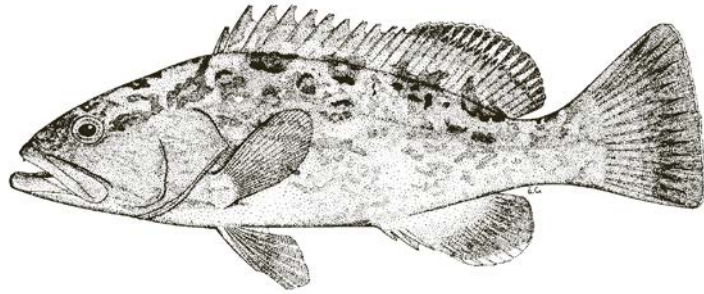


Gag

Mycteroperca microlepis

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From Heemstra et al. (2002).

DESCRIPTION

The Gag, a medium-sized grouper of interest to fisheries, is one of the most common groupers 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 ft.) where they are top-level predators (Sedberry 1988; McGovern et al. 1998; SCDNR-MARMAP unpub. data).

Taxonomy and Basic Description

The 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. The maximum adult total length (TL) for Gag is 1.2 m (4 ft.); maximum weight is 39 kg (86 lbs.) (Murdy and Musick 2013, Heemstra et al. 2002).

The 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; 2 canine teeth are present anteriorly in each jaw; the preopercular margin is angulate, with a distinct notch at an 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 the pectoral fin. The anal fin has 3 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 extended rays (Murdy and Musick 2013, Heemstra et al. 2002).

Gag color is variable; the predominant color pattern consists of a brownish-gray ground color with dusky worm-like markings (vermiculations) on the 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 5 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 and Musick 2013; Heemstra et al. 2002). The "blackbelly" (or "charcoal belly") and "blackback" phases are usually displayed by large adult males; 91.7% 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 the snout and front of the jaws; the caudal fin is white with a black margin posteriorly (Heemstra et al. 2002).

Status

The stock of Gag off the southeast Atlantic coast was listed in 2012 as undergoing overfishing under Sustainable Fisheries Act (SFA) standards; however, the stock was considered to be rebuilding (NOAA Fisheries 2013a). The most recent stock assessment was completed in 2006 (with 2004 as the last year of data included) and results indicated that the stock off the coast of the Southeastern US was reaching an overfished condition and that overfishing was occurring (SEDAR 10). An updated SouthEast Data, Assessment, and Review (SEDAR) stock assessment is scheduled for 2014.

POPULATION SIZE AND DISTRIBUTION

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 ft.) (SCDNR-MARMAP unpub. data, see Figure 1). Gag are protogynous hermaphrodites, which means that they are born as females and change sex from female to male at a certain size and age. Off South Carolina's coast, sexual transition occurs when the fish are between about 89 and 114 cm (35-45 in.) long, at between 8 and 16 years of age (McGovern et al. 1998 and SCDNR-MARMAP unpub. data).

An estimate of absolute Gag population size in South Carolina is not available. South Carolina commercial fishery landings have averaged 119 kg (262.622 lbs.) per year from 1980 to 2011 (NOAA Fisheries 2013b online data—see Figure 2), while recreational landings in South Carolina averaged 12,789 kg (28,195 lbs.) per year from 1984 to 2011 (NOAA Fisheries 2013b on-line data—see Figure 2). The sharp decline in commercial landings after 1997 may have been a function of management measures that were imposed beginning in 1998, including an increased minimum size (increasing from 51 to 61 cm or 20 to 24 in. total length) and a January-April spawning season closure.

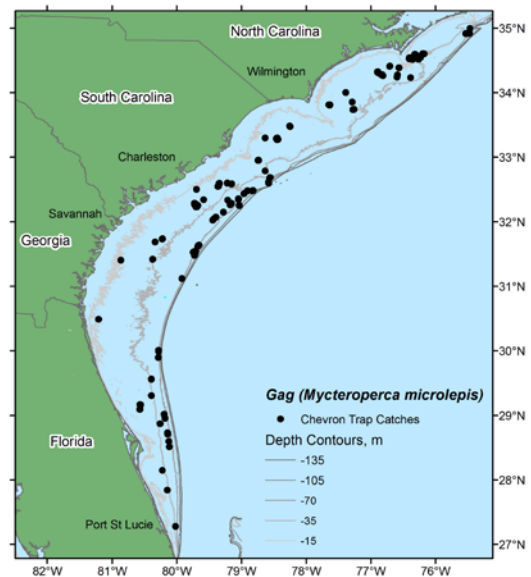


Figure 1: Gag locations.

Fishery-independent data collected by SCDNR during the Marine Resources Monitoring, Assessment and Prediction Program (MARMAP) reef fish survey indicate declines in relative abundance of Gag from the late 1980s through the mid-1990s (SCDNR-MARMAP unpubl. data, see Figure 3). The relative abundance has hovered around a long term average since 2001, but note that catch rates and sample sizes have been very low.

