Fish Assemblages of the Gulf of Mexico, including the Flower Garden Banks National Marine Sanctuary

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ABSTRACT

Biogeographic comparisons of the faunal compositions among regions can provide insight into the degree and direction of connectivity among regions, and highlight locations with relatively unique sets of taxa. We used data from the Reef Environmental Education Foundation (REEF) Fish Survey project to conduct a multivariate analysis of reef fish assemblages across sites throughout the Gulf of Mexico, including the Flower Garden Banks National Marine Sanctuary (FGBNMS). REEF coordinates a regional citizen science fish monitoring program with data that are input into a centralized, online database. Since 1994, REEF surveyors have collected nearly 5,000 roving diver surveys from 330 sites throughout the Gulf of Mexico, including 2,868 surveys within the FGBNMS. The fish assemblages of the FGBNMS, based on 10 years of data are summarized. The degree of faunal relatedness among regions in the Gulf of Mexico in terms of species composition is also presented, using a multivariate MDS plot. These results will be useful for marine resource management and planning at the FGBNMS and wider Gulf of Mexico, and emphasize the importance of large-scale data collection programs.

KEYWORDS: coral reef fish, Gulf of Mexico, Flower Garden Banks National Marine Sanctuary, volunteer monitoring, Reef Environmental Education Foundation (REEF) Fish Survey Project, biogeography, roving diver survey

Ensambladuras de los pescados del golfo de México: incluyendo el Flower Garden Banks National Marine Sanactuary

Las comparaciones biogeográficas de las composiciones del faunal entre regiones pueden proporcionar la penetración en el grado y la dirección de la conectividad entre regiones, y destacan localizaciones con los sistemas relativamente únicos de taxa. Utilizamos datos del proyecto ambiental de la encuesta sobre los pescados de Reef Environmental Education Foundation (REEF) para conducir un análisis multivariate de las ensambladuras de los pescados del filón a través de sitios a través del golfo de México, incluyendo el Flower Garden Banks National Marine Sanctuary (FGBNMS). REEF coordina un programa de supervisión regional de los pescados de la ciencia del ciudadano con los datos que se entran en una base de datos centralizada, en línea. Desde 1994, los topógrafos del REEF han recogido casi 5.000 encuestas sobre el zambullidor de la vagueación a partir de 330 sitios a través del golfo de México, incluyendo 2.868 exámenes dentro del FGBNMS. Las ensambladuras de los pescados del FGBNMS, basadas en 10 años de datos se resumen. El grado de relatedness del faunal entre regiones en el golfo de México en términos de composición de la especie también se presenta, usando un diagrama multivariate de MDS. Estos resultados serán útiles para la gerencia y el planeamiento marinas de recurso en el FGBNMS y el golfo de México más ancho, y acentúan la importancia de los programas en grande de la colección de datos.

PALABRAS CLAVES: el pescado del filón coralino, Golfo de México, Flower Garden Banks National Marine Sanctuary, voluntario que supervisa, Reef Environmental Education Foundation (REEF) Fish Survey Project, biogeografía, encuesta

INTRODUCTION

The Gulf of Mexico marine ecosystem, including the Flower Garden Banks National Marine Sanctuary (FGBNMS), is a unique resource, providing opportunities for recreation, tourism, and education to a worldwide audience. As with all marine ecosystems, the area faces increasing natural and anthropogenic threats and requires comprehensive inventory and monitoring data for effective management. Recreational divers are in a unique position to collect such information. Volunteer-collected data serve an important role in the management and understanding of natural resources. National, regional and local government strategies often include education and awareness as critical components. Citizen science programs meet the mandate for education and constituency building by training and involving volunteers. Such programs are also an ideal approach for managers needing to collect data with limited funds. Marine resource managers are consistently challenged to make decisions despite limited knowledge of the system they are charged to protect. Without complete inventories, management efforts themselves become incomplete.

