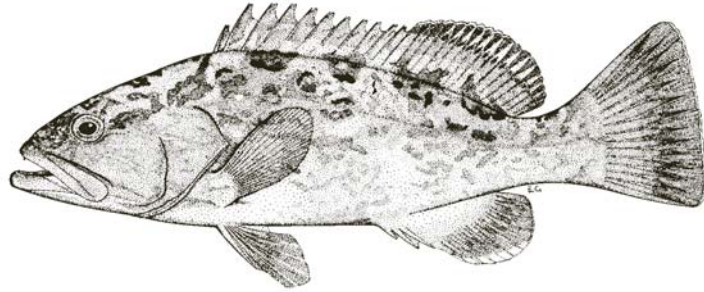


## Gag

*Mycteroperca microlepis*

Contributor: George R. Sedberry



From Heemstra et al. (2002).

### DESCRIPTION

Gag, a medium-sized grouper of interest to fisheries, is the most common grouper in commercial and recreational fishery landings in

South Carolina. It is estuarine-dependent; juveniles occupy South Carolina estuaries for the first few months of life. Adults are found on offshore reefs and man-made structures to depths of 107 m (351 feet), where they are top-level predators (Sedberry 1988; McGovern et al. 1998; SCDNR-MARMAP unpub. data).

### Taxonomy and Basic Description

Gag is a member of the family Serranidae (sea basses and groupers), subfamily Epinephelinae (groupers). Serranids are members of a large diverse order of bony fishes, the Perciformes, which includes basses, sunfishes, perches, drums, snappers and many families of familiar shallow-water fishes. The genus *Mycteroperca* includes scamp, yellowmouth grouper, black grouper and many other species in addition to gag. Maximum adult total length (TL) for gag is 1.2 m (4 feet); maximum weight is 39 kg (86 pounds) (Murdy et al. 1997, Heemstra et al. 2002).

Gag is a slender gray-olive grouper with body depth distinctly less than head length. The body is elongate and compressed; the head is pointed; the mouth is large; two canine teeth are present anteriorly in each jaw; the preopercular margin is angulate, with a distinct notch at angle; scales are very small and number from 120 to 140 in the lateral line series; the dorsal fin is continuous with 16 to 19 soft rays; and the pelvic fin inserts perpendicular to pectoral fin. The anal fin has three spines and 11 soft rays. The dorsal fin has 11 slender spines (rarely 10 or 12) without fleshy tips; these spines are not noticeably short and the membranes between them are not deeply notched. The caudal fin is emarginated without rays (Murdy et al. 1997; Heemstra et al. 2002).

Gag color is variable; the predominant color pattern consists of a brownish gray ground color with dusky wormlike markings on side. Adults have a narrow pale or white margin on dusky median fins; juveniles are much paler and have numerous dusky brown marks laterally. Adult females and juveniles are generally brownish grey with darker vermiculations. A resting, or "camouflage phase," shows five dark brown saddles separated by short white bars below the dorsal fin; this pattern is characteristic of fish that are sitting on the bottom (Murdy et al. 1997, Heemstra et al. 2002). The "blackbelly" (or "charcoal belly") and "blackback" phases are usually displayed by large adult males; 91.7 percent of "charcoal bellies" are male (Collins et al. 1998). The blackbelly phase is mostly pale grey, with faint dark reticulations below the soft dorsal fin; the belly and ventral part of the body above the anal fin are black, as is the margin of the soft dorsal fin, central rear part of caudal fin and rear margins of pectoral and pelvic fins. The blackback phase is similar to the blackbelly phase but with more black pigment present on the rear part of the body, the dorsal half of the peduncle, all of the soft dorsal and anal fins and over

snout and front of jaws; the caudal fin is white with a black margin posteriorly (Heemstra et al. 2002).

