

Description of MARMAP Sampling

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 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. 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.

Monitoring of Reef Species

Since 1978, MARMAP has monitored reef fish abundance and collected specimens for life history studies. The primary gear types that have been used to sample reef fishes are Florida traps, blackfish traps, chevron traps, bottom longline, kali pole, vertical longline, and hook and line gear. From 1978 to 1987, Florida traps and blackfish traps baited with cut clupeids were soaked for approximately two hours during daylight at 12 study areas with known live-bottom and/or rocky ridges. In 1988 and 1989, Florida snapper and chevron traps were fished synoptically for approximately 90 minutes from a 33.5 m research vessel that was anchored over a randomly selected reef locations. After 1989, blackfish traps and Florida traps were discontinued. Only chevron traps were deployed at stations randomly selected by computer from a database of approximately 2,500 live bottom and shelf edge locations and buoyed for approximately 90 minutes. This database was compiled from MARMAP visual UWTV studies with additional locations added from catch records from the MARMAP and other MRRI projects. During the 1990s, additional sites were obtained for the North Carolina and south Florida area from scientific and commercial fisheries sources to facilitate expanding the overall sampling coverage.

Sample sites are all located in the central SAB from 27° N to 34° N. Trapping has occurred to depths as great as 218 m but the majority of trap sampling has occurred at 16 to 91 m. During all years, sampling was conducted during daylight to eliminate light phase as a variable. Night hours were reserved for workup of fishes, steaming time between sites and for tagging and recapture of priority species. CTD profiles were taken after each trap set and before each longline set.

Hook and line stations were fished during dawn and dusk periods, one hour preceding and after actual sunrise and sunset. Rods utilizing Electromate motors powered 6/0 Penn Senator reels and 36 kg test monofilament line were fished for 30 minutes by three anglers. The terminal tackle consisted of three 4/0 hooks on 23 kg monofilament leaders 0.25 m long and 0.3 m apart, weighted with sinkers 0.5 to 1 kg. The top and bottom hooks were baited with cut squid and the middle hook baited with cut cigar minnow (*Decapterus sp.*). This same method of sampling was used between 1978-2001. However, less emphasis has been placed on hook and line sampling during the 1990s to put more effort on tagging of fishes at night and running between stations.

In 1997, we began using two types of longline gear to sample the snapper-grouper complex in depths greater than 90 m. Each type of long line was intended to sample one of two unique bottom types (smooth tilefish grounds or rough bottom). In the tilefish grounds (areas of smooth mud), a horizontal long line was deployed and in areas of rough bottom contours, a short vertical long line was used to follow the bottom profile. The horizontal long line consists of 1676 m of 3.2 mm galvanized cable deployed from a longline reel. A total of 1219 m of the cable is used as groundline and the remaining 457 m is buoyed to the surface. One hundred gangions, comprising of an AK snap, approximately 0.5 m of 90 kg monofilament

and a #6 or #7 tuna circle hook, are baited with a whole squid and clipped to the ground cable at intervals of 12 m. The gear is set while running with the current at a speed of 4 - 5 knots. An 11 kg weight is attached to the terminal end and 100 gangions are then attached to the ground line, followed by another weight at the terminal end of the ground line. The remaining cable is pulled off of the reel and buoyed with a Hi-Flyer and a polyball trailer buoy. The gear is soaked for 90 minutes and retrieved by fairleading the cable from a side davit of the vessel back on to the longline reel. A similar bottom longline was deployed by MARMAP during the 1980s, however, red porgy are not taken in the tilefish grounds.

Where bottom type is rough at depths of 90 to 200 m, short vertical relief longlines consisted of 25.6 m of 6.4 mm solid braid dacron groundline dipped in green copper naphenate. The line is deployed by stretching the groundline along the vessel's gunwale with 11 kg weights attached at the ends of the line. Twenty gangions baited with a whole squid were placed 1.2 m apart on the groundline which was then brommelled to an appropriate length of poly warp and buoyed to the surface with a Hi-Flyer. Sets are made for 90 minutes and the gear is retrieved utilizing a pot hauler. Large red porgy are taken with this gear type particularly off NC at depths of 90-120 m. This gear type has only been used since 1997 and a long term data set is not available. During the 1980s, kali pole gear was used on deep water reefs at depths ~150-200 m. Catch per unit effort for the longline gear is expressed as the number per 100 hooks.

UWTV recordings were made using a Simrad-Osprey Subsea low light camera attached to a vane stabilized frame during day light hours. The camera is maintained off the bottom 1 - 2 m 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.

Length-frequency data from the catches (to the nearest 1 cm) were recorded by a shipboard data acquisition system. This comprised of a Limnoterra FMB IV digital measuring board and a Toledo model 8142 digital scale, interfaced by an XT personal computer with customized software. During length frequency, subsample tables for priority species were also kept so specimens could be retained for additional life history studies. During length frequency workup, the only length recorded for red porgy is fork length. After length frequency workup, fishes are stored on ice for life history workup during night.

