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BIOLOGICAL RESEARCH ON SNAPPERS AND GROUPERS
AS RELATED TO FISHERY MANAGEMENT REQUIREMENTS

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FISHERY RESOURCES OF THE WESTERN CENTRAL ATLANTIC OCEAN

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BIOLOGICAL RESEARCH ON SNAPPERS AND GROUPERS
AS RELATED TO FISHERY MANAGEMENT REQUIREMENTS ^{1/}

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ABSTRACT

Fewer than two dozen pertinent studies have been published on the biology of snappers and groupers as related to fishery management requirements. Almost half of this research was based on tagging programs which described migratory patterns. There has been only one major effort on the basic life history of red grouper (Epinephelus morio) and two investigations on red snapper (Lutjanus campechanus) life history. This paucity of data exemplifies the need for similar life history studies, if sound management policies are to be adopted in assuring maximum sustained yield.

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Twelve years ago in a brief note describing length-weight relationships of young red snapper (Lutjanus campechanus) from the northern Gulf of Mexico, Charles Dawson began his text by chiding fishery biologists for neglecting to gather sufficient biological information to adequately manage the fishery for this extremely valuable species. Today, in Pensacola, Fla., the birthplace 125 years ago of this important Gulf fishery, we may finally examine what yet needs to be known.

Dr. Dawson's admonishments were not unheeded. Two years later, in 1965, Frank Moseley presented a master's thesis to the University of Texas faculty on the biology of red snapper in the northwestern Gulf of Mexico. That same year, Martin Moe began a contribution to the life history of red grouper (Epinephelus morio) for the (then) Florida Board of Conservation, which also eventually fulfilled partial requirements of a master's degree at the University of South Florida. Previously, most of the biological research on snappers and groupers was confined to contributions from a series of tagging studies conducted in Florida with assistance from the Schlitz Brewing Company and from scattered ecological surveys, such as John Bardach's observations on Bermuda reef fish movement and Springer and McErlean's similar studies at Key Largo in the Florida Keys. These tagging studies, as well as earlier surveys of the actual fisheries and gear development work, did not address key aspects of the biology of groupers and snappers. Thus, these studies did not supply vital information required to support management recommendations, should the fisheries need such regulation.

Even with Moe's contributions to red grouper life history, Moseley's work on red snapper life history, and Bradley and Bryan's investigation of red snapper and associated fishes and crustaceans trawled off Texas in 1970-72, we wonder whether there is sufficient biological information to correctly manage the stocks. The latter work (conducted by the Texas Parks and Wildlife Department with PL 88-309 funds from the National Marine Fisheries Service, NOAA), one other short contribution to the age of sexual succession in protogynously hermaphroditic gag (Mycteroperca microlepis) by McErlean and Smith in 1964, and current work on red snapper age, growth, and reproduction (by Florida Department of Natural Resources biologists) are just beginning to answer some of the following fishery management questions:

1) HOW LONG DO THE FISH LIVE; HOW FAST DO THEY GROW; AND WHAT AGE CLASSES ARE VULNERABLE TO THE FISHERIES?

- * Red grouper can live as long as 30 years, but their effective fishable life span is 17 years. Growth rates of male and female red grouper have been theoretically established for ages 1-15. Males reach a slightly larger ultimate length than do females, but the rate of growth for each sex is believed to be similar.
- * Gag have tentatively been described as attaining 18 cm standard length (SL) within the first year and subsequently growing from 8 to 10 cm SL per year, up to age 6. Eventual age has not been established and theoretical growth has not been determined.

- * Red snapper may live at least 9-11 years, but neither their effective fishable life span nor theoretical growth rates have been adequately determined. Western Gulf of Mexico red snapper were estimated to achieve 20-25 cm SL within a year and to grow from 6 to 9 cm per year, up to their fourth "spawning period." Analysis of measurements at recapture of tagged red snapper revealed that such an estimated growth rate appears reasonable.

2) WHEN DO THE FISH BECOME SEXUALLY MATURE; WHAT IS THE FECUNDITY OF FISH OF THE PRINCIPAL SPAWNING AGES?

- * Red grouper, protogynously hermaphroditic, undergo sexual transition from female to male between ages 5-10 years at a rate of approximately 15% per year. Males are reproductively significant in the population after 10 years. Females are mature (capable of spawning) between ages 4-6 but, in terms of fecundity, achieve their greatest reproductive potential when they reach 8-12 years of age.
- * Gag, also protogynously hermaphroditic, mature as females during their 4th or 5th year and transform into males at approximately age 10 or 11.
- * Red snapper have been thought to mature within only one year, but this has yet to be verified.

3) WHERE, WHEN, AND HOW OFTEN DO THEY SPAWN?