## Status

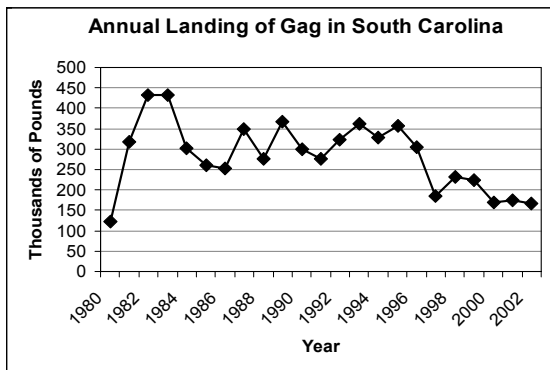
Gag is included on the International Union for the Conservation of Nature (IUCN) List of Threatened Species as vulnerable; however, this assessment is dated (Huntsman 1996). A taxon is considered vulnerable by IUCN when it is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium-term future. The stock of gag off the southeast Atlantic coast was listed in 2003 as undergoing overfishing under Sustainable Fisheries Act (SFA) standards; however, the stock was considered to be rebuilding (NMFS 2004). In the latest Report to Congress (2003), it was not considered overfished; however, the report indicated that reduction in mortality was necessary because gag is considered to be experiencing overfishing (NMFS 2004).

## POPULATION DISTRIBUTION AND SIZE

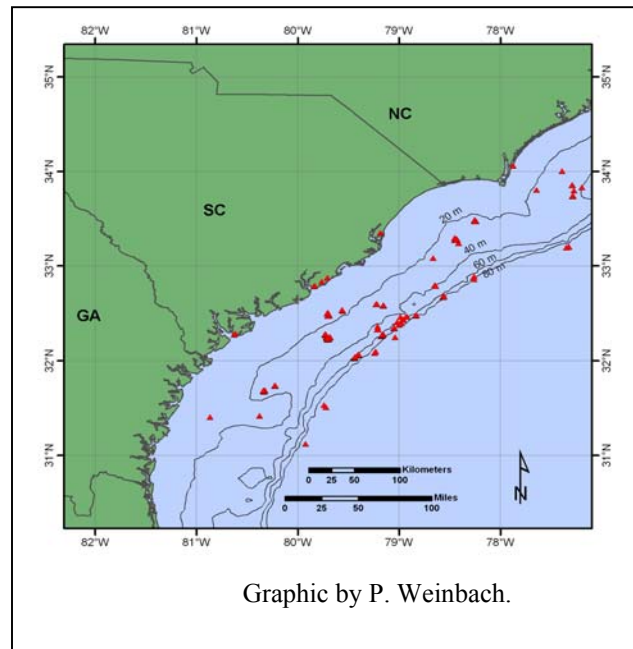
Gag are found in the western Atlantic, primarily from North Carolina to the Yucatan Peninsula, Mexico. Juveniles do occur as far north as Massachusetts. This species is rare in Bermuda. There is one record of gag in Cuba. Gag are also reported from eastern Brazil (Heemstra and Randall 1993; Heemstra et al. 2002). Juveniles are present in estuaries. In South Carolina waters, gag occur from brackish water out to the edge of the territorial sea and beyond. On the continental shelf off South Carolina, gag have been collected at depths from 15 to 107 m (49 to 351 feet) (SCDNR-MARMAP unpub. data).

An estimate of absolute gag population size of in South Carolina is not available. South

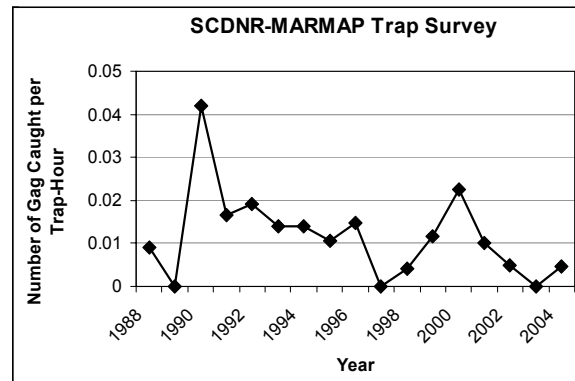
Carolina commercial fishery landings have averaged 250,316 pounds per year from 1993 to 2002



(NMFS 2005a); recreational landings in South Carolina averaged 25,463 pounds per year from 1994 to 2003 (NMFS 2005b). The sharp decline in commercial landings after 1997 may have been a function of management measures that were imposed in 1998, including an increased minimum size (increasing from 51 to 61 cm or 20 to 24 inches TL) and a March-April spawning season closure.