The Reef Environmental Education Foundation (REEF) is an international marine conservation organization supporting hands-on grassroots activities designed to educate and engage local communities in conservation-focused activities. REEF coordinates the Volunteer Survey Project, an ongoing effort that enables volunteer divers to collect fish sighting information during recreational dives. The project originated in 1993, and to date has gathered more than 100,000 surveys throughout the Caribbean, Gulf of Mexico, west coast of the US and Canada, the tropical eastern Pacific, and Hawaii. The focus of the Volunteer Survey Project is on training divers to collect fish data, and

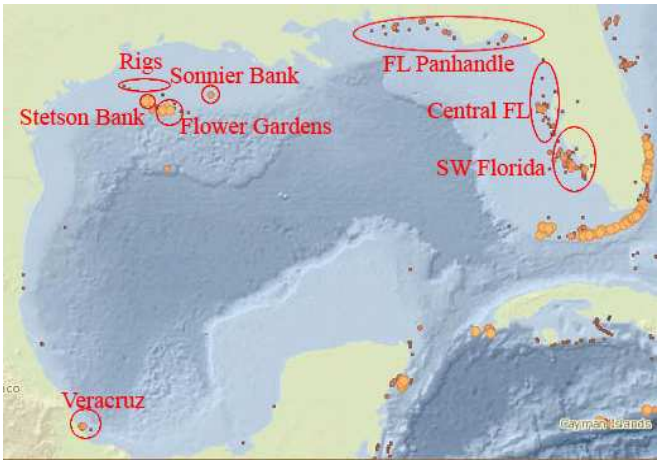

Figure 1. Map showing REEF survey locations in the Gulf of Mexico and the eight geographic areas used in the regional comparison (note that "Rigs" include several oil and gas platforms, and not all are enclosed in the circle on the map). As of September 2006, a total of 4,931 REEF surveys from 339 sites in the Gulf of Mexico had been conducted.

then managing this information, including annual reporting and website display. In 1995, REEF initiated a long-term monitoring project at the FGBNMS. This coordinated effort aims to generate a minimum amount of fish assemblage data collected from the Sanctuary each year, and compliments data collected at the FGBNMS by REEF volunteers during their regular diving activities. In addition to the FGBNMS surveys, REEF surveyors have conducted surveys at hundreds of additional locations throughout the Gulf of Mexico region, including the East Coast of Florida, the Florida Panhandle, oil platforms, and Veracruz (Mexico). This large regional dataset can provide for biogeographic comparisons of the fish assemblage compositions in the Gulf of Mexico, can provide insight into the degree of connectivity, and highlight locations with relatively unique sets of taxa.

Data collected through the REEF Volunteer Survey Project provide temporal documentation of fish composition changes over time and can be useful in the evaluation of the efficacy of management actions such as zones and harvest restrictions. In addition, the focus on total fish diversity provide critical data needed to better understand the effects of management strategies using an assemblage-wide approach, rather than traditional single species or single family analysis.

Between 1995 and September 2006, 2,984 REEF surveys were conducted in the FGBNMS and a total of 300 species were documented (including hybrids, a few lumped genera, and sea turtles). An additional 2,028 REEF surveys were conducted throughout the larger Gulf of Mexico region. This paper summarizes these data and includes a comprehensive species list, trend information on key species, and a regional comparison of fish assemblages. Figure 1 shows a map of the areas included in the regional comparison.

STUDY AREA

The East and West Flower Garden Banks (EFG and WFG), located 110 km southeast of Galveston, Texas, are underwater features on the edge of the U.S. Gulf Coast continental shelf. The banks were caused by the uplift of Jurassic age salt and rise about 100 m above the surrounding depths to within 18 m of the surface. The banks support bank reefs that are the northernmost coral reefs in the continental U.S. The reefs of the Flower Garden Banks have been well documented and are characterized by low coral diversity, high coral cover, large coral size, and low macroalgae abundance relative to most Caribbean reefs (Boland *et al.*, 1983; Bright *et al.*, 1974; Bright and Pequegnat, 1974; Dennis, 1985; Dennis and Bright, 1988; Gittings *et al.*, 1993; Rezak *et al.*, 1985). The Flower Gardens are dominated by massive boulder coral species and lack gorgonian and acroporid species.

Stetson Bank (SB) is located approximately 112 km south southeast of Galveston, Texas. The bank is an outcrop of consolidated sedimentary rock (sandstone, siltstone and claystone) thrust upward by an underlying salt dome (Bright et al. 1974). The upper zone (17 m to 36 m) encompasses 0.134 km^2 of the bank and consists of a variety of habitats, including pinnacles, near vertical walls, cone shaped mounds, road-like plateaus and numerous crevices (Hyde 1993). The average depth of the upper zone is 23m and the shallowest depth is 16.8 m.

