits to the stock, or how much spawning biomass an average recruit would be expected to produce.

Species - A group of similar fish that can freely interbreed and produce viable offspring.

Sport Fishery - See recreational fishery.

Standing Stock - See biomass.

Stock - A grouping of fish usually based on genetic relationship, geographic distribution, and movement patterns. Also a managed unit of fish.

Surplus Production - The total weight of fish that can be removed by fishing without changing the size of the population.

TAC - See total allowable catch.

Total Allowable Catch (TAC) - The annual recommended catch for a species or group of species. The regional council sets the TAC from the range of the allowable biological catch (ABC).

Total Mortality (Z) - A measurement of the rate of removal of fish from a population by both fishing and natural causes. Total mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of fish dying in one year. Instantaneous mortality is the percentage of fish dying at any one time.

Unit Stock - A population of fish grouped together for assessment purposes, which may or may not include all fish in the stock.

Yield - The production from a fishery in terms of numbers or weight.

Yield Per Recruit - A model that estimates yield in terms of weight, but more often as a percentage of the maximum yield, for various combinations of natural mortality, fishing mortality, and time exposed to the fishery.

Z - See total mortality.