
Annual Report – FY 2005

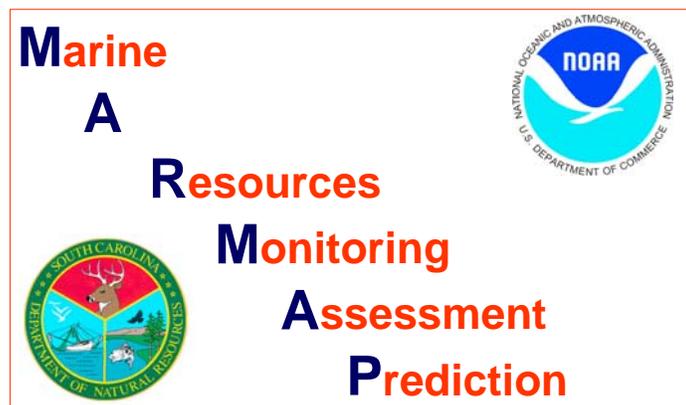
A summary of monitoring and tagging work by the Marine Resources Monitoring and Assessment Program at Gray's Reef National Marine Sanctuary during 2005.

Submitted to:

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Introduction

The Marine Resources Monitoring, Assessment, and Prediction (MARMAP) program has conducted research on reef fish between Cape Lookout, NC, and Cape Canaveral, FL, for 30 years. Sponsored by National Marine Fisheries Service (NMFS), the program mission has been to determine the distribution, relative abundance, and critical habitat of the economically and ecologically important fishes of the South Atlantic Bight and relate these to environmental factors and exploitation activities.

During 1993-1995, the MARMAP program monitored black sea bass abundance and conducted tagging work to assess the status of fish populations within the Gray's Reef National Marine Sanctuary (GRNMS). No sampling was conducted during 1996, 1997 and 2003.

In October 2005, stations at Grays Reef National Marine Sanctuary were again included in the MARMAP database and sampled in a non-destructive fashion during MARMAP's reef fish survey. Additionally, population abundance of black sea bass, *Centropristis striata*, in GRNMS was quantified by a tag recapture study, continuing efforts that were initiated in 1993 to assess the status of fish populations.

During October 2005 our objectives were to:

1. Conduct routine MARMAP reef fish sampling in GRNMS to assess species composition and length-frequency parameters.
2. Compare results from GRNMS to similar habitats that are routinely sampled by MARMAP.
3. Tag fishes within the sanctuary to monitor movements.
4. Conduct a population study of black sea bass via the Petersen method and compare results to those of 1993-1995, 1999-2002 and 2004.
5. Use tagging and length frequency data to estimate fishing mortality at GRNMS.

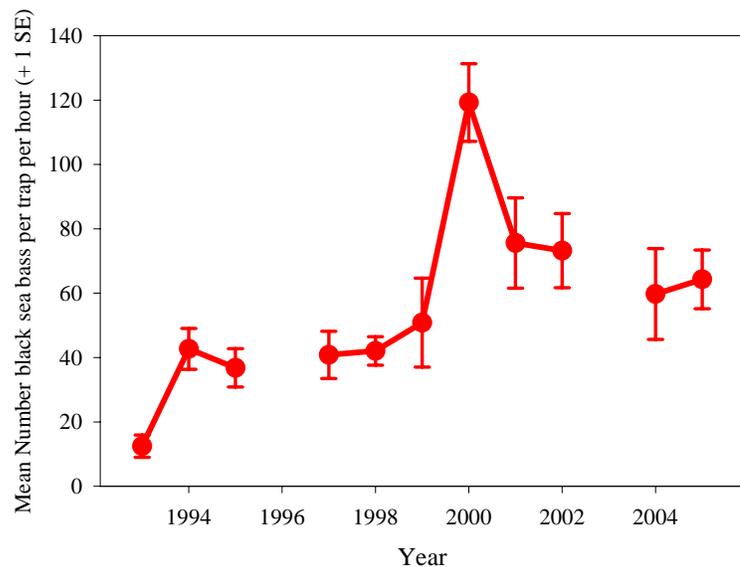
Conduct routine MARMAP reef fish sampling in GRNMS to assess species composition and length-frequency parameters.