Fish diversity at these banks is comparatively low (approximately 300 species), but abundances are high (Pattengill, 1998, REEF Database, 2006). Fish families and groups that are notably absent or only represented by one or few species in low abundance include grunts (Haemulidae), snappers (Lutjanidae), and hamlets (*Hypoplectrus* sp.).

The EFG and WFG are managed and protected by the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Sanctuary Program and the Department of Interior's Minerals Management Service, and, together with Stetson Bank, they make up the Flower Garden Banks National Marine Sanctuary (FGBNMS).

The Florida Panhandle features many barrier islands and beaches that are generally wave dominated (Geselbracht *et al.* 2005). The area also includes the Apalachicola River fluvial delta and has a relatively steep offshore gradient. Farther east and south, the coastal habitat transitions into the West Central and Southwest Coast Florida region, which is known for its diverse barrier island system and a wide Continental Shelf that extends more than 160 km out into the Gulf of Mexico. There are approximately 3,500 oil and gas platforms in the Gulf of Mexico. Many of these are well known sport diving locations due to the interesting mix of reef-associated and pelagic species. The area around Veracruz (Mexico) includes

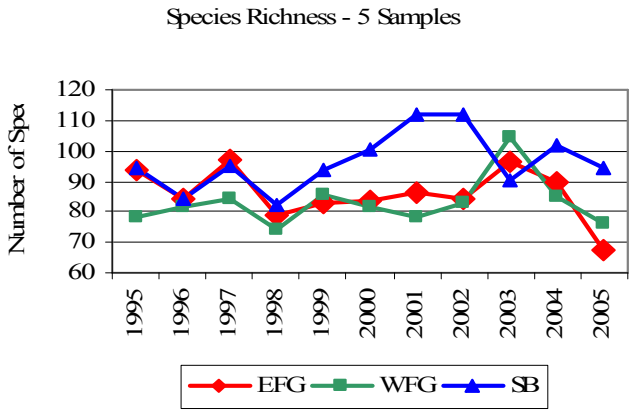

Figure 2. Fish species richness at the FGBNMS over a 10-year period. Richness estimates are based on Expert sightings with a sample size of 5 surveys, using the Michaelis-Menten model for species accumulation. Species richness was highest at Stetson Bank in most years and there has not been a significant positive or negative trend in richness during the study period.

Table 1. REEF survey effort by year at each of the three banks of the FGBNMS, total effort followed by REEF Expert Surveyor effort in italics

YEAR	WFG	EFG	SB
1995	106 (*20*)	101 (*22*)	67 (*25*)
1996	149 (*23*)	148 (*25*)	75 (*16*)
1997	203 (*32*)	180 (*33*)	70 (*20*)
1998	62 (*16*)	74 (*14*)	36 (*8*)
1999	73 (*21*)	86 (*15*)	69 (*12*)
2000	65 (*16*)	81 (*27*)	70 (*23*)
2001	90 (*13*)	137 (*13*)	119 (*14*)
2002	63 (*5*)	77 (*27*)	68 (*6*)
2003	96 (*59*)	49 (*43*)	72 (*38*)
2004	63 (*27*)	74 (*43*)	95 (*44*)
2005	24 (*8*)	26 (*6*)	68 (*25*)

small, platform-type reefs. Reefs in this area are highly stressed. Stressors include both anthropogenic impacts such as physical damage, land-based pollution, and physical removal of coral for building materials, as well as natural stresses due to low winter temperatures and runoff during the rainy season (Lang *et al.* 1998).

METHOD

REEF surveyors collect fish assemblage data using the Roving Diver Technique (RDT; Schmitt and Sullivan 1996). The RDT is a non-point survey method and involves divers moving freely about a dive site. During a survey dive, all positively identified fish species are recorded. Cumulative log scale abundances of each species are also estimated during the dive and updated at the conclusion of the dive. Categories of abundance are Single (1), Few (2-10), Many (11-100), and Abundant (> 100). Other data recorded include the date, location, survey start time, estimated visibility, and observer's name. REEF volunteers submit their survey data on paper scanforms (online data entry was introduced in 2005). After scanforms are received, REEF staff manually review the forms to ensure completeness and to check for errors. The scanforms are then optically scanned. The resulting data file is loaded onto the REEF data server, a custom quality control program is run to check the file against the existing REEF data and for additional errors. Once the file has been checked, the data are parsed into an SQL database. The paper scanforms are then electronically archived as images through NOAA's Climate Data Modernization Program. The SQL database then serves as the backbone for a variety of summary reports that can be run from the REEF website; REEF staff also generate raw data files based on custom queries.