- * Gonadal activity of red grouper was evident in tissue collections made in January and February, as well as in October and November samples. Correlated with the photoperiod, the January-February gonadal activity culminated in late spring spawning, while the October-November activity regressed into a "resting state" by December. No histological evidence was found to suggest individual fish spawned more than once each year. Spawning occurs principally during April and May. Off the Florida west coast, spawning is thought to occur in 13-15 fathoms.
- * Gag are in spawning condition from January through March, and spawners are believed to be confined to the commercially exploitable stocks from deeper water off west Florida.
- * Gonadal activity of red snapper has been observed in tissue collections from specimens captured as early as June and as late as November, from depths greater than 20 fathoms off Tarpon Springs, Fla. Spawning is thought to occur several times throughout the summer, principally during July through September. Two spawning areas have been observed during July and August by commercial fishermen. These areas are in 10-20 fathoms, due south of Panama City, Fla., over a firm sand bottom of gentle

gradient and little relief. This agrees with observations off Texas, where spawning activities over level bottom within 20 fathoms have also been reported. Red snapper apparently spawn in the western Gulf of Mexico (and off Campeche) from June (or July) through September, with a peak occurring in July and August. A second spawning during "fall" off Texas has also been postulated.

4) WHERE ARE THE LARVAE AND JUVENILES DISTRIBUTED --SPECIFICALLY, DO THEY REQUIRE CRITICAL ECOLOGICAL NICHES?

- * Little is known of the distribution, or even of descriptive characters of red snapper, red grouper, or gag larvae.
- * Red grouper are thought to leave the plankton to become benthic at about 20-25 mm SL. Juveniles are dispersed in low densities over hard bottom in depths of at least 20 fathoms, where they display cryptic behavior and are thus inaccessible to most collecting gear.
- * Juvenile gag have a similar distribution but extend, especially during summer, even farther into sheltered, saline bays and coastal lagoons, where they inhabit Thalassia grass flats or congregate near rock piles. They are often taken with other fishes incidental to bait shrimp trawled from grass flats along Florida's central west coast.
- * Juvenile red snapper have been captured off Texas over smooth bottom which is regularly trawled for shrimp. It is generally thought that as red snapper grow older, they seek deeper water, although some evidence indicates juveniles subsequently return to shallower water during spring and summer after the first winter's emigration from such areas.

5) WHAT IS THE DISTRIBUTION OF JUVENILES RELATIVE TO THE FISHERY; WHAT CAUSES SUCH A DISTRIBUTION?

- * Red grouper from 1 to 6 years old (less than 50 cm SL) inhabit nearshore reefs and historically have been the mainstay of the central west Florida coastal party boat fishery. Larger, older fish have comprised the commercial catch from deeper water farther offshore. Moe cautioned that since long-lived, slow-growing fishes are more susceptible to population reduction through fishing pressure than short-lived, fast-growing fishes, constant and intensified removal of newly recruited year classes could hinder maintenance of sufficient numbers of large fish needed to maintain the reproductive viability of the resource.
- * Gag follow the same pattern as red grouper, displaying an even greater variation in distribution during their life span.

Unfortunately, specific details are not as well known as they are for red grouper.

- * Red snapper juveniles, up to about 15 cm fork length (FL), that seasonally inhabit smooth bottom during summer have been readily captured with shrimp trawls. Young red snapper of a similar size have also been collected with hook and line over smooth bottom off Florida, where they appear to forage in compact schools. The young red snapper do not remain long in one spot, but definitely return to the same vicinity in subsequent summers, as evidenced by tag returns.

The stomach contents of juvenile red snapper captured in shallow water indicate they are opportunistic feeders. Invertebrates (shrimps, crabs, and squids) constitute a substantial portion of their diet, with even tunicates being included (probably by accident) due to sheer availability rather than desirability. Stomach eversion of larger fish from deeper waters, due principally to fishing methods, hinders accurate diet comparisons. Seasonal changes in benthic macrofauna with the onset of winter undoubtedly influence the assumed movement of red snapper into deeper water (greater than 15 fathoms) following summer forages. The predominance of squids and mud-burrowing shrimps in the stomachs of young red snapper is evidence of nocturnal feeding behavior.

6) WHAT ARE THE GENERAL MOVEMENT PATTERNS OF EXPLOITABLE FISH STOCKS; WHAT IS THEIR AVAILABILITY TO THE FISHERY; AND HOW IS THIS RELATED TO THE REPRODUCTIVE OR RECRUITMENT PATTERNS OF THE SPECIES?

- * Red grouper move offshore from the shallower reef environments as they attain sexual maturity at about 40 cm SL (age 5). Commercial fishermen report seasonal movement of the species in deeper, offshore water (15-50 fathoms); extensive movement is also verified by tag returns, although distinct patterns are not known. Young red grouper do not move during their residence at nearshore reefs.
- * Black grouper (Mycteroperca bonaci) tagged and released at inshore patch reefs in the Florida Keys also displayed strong home-reef specificity. Even a hurricane failed to disrupt their residence during that study. This seems to be common with serranids, judging from similar results in Bermuda tagging studies. When individual Nassau grouper (Epinephelus striatus) and red hind (E. guttatus) were transported to other reefs in the vicinity, they all returned to their original reef. Extensive tagging of young gag at nearshore reefs off the Florida west coast yielded the same evidence of tenacious reef specificity.

- * Red snapper also definitely show specific reef residency. This is indicated by seasonal returns to summer forage areas, as well as distinct congregation at reefs in deeper water. The only extensive movement seen in red snapper tagged in the northern Gulf of Mexico occurred among fish released at reefs in water deeper than 15 fathoms. It is unknown whether such movement was forage-motivated or whether it occurred in response to reproductive stimuli. Again, movement was only notable when the fish began living in deeper, offshore areas after leaving the shallower reefs, where they did not move appreciably.

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