During July 1993-1995, July 1998-2001, August 2002, and October 2004 - 2005, chevron-shaped wire fish traps (Collins 1990) baited with cut clupeids were deployed at randomly selected reef stations in GRNMS and soaked for approximately 90 minutes. After each trap set, depth, salinity, and temperature were measured with a CTD. All fishes were sorted to species, weighed and measured

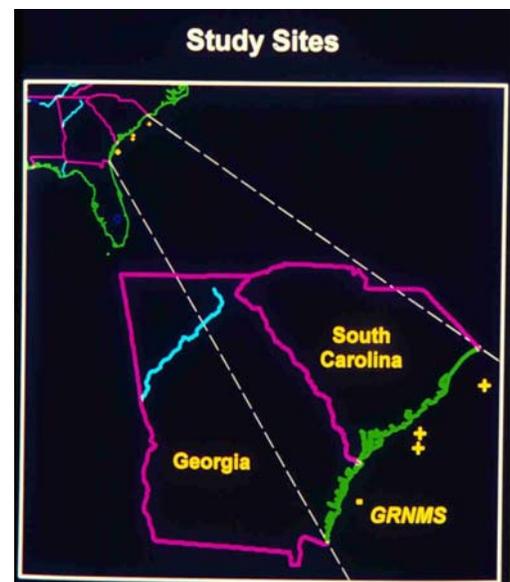
to the nearest cm and returned alive to the water. Ten species were caught in the chevron traps during October 2005. Catches were numerically dominated by black sea bass (95%) and scup (3%). The remaining 2% of the catch included pinfish, gray triggerfish, spottail pinfish, pigfish, scamp and leopard toadfish.

The average number of black sea bass caught per trap has increased since 1993 with a tremendous jump occurring during 2000. The number of black sea bass caught per trap decreased from an average of 119 fish in 2000 to 59 fish during 2004 followed by a slight increase in 2005. There has been an overall increasing trend in CPUE since 1993, with annual fluctuations.

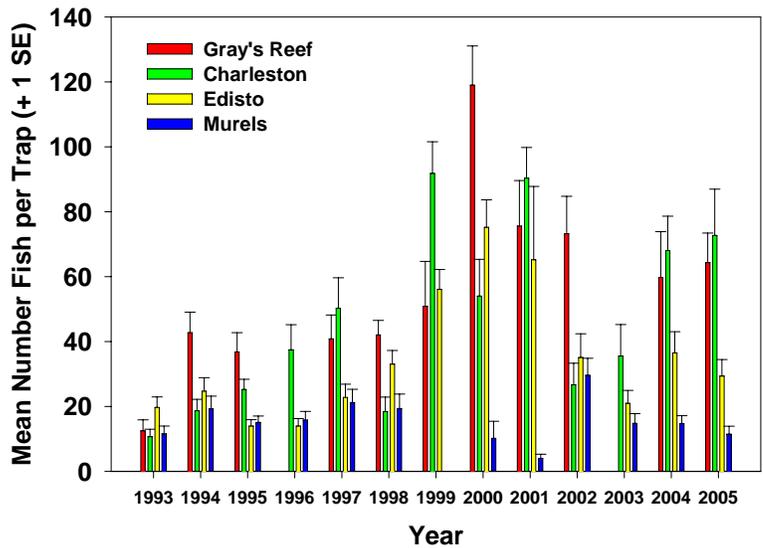


Compare results from GRNMS to similar habitats that are routinely sampled by MARMAP.