In partnership with the FGBNMS, REEF has coordinated teams of REEF surveyors to conduct fish surveys at the EFG, WFG, and SB each year, starting in 1995. The survey teams consist of Advanced Assessment Team REEF Experts; these are surveyors who have conducted a minimum number of REEF surveys and have passed an experience level exam. Beginning in 2003, following a series of REEF training workshops for Veracruz Marine Park staff and volunteers, a team of divers started an ongoing fish monitoring programs in the park. Their efforts have generated hundreds of surveys in and around the park. Unlike these areas, where coordinated survey projects have primarily led to a large number of REEF surveys, REEF survey efforts along the west coast of Florida has primarily resulted from resident REEF members who conduct surveys during their ongoing diving activities.

RESULTS

During the 10-year period, a total of 2,836 Species and Abundance REEF surveys were conducted within the FGBNMS; 994 at the WFG, 1,033 at the EFG, and 809 at SB (Table 1). An additional 32 Species-Only REEF surveys were conducted during this time. These are surveys that record only species presence (no abundance data) and may or may not represent a comprehensive species list and can include sightings over multiple dives. Surveys were conducted at all buoys at each bank; however survey effort was concentrated on the historical monitoring buoys at WFG #5 (526 surveys), EFG #2 (470 surveys), and at the center buoy on SB (#2; 394 surveys). Survey effort varied from year to year and ranged from 24 surveys to 203 surveys (Table 1).

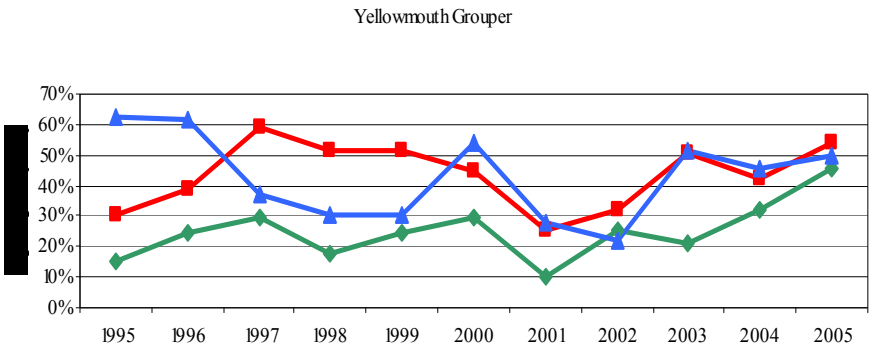

Figure 3. Sighting Frequency of yellowmouth grouper (*Mycteroperca interstitialis*) at the FGBNMS over a 10-year period. While yellowmouth grouper is the most frequently sighted grouper in the Sanctuary, this species has exhibited periodic increases and decreases in frequency at all three banks.

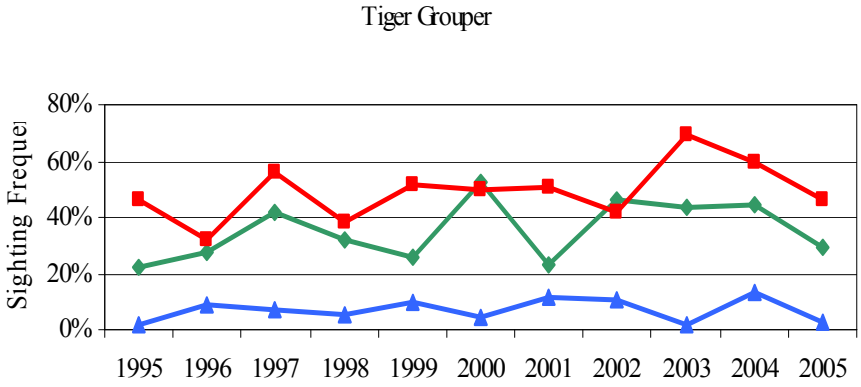

Figure 4. Sighting Frequency of tiger grouper (*Mycteroperca tigris*) at the FGBNMS over a 10-year period. While rare at SB, tiger grouper is the second most frequently sighted grouper at the FGB. This species exhibits significant variation from year to year at the FGB.

