9.2 Research Programs

9.2.1 Fishery-Independent

9.2.1.1 MARMAP

For thirty 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 Ft Pierce, 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. Research toward fulfilling these goals has included trawl surveys (from 6-350 m depth); ichthyoplankton surveys; location and mapping of reef habitat; sampling of reefs throughout the SAB; life history and population studies of priority species; tagging studies of commercially important species and special studies directed at specific management problems in the region. Survey work has also provided a monitoring program that has allowed the standardized sampling of fish populations over time and development of an historical base for future comparisons of long-term trends.

Current Objectives

Annual MARMAP cruises to assess relative abundance of reef fishes in the sponge-coral and shelf edge (live bottom) habitats of the South Atlantic Bight (SAB) have been conducted since

1978. MARMAP currently samples natural live bottom habitat from Cape Lookout, NC to the Ft. Pierce area, FL. The current main MARMAP objectives are to:

- sample reef fishes in the snapper-grouper complex at using a variety of gears in live bottom, rocky outcrop, high relief, and mud bottom habitats,
- collect detailed data for time series description of species for annual composition and relative abundance,
- obtain population characteristics on fish species of interest through life history information analysis, including age and growth, sex ratio, size and age of sexual maturation and transition, spawning season, fecundity, and diet. Priorities are dictated by the SEDAR schedule and other management considerations,
- collect hydrographic data (e.g. depth, temperature, salinity, etc.) for comparison to fish abundance and composition indices,
- collect DNA samples from selected fish species for stock identification
- expand sampling area in North Carolina and south Florida as well as reconnoiter new live bottom areas with underwater video (UWTV) to add to the MARMAP site database.

Since the inception of the MARMAP program various gear types and methods of deployment have been used. In recent years MARMAP has mostly used the Chevron trap (CHV), short (or vertical) long line (VLL), and the long (or horizontal) long line (HLL) using standard deployment and retrieval methods. At each sampling site CTD profiles are taken to record water conditions (e.g. temperature, salinity, etc.). The gears and methodology has been consistent over the years to allow for long term analysis and comparisons.

Chevron fish trap

The chevron trap is an arrowhead-shaped trap (maximum dimensions of 1.5 m x 1.7 m x 0.6 m.; 0.91 m3 volume) constructed of 35 mm x 35 mm square mesh plastic-coated wire, with one funnel entrance and one release panel. Each trap is baited with a combination of whole or cut herrings (*Brevoortia*, family *Clupeidae*). Bait is suspended on 4 stringers (approximately 4 fish per string) within the trap, with 6-8 loosely placed fish in the in the trap. The traps are tethered individually using 8-mm (5/16 inch) polypropylene line to a polyball buoy and a Hi-Flyer buoy attached to a 10-m trailer line. Chevron traps are deployed during daytime hours at stations randomly selected by computer from a database of approximately 2,500 live bottom and shelf edge locations and soaked for approximately 90 minutes. Up to six traps, separated by a minimum distance of 200 m, are fished at the same time. Chevron traps have been used since 1988 and the majority of trap sampling has occurred between 16 to 91 m.

Short (vertical) long line

Short longlines have been used where bottom topography is rough at depths to about 220m. This gear type consists of a 26 m (84 ft) groundline with 20 baited hooks brommelled to an 8-mm (5/16 inch) polypropylene line attached to a polyball buoy and a Hi-Flyer buoy attached to a 10-m trailer line to the surface. The hooks, attached at 1.2 m intervals, are baited with double hooked squid. Weights are attached to each end of the groundline. The weights and groundline are deployed such that the line is draped over bottom relief. Each line is soaked for

approximately 90 minutes and six lines may be fished at the same time. This gear type has been used since 1997.

Long (horizontal) long line
Horizontal longline is deployed at depths ranging from 180 to 235 m over smooth mud bottom, areas that are prime habitat for golden tilefish. The horizontal longline consists of 1500 to 1700m of 0.32 mm galvanized cable deployed from a longline reel. Approximately 1220 m of the cable is used as groundline and the remaining line is buoyed to the surface. Two weights are attached to the terminal end and 100 gangions baited with double hooked squid are attached at 12 m intervals. At the end of the groundline, two weights are attached and at the end of the cable one or two polyballs and a Hi-Flyer trailer buoy are attached. The gear is soaked for 90 minutes and two lines are soaked at the same time.