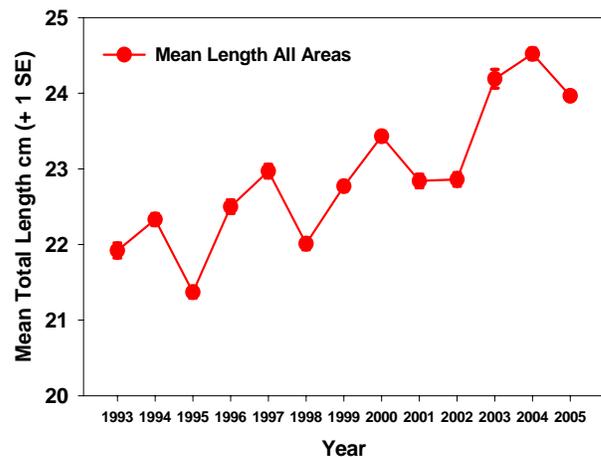
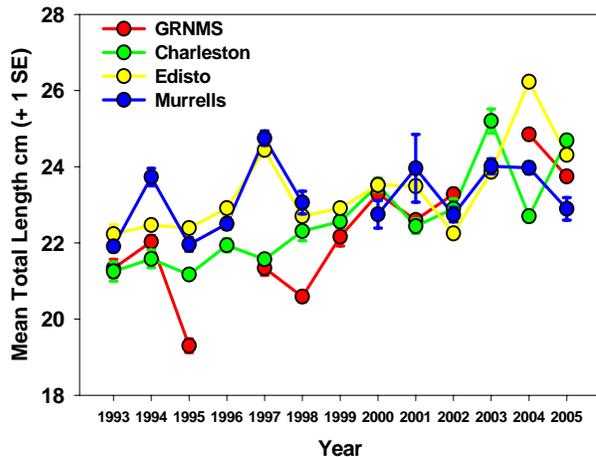
The average number of fish caught per trap and mean total length (TL) of black sea bass were compared to other study sites off Charleston (18 m; 32° 30' N, 79° 41' W), Edisto Island (26 m; 32° 16' N, 79° 43' W and Murrell's Inlet (26 m; 33° 16' N, 78° 26' W) that are similar in depth to GRNMS.



Relative abundance of black sea bass at GRNMS, Charleston and Edisto was much greater during 1999-2001 than during 1993-1998. However, there was a substantial decline in abundance at the Charleston and Edisto sites during 2002, which was reversed in 2004 and 2005. Abundance of black sea bass at GRNMS was much greater during 200 and 2002 than the other sites that are similar in depth.