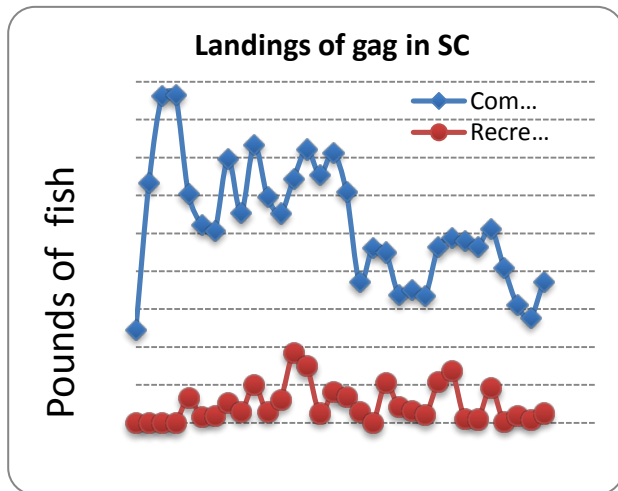


Figure 2: Commercial and recreational catches of Gag in South Carolina.

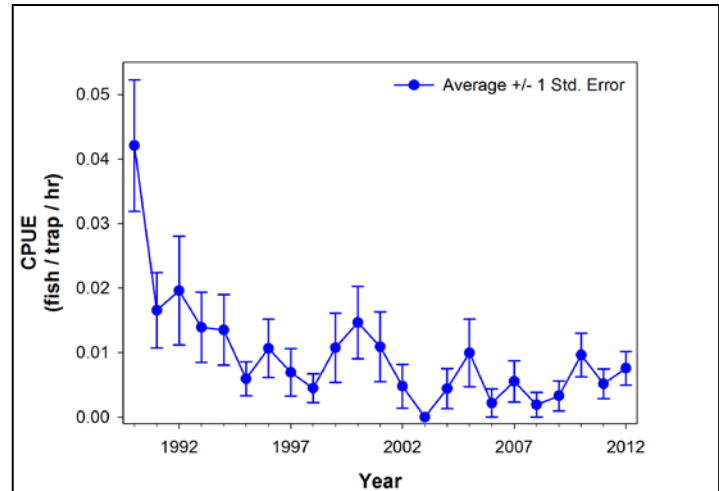


Figure 3: Relative abundance (CPUE) of Gag in the south east region based on fishery independent MARMAP data.

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; Adamski et al. 2011). 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 ft.) 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). Off South Carolina's coast, Gag spawning occurs on reefs along the outer continental shelf from January through April, peaking in March and April (McGovern et al. 1998, MARMAP unpub. data). Gag may form pre-spawning aggregations in shallow water (20 m or 66 ft.) before moving to shelf-edge reefs (50 to 100 m or 164 to 328 ft.) to spawn (McGovern et al. 1998; Sedberry et al. 2006).

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 as 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 (SEDAR 2006, NOAA Fisheries 2013). Because Gag are long-lived (26 years), slow growing and late maturing (it takes 6 years to reach 100% maturity in females), overfishing is a primary concern as such activity is likely to skew age compositions 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 or 135 to 299 ft.); 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) of Gag off the southeastern Atlantic coast—as defined by the US Fish and Wildlife Service and National Marine Fisheries Service—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 reduced biomass of male Gag (Huntsman et al. 1999; McGovern 1998; Coleman et al. 2000).

During closure of the Gag fishery, Gag can still be present in by-catch 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 of South Carolina is managed in federal waters by the South Atlantic Fishery Management Council (SAFMC 2013). In the commercial fishery, a limited access permit is required. There also is a commercial and recreational 61 cm (24 in.) total length minimum size limit. Gag must be landed with the heads and fins intact to facilitate enforcement of regulations. Between January 1 and May 1, during the peak spawning period, there is a prohibition on recreational and commercial harvest and possession of Gag and other shallow water groupers. 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 ban of traps and trawls in the fishery. Gear restrictions have also resulted in a 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 3 groupers (mixed species) per person, although no more than one may be a Gag or a Black Grouper. In addition, the SAFMC established Marine Protected Areas (MPA) in the region in 2009 that are closed to bottom fishing year-round (SAFMC 2013). The Council considered potential sites where Gag live and spawn in the MPA designations (Sedberry et al. 2006). The scheduled SEDAR stock assessment for Gag in 2014 will provide updated information as to the status of the population in the region.

CONSERVATION RECOMMENDATIONS

- Continue to evaluate the effects of fishing and management plans, especially MPA's that prohibit bottom fishing, 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 and possibly protect those areas from harvest.
- Develop a state management plan for Gag that will insure adequate sex ratios for successful spawning and fertilization of eggs.
- 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.

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 has shown an increase in mean size of Gag sampled following implementation of size regulations. MARMAP is also 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, sex reversal, and sex ratios with at least 20% 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.

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