From the 1990s through the present, specimens for life history workup were collected from eight geographical areas designated by each whole degree of latitude from 27⁰ N to 34⁰ N. South of 32⁰ N and north of 33⁰ N, fifteen specimens of each 1 cm size class were retained from each trip for *Centropristis striata*, and *Rhomboplites aurorubens*. Fifty specimens for *Pagrus pagrus* and *Balistes capriscus* were retained. In mid latitudes, 32⁰ N to 33⁰ N, five specimens of each 1 cm size class were retained for *Centropristis striata*, *Rhomboplites aurorubens*, *Balistes capriscus*, *Haemulon aurolineatum* and *Diplectrum formosum*. Ten specimens were retained for *Pagrus pagrus*. In all latitudes, all red porgy larger than 350 mm FL were retained for life history studies. All other priority specimens were kept for the entire sampling area. During the 1980s, all priority species (species of commercial and recreational important) caught (including red porgy) were retained for life history workup.

During life history workup, a Limnoterra fish measuring board with 1-mm resolution was used to measure priority species (SL, FL, and TL) with their weights determined by a triple beam balance to the nearest gram. This system was connected to an AT 486-type computer for life history data storage with a paper output as backup.

Mean CPUE of fish caught with traps or hook and line gear is calculated for each year by species as:

$$Mean\ CPUE\ (no.\ fish\ per\ trap\ -\ hr.) = \frac{\sum \frac{no.\ fish\ caught}{soak\ time\ (hr.)}}{no.\ samples}$$

Catch per unit effort for red porgy caught with trapping is calculated for individuals taken in water deeper than 26 m since red porgy are infrequently taken in shallow water. This area includes mid-shelf live bottom

reefs as well as shelf edge rocky outcrop habitat. Catch per unit effort is also calculated at four study areas (combined) off South Carolina that have been consistently sampled by MARMAP since 1983. Locations for the study areas are: 32153 <= lat <= 32172 and 79088 <= long <= 79108 or 32201 <= lat <= 32219 and 79013 <= long <= 79035 or 32251 <= lat <= 32276 and 78560 <= long <= 78583 or 32501 <= lat <= 32522 and 78147 <= long <= 78170 or 32043 <= lat <= 32054 and 79136 <= long <= 79145 . The sites are ~ 50 m deep with a bottom type that consists of rock outcroppings and 1-2 m of relief.