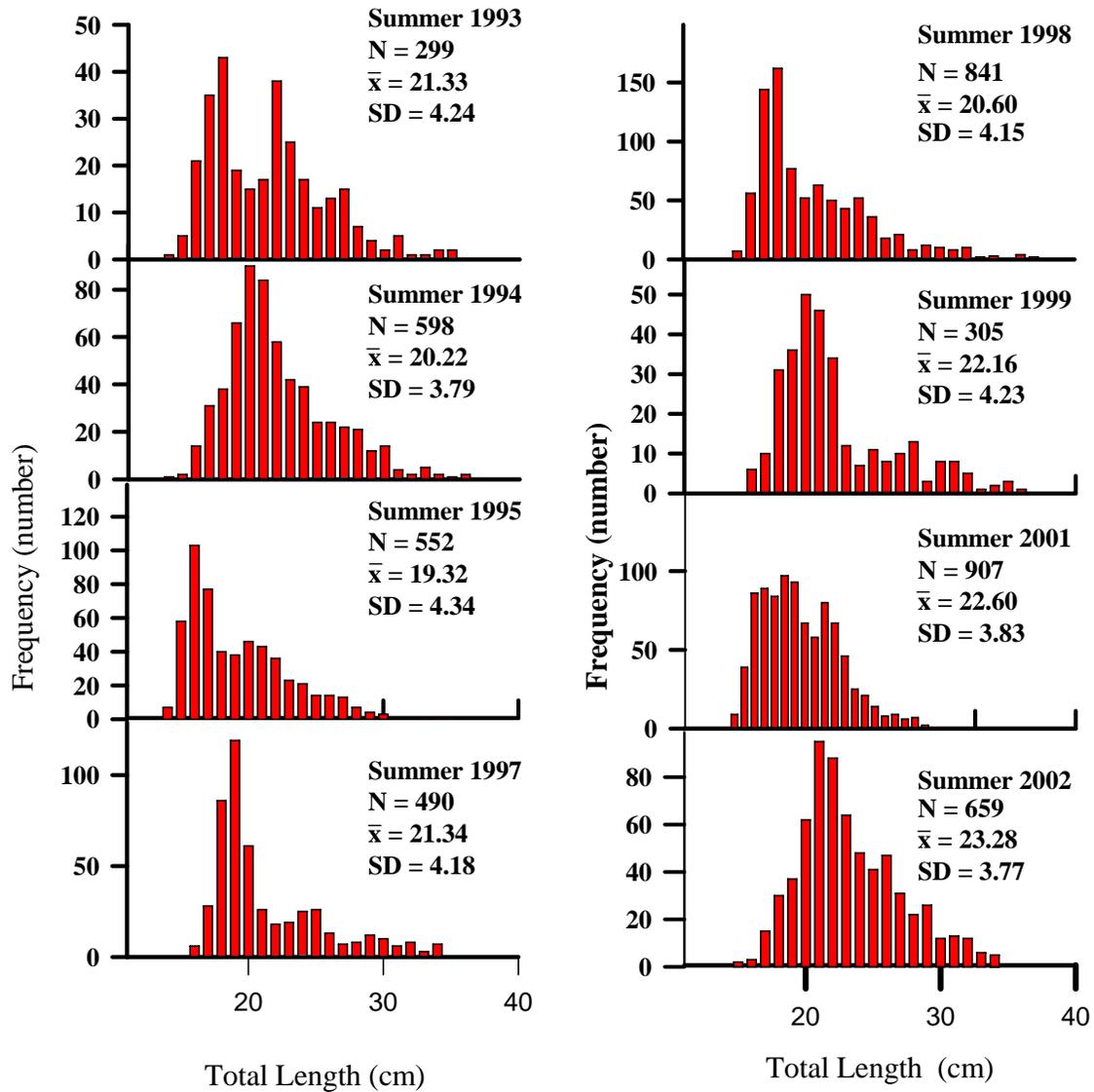
The mean length of black sea bass at all sites has gradually increased from 21.9 cm in 1993 to 24.5 cm TL in 2004 with a decrease to 23.8 cm in 2005. Like other locations, the mean length of black sea bass taken at Gray's Reef has gradually increased from 21.3 cm TL in 1993 to 24.9 cm TL in 2004, followed by a slight decrease to 23.7 cm TL in 2005. The mean length of black sea bass taken at GRNMS and the Charleston site which are both 18 m deep was usually smaller than mean length of black sea bass sampled at the 26 m sites (Edisto and Murrells), however, the large differences in 2005 between the four sites, were greatly reduced in 2005. We did not sample GRNMS in 1996 or off Murrells