Landings of gag have declined steadily since the fishery became well established in the early 1980s. Fishery-independent data collected by SCDNR during the Marine Resources Monitoring, Assessment and Prediction program (MARMAP) reef fish survey (McGovern et al. 1999) indicate declines in catch per unit of effort and relative abundance of gag from the late 1980s through 2004, although catch rates and sample sizes were very low.



## HABITAT AND NATURAL COMMUNITY REQUIREMENTS

Juvenile gag occupy high-salinity estuaries and are found in habitats with natural or artificial vertical structure, such as seagrass beds, oyster reefs, wrecks, pilings and dredged canals (Keener et al. 1988). Oyster reefs are a favored habitat for juveniles in South Carolina. Postlarvae recruit to inlets, harbors and saltmarsh creeks in March through June (peak in April) and remain until waters cool in October, when they move offshore. Post-juvenile gag are found in depths from 15 to 107 m (49 to 351 feet) on rocky reefs or man-made hard bottom (Heemstra et al. 2002; SCDNR-MARMAP unpub. data). In offshore waters, gag occupy natural and artificial reefs, including wrecks, hard bottom, live bottom, shelf-edge scarps, ledges, sponge/coral habitat and other habitats that provide vertical relief above the bottom. Small juveniles feed on crustaceans; adults are piscivores (Mullaney 1994). Spawning occurs on reefs along the outer continental shelf. Gag may form pre-spawning aggregations in shallow water (20 m, 66 feet) before moving to shelf-edge reefs (50 to 100 m, 164 to 328 feet) to spawn (McGovern et al. 1998, Sedberry et al. in press).

## CHALLENGES

Coastal development adversely affects salt marsh, which is important habitat for juvenile gag. Gag may also be adversely affected by loss of oyster reef habitat that results from the oyster (*Crassostrea virginica*) fishery; gag use this habitat for the first few months of their lives in South Carolina. Gag are vulnerable to heavy fishing pressure (McGovern et al. 1998; Coleman et al. 2000; Collins and Harris 2000; Musick et al. 2000) and are considered to be experiencing overfishing (NMFS 2004). Because gag are long-lived (26 years), slow growing and late maturing (it takes six years to reach 100 percent maturity in females), overfishing is a primary concern as such activity is likely to skew age ratios and reproductive ability of the population. Additionally, gag undergo sex reversal, which further results in skewed sex ratios under heavy fishing pressure; the largest fish are males and are selectively removed by the fishery (McGovern et al. 1998; Coleman; 2000). Gag form spawning aggregations in deep water (41 to 91 m, 135 to 299 feet.); if caught from these depths and subsequently released, mortality is high due to pressure changes. In addition, gag are larger in deep water and tend to be more sedentary with increasing depth, further increasing the vulnerability of males to fishing pressure (McGovern et al. 2005).

The Distinct Population Segment (DPS), as defined by the U.S. Fish and Wildlife Service and National Marine Fisheries Service, of gag off the southeastern Atlantic coast has been described as vulnerable because of low productivity, protogyny (sex reversal, female to male), aggregation behavior and overfishing. Sex reversal has resulted in a much reduced biomass of male gag (Huntsman et al. 1999; Coleman et al. 2000).

During closure of the gag fishery, gag are still present in bycatch when other reef fishes are targeted. The impact on gag habitat by bottom-fishing gear (baited hook) is believed to be minor. Damage to reef habitat by anchored fishing vessels has not been studied in the region. Destruction and pollution of juvenile habitat is of concern (Coleman et al. 2000).