Description of the MARMAP monitoring data set

Included on CD, is a data set in ASCII "CPUE" and Excel format that includes MARMAP monitoring reef fish data since 1978. The layout for the data is as follows and can be found in file entitled "PORGYCPUE.SAS":

```
DATA INITIAL; INFILE 'C:\PORGYDATA\CPUE' LRECL = 421;
INPUT PID 1-3 COLL 4-9 GEAR $10-12 SPECIES $16-19 EST $29 @23 TOTWGT
6.3 NUM 30-34 @35 SUBWGT 5.2 MEAS 40-41 DAY 234-235 MONTH 236-237
YEAR 238-239 VESSEL 244-245 LAT 330-334 LONG 335-339 @287 STRATA
$CHAR4.DEPTH 367-369 DUR 370-372 CC 377 NAME $385-420
LEN1 43-45 FR1 46-48 LEN2 49-51 FR2 52-54
LEN3 55-57 FR3 58-60 LEN4 61-63 FR4 64-66
LEN5 67-69 FR5 70-72 LEN6 73-75 FR6 76-78
LEN7 79-81 FR7 82-84 LEN8 85-87 FR8 88-90
LEN9 91-93 FR9 94-96 LEN10 97-99 FR10 100-102
LEN11 103-105 FR11 106-108 LEN12 109-111 FR12 112-114
LEN13 115-117 FR13 118-120 LEN14 121-123 FR14 124-126
LEN15 127-129 FR15 130-132 LEN16 133-135 FR16 136-138
LEN17 139-141 FR17 142-144 LEN18 145-147 FR18 148-150
LEN19 151-153 FR19 154-156 LEN20 157-159 FR20 160-162
LEN21 163-165 FR21 166-168 LEN22 169-171 FR22 172-174
LEN23 175-177 FR23 178-180 LEN24 181-183 FR24 184-186
LEN25 187-189 FR25 190-192 LEN26 193-195 FR26 196-198
LEN27 199-201 FR27 202-204 LEN28 205-207 FR28 208-210
LEN29 211-213 FR29 214-216 LEN30 217-219 FR30 220-222;
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A description of these data elements follows:

PID = Project identity. "105" - fishery-independent MARMAP data and "150" - fishery dependent data collected by MARMAP.

COLL = Collection Number

GEAR = Gear Code (See Table 1).

SPECIES = Species Code. The species code for red porgy is "A272". "X999" indicates that no species were taken. Other species codes can be determined from the names.

EST = indicates if subsample was taken. 1 indicates whole catch has length measurements. C indicates that lengths taken from subsample. Red porgy are never subsampled.

TOTWGT = Total weight (kg) of all fish of a certain species in a collection

NUM = Number of fish of a certain species in a collection.

SUBWGT = Weight of subsample if taken. Subsamples were never taken on red porgy or any other priority species.

MEAS = Measurement Code. 00 Total Length; 04 Fork Length. Red porgy are measured in fork length during length frequency workup.

VESSEL = DP = R/V DOLPHIN; OE = R/V Oregon I; PO = R/V Palmetto

DAY = Day

MONTH = Month

YEAR = Year

LAT = Latitude

LONG = Longitude

DEPTH = Depth in meters

DUR = Duration in minutes

CC = Catch Code. 0 = no catch, 1 = catch with finfish, 2 = catch with no finfish, 3 = no catch; gear lost or damaged, 4 = catch mixed or lost, 6 = gear damaged, catch questionable, 7 = NA, 9 = reconnaissance sample.

NAME = Species name.

LEN 1 to 30 = Length of fish

FR 1-30 = Frequency of length.

Table 1. Gear codes for gear used by MARMAP during reef fish cruises.

014 HOOK AND LINE - Personal

041 MINI ANTILLEAN S-TRAP - BAITED

043 SNAPPER REEL, ELECTRIC OR MANUAL, 2 HOOKS

052 MINI ANTILLEAN S-TRAP - UNBAITED

053 BLACKFISH TRAP - BAITED

054 BLACKFISH TRAP - UNBAITED

055 EXPERIMENTAL LARVAL TRAP

056 MINNOW TRAP - COVERED

057 MINNOW TRAP - UNCOVERED

059 FINE MESH TRAP

060 CUBIAN TRAPEZE - 1 X 2M .947MM MESH

061 VERTICAL LONG LINE

073 EXPERIMENTAL TRAP

074 FLORIDA "ANTILLEAN" TRAP

086 KALI POLE STANDARD (MARMAP)

087 BOTTOM LONGLINE

296 25 MM DIA. FILTER

297 THERMISTOR

298 CTD

299 SURFACE HYDRO SAMPLE

300 NISKIN BOTTLES - STANDARD CAST

301 NISKIN BOTTLES - SURFACE AND BOTTOM

305 XBT

324 CHEVRON TRAP (MARMAP)

501 BOTTOM TRIPOD FIXED TV

502 STAT. TV STATION - HORIZONTAL

503 STAT. TV STATION - VERTICAL

504 DRIFT TV TRANSECT - HORIZONTAL

505 DRIFT TV TRANSECT - VERTICAL

506 TOWED TV TRANSECT - HORIZONTAL

507 TOWED TV TRANSECT - VERTICAL

513 PAN & TILT TV

Changes in Vessels

Three research vessels have been used by MARMAP since 1972, the R/V DOLPHIN, R/V OREGON I, R/V PALMETTO. During 1973-1980, MARMAP used the R/V DOLPHIN. This was a 105' converted ocean tugboat. It had a single screw and an active rudder. It was outfitted for trawling, plankton work, hydro casts, trapping and was used by NMFS prior to MARMAP. The R/V OREGON I was used by MARMAP during 1981-1988. It was a 105' vessel that was built by NMFS during WWII to trawl off Alaska. It 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, a double stainless sink, 40 cu. ft. chest freezer, small bait freezer, 120 volts AC and 12 volts DC power supplies. The main deck has 1,014-sq. ft. of open deck space, with davits on both sides. 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.

Changes in Captains

There has been little change in individuals that were captains on these research vessels. Captain John Causby was the captain of the R/V Dolphin during 1973-1980, captain of the R/V OREGON I, and captain of the R/V PALMETTO during 1989-2000. Captain Julian Mikell who was the mate for John Causby since 1978 took over as captain of the R/V PALMETTO in 2000.

Changes in Investigators and Chief Scientists

The Principal Investigators of MARMAP have been: Victor Burrell, 1972-1976; Fred Berry, 1977-1978; Charlie Barans, 1979-1984; George Sedberry, 1985-1993; and Jack McGovern, 1994-current. **Since 1973, scientific personnel, including chief scientist have varied with each cruise.** Individuals that functioned as chief scientist during the 1980s include (alphabetical order): Charlie Barans, Dan Machowski, Bill Roumillat, George Sedberry, Dave Schmidt, Charlie Wenner, and Dave Wyanski. Individuals that were chief scientist during the 1990s through 2001 are: Pat Harris, Dan Machowski, Jack McGovern, Dave Schmidt, George Sedberry, and Dave Wyanski.