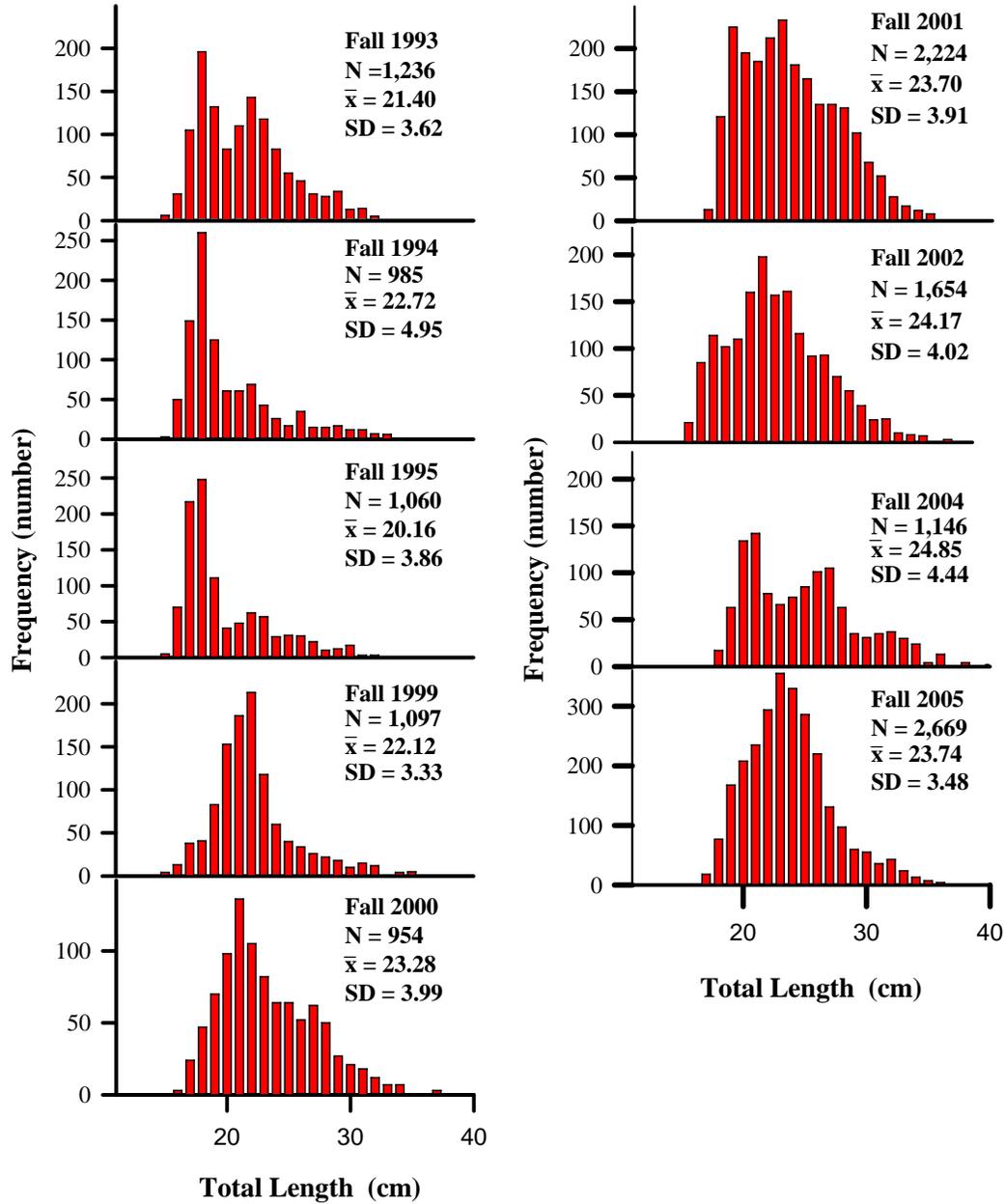
Inlet during 1999. The mean length of black sea bass at Grays Reef was greatest during 2004 and 2005. The overall increase in mean size is probably due to increased size limits (25 cm TL in 1999).

Length frequency plots of black sea bass caught with chevron trap during summer and fall of 1993 to 2001 revealed that there was a substantial increase in the number of larger fish caught by trapping gear in recent years than during 1993-1995. Larger fish were more frequently caught during fall in 2001 and 2002 than during the summer. The relatively consistent number of small fish caught each year suggests that the increase in mean size observed over time is probably not due to recruitment failure.

Black Sea Bass (Gray's Reef - Summer)



Black Sea Bass (Gray's Reef - Fall)



Tag fishes within the sanctuary to monitor movements.



During Summer 1993, Fall 1993-1995, and Fall 1999-2002 and 2004-2005, fishes of commercial and recreational importance were measured to the nearest mm and tagged at GRNMS. Numbered plastic internal anchor tags were inserted (usually on the left side of the body) anterodorsal to the anus. The tags had external streamers with printed information that was identical to the anchor. During the eight years, a total of 14,360 black sea bass were tagged at GRNMS. There were 971 fish recaptured through MARMAP sampling and recreational fishermen recaptured 236 fish.