## CONSERVATION ACCOMPLISHMENTS

The gag fishery off South Carolina is managed in federal waters by the South Atlantic Fishery Management Council (SAFMC 2005). In the commercial fishery, a limited access permit is required and there is a 61 cm (24 inches) TL minimum size limit. Gag must be landed with the heads and fins intact to facilitate enforcement of regulations. During March and April, the peak spawning season, harvest and possession is limited to the recreational bag limit and sale and purchase of gag is prohibited. At other times, gear restrictions apply; the most important of these restrictions are the prohibition of longline use in areas shallower than 50 fathoms and the banning of traps and trawls in the fishery. Gear restrictions have also resulted in lowered risk of habitat damage from wire traps and bottom trawling; however, anchor damage to benthic habitats from hook-and-line fishermen may still occur. The recreational fisherman is limited to five groupers (mixed species) per person, although no more than two may be gag or black grouper, individually or combined. Other commercial restrictions concerning minimum size and bag limits also apply to recreational fishermen. These regulations have resulted in limited recent recovery of the stock, although overfishing is still a problem (NMFS 2004). In addition, the SAFMC is considering designating Marine Protected Areas (MPA) that would be closed to bottom fishing year-round; SAFMC has identified some potential sites where gag live and spawn (Sedberry et al. in press). If implemented, it is expected that Marine Protected Areas (MPAs) that prohibit bottom fishing year-round will increase biomass and abundance of gag within the MPAs, and that the MPAs will also have a region-wide positive effect on the stock.

## CONSERVATION RECOMMENDATIONS

- Continue to evaluate the effects of fishing and management plans on gag stocks.
- Initiate studies of the behavior, genetics and physiology of sex reversal, maturation and migration, timing of sex reversal, formation of shallow pre-spawning aggregations, and movement of fish to spawning sites for gag.
- Establish a pre-recruit index of abundance by monitoring the abundance of juvenile gag in South Carolina estuaries. Such an index could be used to evaluate recruitment success and predict trends in adult population size.
- Map key saltmarsh and oyster reef habitat utilized by juvenile gag.
- Develop a state management plan for gag that will insure adequate sex ratios for successful spawning and fertilization of eggs.

- Encourage designation and implementation of Marine Protected Areas (MPAs) that prohibit bottom fishing year-round.
- Reduce the loss of salt marsh habitat by working with developers, local governments, the Army Corps of Engineers and other partners to deter development in sensitive areas.
- Document key oyster reef habitat used by juvenile gag and protect those areas from harvest.

## MEASURES OF SUCCESS

The SCDNR-MARMAP program that annually monitors relative abundance, length frequency, size and age at maturity and sex ratios of reef fishes can detect changes in those parameters that result from management efforts. For example, MARMAP data show an increase in mean size of gag sampled following implementation of size regulations. MARMAP is currently monitoring sex ratios, which should indicate a restoration of normal sex ratios, if spawning season closures and other management measures have been effective. Measurement of management success is difficult in the absence of long-term historical data that precede expansion of the fishery in the 1970s; however, MARMAP monitoring can detect changes in relative abundance, size, age, maturity and other population parameters that respond to fishing pressure or management regulations. Increases in abundance, size, size and age at maturity and sex reversal, and sex ratios with at least 20 percent males would indicate positive trends in the population. A pre-recruit index of abundance of juveniles could also be used to measure changes in recruitment as a result of fishing or regulation.

## LITERATURE CITED

- Coleman, F.C., C.C. Koenig, G.R. Huntsman, J.A. Musick, A.M. Eklund, J.C. McGovern, R.W. Chapman, G.R. Sedberry and C.B. Grimes. 2000. Long-lived reef fishes: The grouper-snapper complex. *Fisheries*. 25(3):14-21.
- Collins, L.A., A.G. Johnson, C.C. Koenig, M.S. Baker. 1998. Reproductive patterns, sex ratio, and fecundity in gag, *Mycteroperca microlepis* (Serranidae), and the protogynous grouper from the northeastern Gulf of Mexico. *Fish. Bull.* 96:415-427.
- Harris, P.J. and M.R. Collins. 2000. A comparison of the age, growth, and age at maturity for gag, *Mycteroperca microlepis*, from the southeastern United States during 1976-1982 and 1994-1995. *Bull. Mar. Sci.* 66:105-117.
- Heemstra, P.C., W.D. Anderson Jr. and P.S. Lobel. 2002. Serranidae. Pages 1308-1369, in K.E. Carpenter, editor. *The living marine resources of the western central Atlantic. Volume 2. Bony fishes part 1 (Ascipenseridae to Grammatidae)*. FAO Species Identification Guide for Fishery Purposes, American Society of Ichthyologists and Herpetologist Special Publication 5. Rome.
- Heemstra, P.C. and J.E. Randall. 1993. FAO species catalogue. Vol. 16. Groupers of the world. (Family Serranidae, Subfamily Epinephelinae). An annotated and illustrated catalogue of

the grouper, rockcod, hind, coral grouper and lyretail species known to date. FAO Fish. Synops. No. 125, Vol. 16. 382 pp.