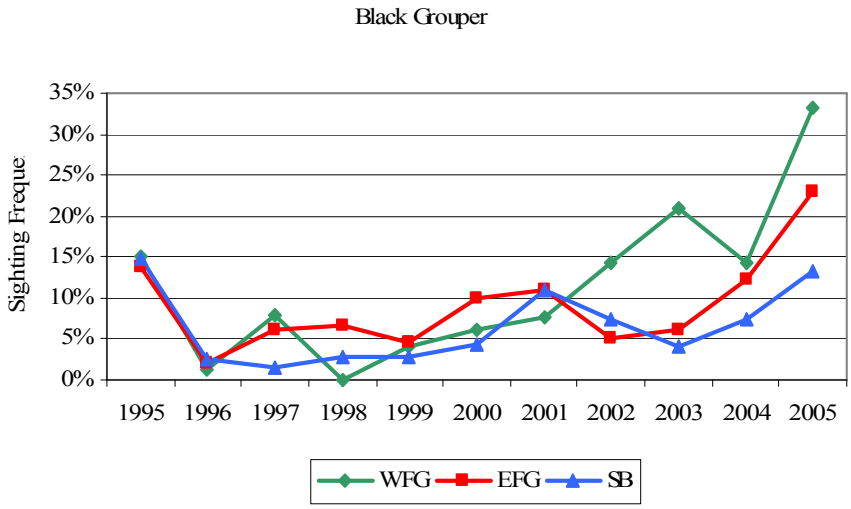

Figure 5. Sighting Frequency of black grouper (*Mycteroperca bonaci*) at the FGBNMS over a 10-year period. Black grouper appear to be increasing in frequency at all three banks in recent years.

The RDT data provide a relatively complete inventory of fishes for each of the banks in the Sanctuary. Total species richness, based on all RDT surveys conducted between 1995 and 2005 is 300 species (which includes a few hybrid species, a few lumped genera, and sea turtle species); 224 species at the WFG, 233 species at the EFG, and 256 species at SB. Of the 300 species, 28 species were only documented by Expert REEF surveyors and 57 species were only documented by Novice REEF surveyors. Those species only documented by Novice surveyors include very rare or non-resident species (e.g. pelagics) as well as species that were potentially mis-identified.

The top 25 most frequently sighted species are shown in Table 2. There is considerable overlap in top ranked species among all three banks. However, SB has a few species that are frequently sighted species that are more rare at the FGB, including blue angelfish and rock hind. Similarly, species that are frequently sighted at the FGB but rare at SB include black durgon, longsnout butterflyfish, ocean triggerfish, princess parrotfish, queen parrotfish, stoplight parrotfish, and threespot damselfish.

To compare species richness for each FGBNMS monitoring event, it was necessary to compensate for uneven effort between years and between banks. Species accumulation curves were generated using Monte Carlo randomization (1,000 runs) and the Michaelis Menten Mean estimator was used to estimate richness based on 5 Expert surveys (the minimum number of surveys during a given year). Richness estimates by bank and year are shown in Figure 2. Species richness was highest at SB in most years. While the richness estimates vary from year to year, there is not a significant positive or negative trend in richness during the study period. The effect of sample size was evaluated, using the Michaelis Menten Mean estimator based on 5, 12 and 20 Expert surveys and a similar temporal pattern of richness was seen regardless of sample size.

In addition to species lists and sighting frequency, the basic statistic generated from REEF data is the Density Score, which is a weighted average of the abundance categories reported for each species. This score can then be combined with non-sightings information (Sighting Frequency) to generate an Abundance Score. It is calculated as: abundance score = $[(n_S x1)+(n_F x2)+(n_M x3)+(n_A x4)] / (n_S + n_F + n_M + n_A)$ * percent sighting frequency, where n is the number of times each abundance category was assigned.

The trends in either abundance score or sighting frequency between 1995 and 2005 at the FGBNMS for several key species and families were evaluated (Figures 3-10). Sighting frequency is shown for some species, rather than abundance score, because it is a more sensitive measure of change for species that, when sighted, only one or few individuals are seen.