Of the 266 fish recaptured by recreational fishermen to date, 20 (7.5%) were recaptured outside of GRNMS. Seven moved fairly large distances. Five were recaptured off Jacksonville, FL (111 km); two were recaptured off St. Augustine (167 km), and two have moved to the Charleston site (160 km). The remaining individuals moved between 34 and 56 km to live bottom areas surrounding GRNMS like the Savannah Snapper Banks.

Four of the fish that were recaptured outside of Gray's Reef were tagged during 2005. The average size of black sea bass tagged in 2005 recaptured by recreational fishermen was larger (312 mm TL) than the mean size of all black sea bass that were recaptured (266 mm TL). Additionally, black sea bass tagged in 2005 that were recaptured outside of GRNMS by recreational fishermen were larger (362 mm TL) than those recaptured by recreational fishermen with GRNMS (300 mm TL). It is likely that larger fish exhibit more movement. With the increase in the mean size of black sea bass, it may be that there is more movement away from Gray's Reef than occurred during previous years.

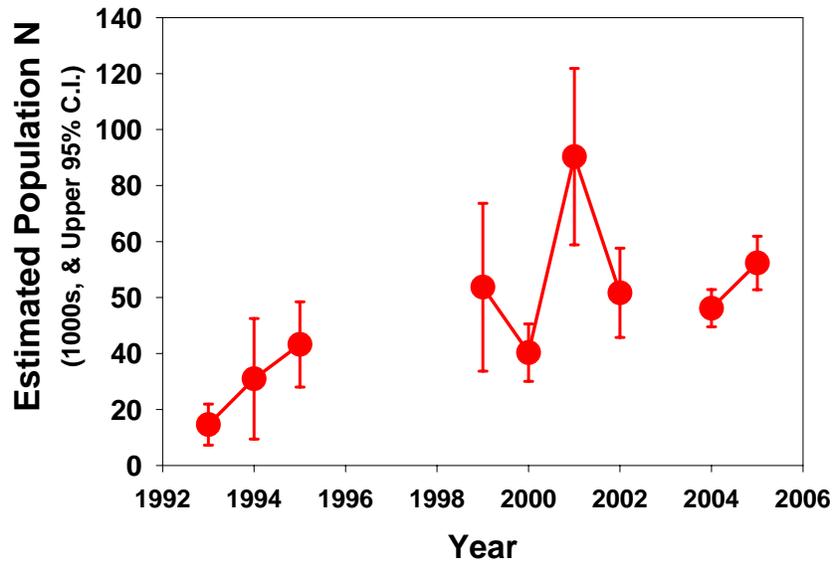


Conduct a population study of black sea bass via the Petersen method and compare results to those of 1993-1995 and 1999-2000.

A Petersen mark recapture experiment was conducted each fall from 1993-1995 and again during 1999-2005. The large area of GRNMS (5,822 ha) prohibited a tagging study of the whole Sanctuary. Therefore, a study was conducted in a small isolated reef area (480 ha) within GRNMS. Previous work indicated that the area was bounded by sand on two sides and



low to moderate relief on the other two sides. Due to the large number of black sea bass caught in traps during the last few years, the previous study area used during 1993-1995 was divided in half. The number of black sea bass determined from the population study was doubled so that comparisons could be made to previous years. On 18-19 October 2005, a total of 1,366 black sea bass were tagged, 1,322 were examined for tags during day 2, and 49 tagged individuals were recovered. The Petersen method provided an estimate of 72,342 individuals in the original study area. Estimated abundance of black sea bass at GRNMS showed a tremendous increase from 1993 to 2001 followed by a decrease through 2004. The population size estimate increased in 2005, and is the second highest estimate since 1993. The population appears to have increased steadily in size, albeit with annual fluctuations, since the first estimate was provided in 1993.



Use tagging and length frequency data to estimate fishing mortality at GRNMS.