- Huntsman, G. 1996. *Mycteroperca microlepis*. In: IUCN 2004. 2004 IUCN Red List of Threatened Species ([www.redlist.org](http://www.redlist.org)). Accessed: January 2005.
- Huntsman, G.R., J. Potts, R.W. Mays and D. Vaughan. 1999. Groupers (Serranidae, Epinephelinae): endangered apex predators in reef communities *in*: Musick, J.A. (ed.), Life in the Slow Lane: Ecology and Conservation of Long-Lived Marine Animals. American Fisheries Society Symposium. 23: 217-231.
- Keener, P. G.D. Johnson, B.W. Stender, E.B. Brothers and H.R. Beatty. 1988. Ingress of postlarval gag, *Mycteroperca microlepis* (Pisces: Serranidae), through a South Carolina barrier island inlet. Bull. Mar. Sci. 42:376-396.
- McGovern, J.C., P.J. Harris and G.R. Sedberry. 1999. The status of reef fish stocks off the southeastern United States, 1983-1996. Proc. Gulf and Carib. Fish. Inst. 50:871-895.
- McGovern, J.C., G.R. Sedberry, H.S. Meister, T.M. Westendorff, D.M. Wyanski and P.J. Harris. 2005. A tag and recapture study of gag, *Mycteroperca microlepis*, off the southeastern U.S. Bull. Mar. Sci. 76:47-59.
- McGovern, J.C., D.M. Wyanski, O. Pashuk, C.S. Manooch II and G.R. Sedberry. 1998. Changes in the sex ratio and size at maturity of gag, *Mycteroperca microlepis*, from the Atlantic coast of the southeastern United States during 1976-1995. Fish. Bull. 96: 797-807.
- Mullaney, M.D., Jr. 1994. Ontogenetic shifts in diet of gag, *Mycteroperca microlepis*, (Goode and Bean), (Pisces: Serranidae). Proc. Gulf Carib. Fish. Inst. 43:432-445.
- Murdy, E.O., R.S. Birdsong and J.A. Musick. 1997. Fishes of Chesapeake Bay. Smithsonian Institution Press, Washington.
- Musick, J.A., M.M. Harbin, S.A. Berkeley, G.H. Burgess, A.M. Eklund, L. Findley, R.G. Gilmore, J.T. Golden, D.S. Ha, G.R. Huntsman, J.C. McGovern, S.J. Parker, S.G. Poss, E. Sala, T.W. Schmidt, G.R. Sedberry, H. Weeks and S.G. Wright. 2000. Marine, estuarine, and diadromous fish stocks at risk of extinction in North America (exclusive of Pacific salmonids). Fisheries. 25(11): 6-30.
- National Marine Fisheries Service. 2004. Sustaining and rebuilding. NMFS 2003 report to Congress: The status of U.S. fisheries. [www.nmfs.noaa.gov/sfa/reports.html#sos](http://www.nmfs.noaa.gov/sfa/reports.html#sos). Accessed: January 2005.
- NMFS. 2005a. Annual Commercial Landing Statistics. Available: [http://www.st.nmfs.gov/st1/commercial/landings/annual\\_landings.html](http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html). Accessed: January 2005.

- NMFS. 2005b. Marine Recreational Fisheries Statistics Survey. Available:  
[www.st.nmfs.gov/st1/recreational/queries/index.html](http://www.st.nmfs.gov/st1/recreational/queries/index.html). Accessed: January 2005.
- Sedberry, G.R. 1988. Food and feeding of black sea bass, *Centropristis striata*, in live bottom habitats in the South Atlantic Bight. J. Elisha Mitchell Sci. Soc. 104(2):35-50.
- Sedberry, G.R., O. Pashuk, D.M. Wyanski, J.A. Stephen and P. Weinbach. *In press*. Spawning locations for Atlantic reef fishes off the southeastern U.S. Proc. Gulf Carib. Fish. Inst. 57.
- South Atlantic Fishery Management Council. 2005. Available:  
<http://www.safmc.net/fishid/fmpro?-db=content&-format=default.html&-view>. Accessed: January 2005.