Underwater TV
UWTV recordings were made using a Simrad-Osprey Subsea low light camera attached to a vane stabilized frame during day light hours. The camera was maintained off the bottom 1 - 2 m off the bottom as the vessel either drifted with the wind and/or current or was towed at low speeds. Recordings for fish identification on bottom habitat and to document new live bottom sites for the MARMAP data base were made on VHS tape and archived for future analysis.

In addition to these gears, hook and line fishing is occasionally used to supplement sampling for life history studies. Historical hook and line data are currently used for the development of a possible standard hook and line survey in the future.

All individuals in each catch (trap or line) are sorted and identified to species level. All individuals of each species are weighed together, while length is individually measured for all fish. All Individuals of selected species are kept for life history work-up, but abundant species such as black sea bass, vermilion snapper, and red porgy are randomly subsampled. All other fish are returned to the ocean. Species selected for life history work-up are: all groupers and snappers, red porgy, white grunt, gray triggerfish, black sea bass, and occasionally other species of interest.

Life History
Fish used for life history studies are measured to the nearest mm (total length, fork length, and standard length) with an electronic fish measuring board interfaced with a personal computer. Individual weights are measured to the nearest gram. Otoliths (mostly sagittae) and gray trigger fish spines, and gonad sections are removed at sea. Otoliths and spines are stored dry in coin envelopes. The otoliths and spines are used to determine the age of the fish in the MARMAP laboratory. This is a done by examining the whole otolith or 0.5-1.0 mm thick sections of otoliths and spines, depending on the species. Increments, one translucent and one opaque zone, or “ring” in the otoliths are counted by independent readers to determine the age of each fish.

Each gonad section is fixed in 10% seawater formalin for 1-2 weeks, and then transferred to 50% isopropanol for 1-2 weeks. Gonad samples are then processed to produce thin, stained sections

on microscope slides. These preparations are examined under the microscope to determine sex and reproductive state using histological criteria.

Data

MARMAP has developed a long-term database for reef fish that has proven valuable in interpreting fisheries landings data and developing regulations for protecting reef fish resources. Restrictions on minimum sizes of most commercially important species make it difficult to monitor life history parameters and abundance data from samples collected from the fishery landings. MARMAP has the only existing long-term program off the Atlantic coast of the southeastern United States that monitors reef fish composition, length frequency, abundance, and life history based on fishery-independent data. These data provide critical input for the assessments of stock status conducted by NOAA Fisheries, and greatly assist stock assessment scientists and the Council in the management of snapper/grouper complex of the South Atlantic Bight.

MARMAP Vessels

Three research vessels have been used by MARMAP since 1972: the R/V Dolphin, R/V Oregon I, and R/V Palmetto. During 1973-1980, MARMAP used the R/V Dolphin. This was a 105' converted ocean tugboat that was outfitted for trawling, plankton work, hydro casts, and trapping. The data collected were used to describe the seasonal distribution and abundance of groundfish and fish larvae throughout the region. The R/V Oregon I was used by MARMAP during 1981-1988. It was a 105' vessel that was outfitted for trawling, plankton work, hydro casts, and trapping. From 1989 to the present, MARMAP has used the R/V Palmetto. The R/V Palmetto is 110', maintains a 5 permanent member sea-going crew, 1 or 2 temporary deckhands, and has accommodations for 9 scientists. There is a 200 sq. ft. wet lab on the main deck with counter space, electronics rack, freshwater and seawater, and freezers. The main deck has 1,014-sq. ft. of open deck space. There is a Sea Crane 120 on the main deck for loading, distributing and deploying gear, as well as the zodiac. It has two hydraulic long-line reels, two hydraulic reels for CTD casts and plankton work and a pot-hauler for retrieving traps.

List of commonly collected species.

Almaco Jack
Bank sea bass
Black sea bass
Blueline tilefish
Gag
Golden tilefish
Gray triggerfish
Greater amberjack
Knobbed porgy
Red grouper
Red porgy

Red snapper
Sand perch
Scamp
Scup
Snowy grouper
Speckled hind
Spottail pinfish
Spotted moray
Tomtate
Vermilion snapper
White grunt