Total mortality (Z) was estimated by linear regression from the slope of the natural logarithm of the age frequency that was fully recruited to trapping gear. An age length key was applied to the lengths of fish collected to determine the age frequency of black sea bass. Natural mortality (M) was estimated to be 0.30 from the equation $M = 2.98/\text{maximum age}$ (Hoenig 1983).

Table 1. Fishing mortality determined by catch curve analysis for black sea caught with trapping gear at GRNMS (summer and fall), Charleston, Edisto, Murrells and all other sites sampled by MARMAP during 1993-2004.

| Year | GRNMS (Summer) | GRNMS (Fall) | Charleston | Edisto | Murrells |
|------|----------------|--------------|------------|--------|----------|
| 1993 | 1.27 | 1.85 | 1.36 | 1.33 | 1.10 |
| 1994 | 1.33 | 1.51 | 1.10 | 1.13 | 1.48 |
| 1995 | 1.74 | 1.66 | 1.47 | 1.13 | 1.05 |
| 1996 | - | - | 1.55 | 1.15 | 1.47 |
| 1997 | 1.64 | - | 1.34 | 0.92 | 1.31 |
| 1998 | 1.23 | - | 1.15 | 1.05 | 1.39 |
| 1999 | 1.16 | 1.34 | 1.24 | 1.05 | - |
| 2000 | - | 1.22 | 1.19 | 1.13 | 1.00 |
| 2001 | 1.46 | 1.29 | 1.36 | 1.21 | 1.58 |
| 2002 | 1.77 | 1.43 | 1.10 | 1.29 | 1.32 |
| 2004 | - | 1.58 | 0.85 | 1.62 | 0.81 |
| 2005 | - | 1.12 | 0.97 | 0.77 | 0.54 |

At GRNMS, fishing mortality was lower during summer 1998-1999 than summer 1993-1995. In addition, fishing mortality during fall 1999-2001 was much lower than during fall 1993-1995. A decline in fishing mortality was also observed at most of the other sites sampled. Since 2002, fishing mortality at GRNMS appears to have increased substantially. During 2005, fishing mortality at GRNMS decreased to the lowest recorded since 1993, as did fishing mortalities at Edisto and Murrells. Only Charleston showed an increase in fishing mortality, but this was still the second lowest mortality recorded for this site. It is unclear why fishing mortality might have decreased in 2005.

Total mortality (Z) was also obtained from tag recaptures reported by recreational fishermen by the equation: $Z_i = -(\log_e R_2 - \log_e R_1)$ where R_1 = the number of fish that were recaptured six months (through April) following a tagging event in October of year i and R_2 = the number of fish that were recaptured after April following October tagging in year i .

Table 2. Fishing mortality determined by catch curve analysis at GRNMS (summer and fall) and tag recapture information during 1993-1995 and 1999-2002.

| Year | GRNMS (Summer) | GRNMS (Fall) | Tagging |
|------|----------------|--------------|---------|
| 1993 | 1.27 | 1.85 | 1.20 |
| 1994 | 1.33 | 1.51 | 1.40 |
| 1995 | 1.74 | 1.66 | 1.77 |
| 1999 | 1.16 | 1.34 | 1.62 |
| 2000 | - | 1.22 | 1.39 |
| 2001 | 1.46 | 1.29 | 0.39 |
| 2002 | 1.77 | 1.43 | 0.77 |
| 2004 | - | 1.58 | 1.08 |

With the exception of 2001 and 2002, estimates of fishing mortality determined from recapture data were similar to estimates determined from catch curve analysis. Fishing mortality could not be determined for 2004 because not enough time has passed for fishermen to report recaptures. Estimates of fishing mortality for Grays Reef are based on converting lengths to ages using age-length keys derived from black sea bass captured in areas which are open to all types of fishing. Therefore, an implicit assumption is made that the age structure of the black sea bass population at Grays Reef is very similar to that of other areas. In the absence of direct aging of specimens sampled from Grays Reef itself, there is no way to test the validity of this assumption.