Changes in sighting frequency of the most common grouper species, yellowmouth grouper, are shown in Figure 3. While this species is the most frequently sighted species, yellowmouth grouper has exhibited periodic increases and decreases in frequency at all three banks during the 10-year study period, with the lowest numbers in 2001 and 2002. Tiger grouper trends are shown in Figure 4. While rare at SB, tiger grouper is the second most frequently sighted grouper at the FGB and has been seen in approximately 40% of the surveys there. This species has exhibited significant annual variation, ranging from 20%-70% sighting frequency from year to year. Trends in black grouper are shown in Figure 5. While infrequently sighted throughout most of the study period, this species appears to be on the increase at all three banks over the last few years.

Figure 6 shows trends in sighting frequency of gray snapper, the only snapper frequently found in the FGBNMS. Gray snapper is consistently higher in abundance and frequency at SB, and frequency at the FGB appears to be cyclical, alternating between periods of low and higher frequency.

Figure 7 shows the abundance score of cocoa damselfish through time. This species is one of the most common damselfish in the Sanctuary. While its abundance was relatively steady throughout most of the time period, a significant decline was noted at all three banks in 2002.

Figures 8a and 8b show the trend in abundance score of three species of parrotfish, stoplight, queen, and princess, at the EFG and WFG over the 10-year study period. There appears to have been a marked decrease in abundance of both the queen and princess parrotfish since 2001. Figure 9 shows the trend in abundance for all species of angelfish combined. Angelfish populations have remained relatively stable over the last 10 years. However, this family of fish, which are predominately spongivores, may exhibit future declines due to the recent spread of a sponge disease that is decimating many of the large sponges in the Sanctuary (Emma Hickerson, FGBNMS, personal communication). The REEF database will serve as a valuable baseline of data for this potential indicator family of fishes.

Figure 10 shows the dramatic change in sighting frequency in trumpetfish over the 10-year period. This species, while never overly common, was a consistent member of the FGB fish community and was seen approximately 25% of the time. However in 2002/2003, this species has all but disappeared from the Sanctuary. It has always been rare at SB. A similar precipitous decline has been documented in the REEF database for this species in several other locations throughout the Caribbean, including the north Bahamas, Cayman Islands, Bermuda, and southeast Florida.

Scaling up from individual species through time at the three banks in the FGBNMS, REEF data from the Gulf of Mexico was used to conduct a regional comparison of the fish assemblages among eight geographic areas. The areas, shown in Figure 1, include Flower Garden Banks (EFG and WFG combined), Stetson Bank, Sonnier Bank (a nearby bank that has been considered as a potential candidate for inclusion in a future boundary expansion of the FGBNMS),

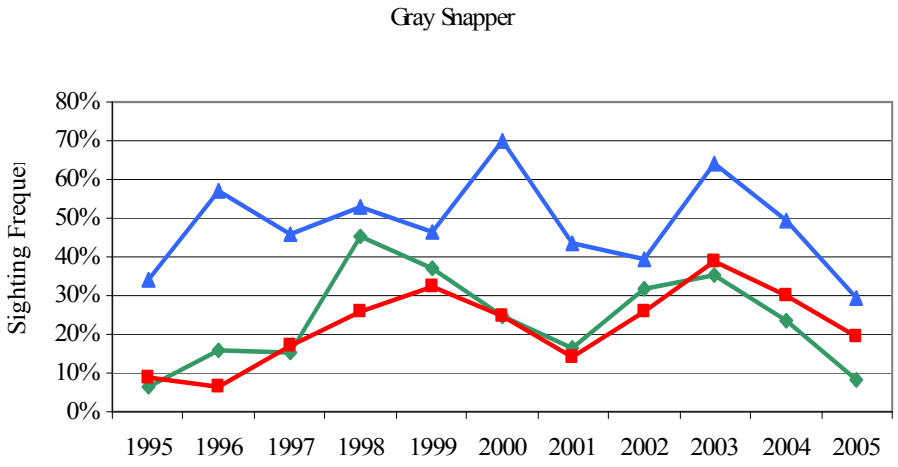

Figure 6. Sighting Frequency of gray snapper (*Lutjanus griseus*) at the FGBNMS over a 10-year period. Gray snapper are more frequently sighted at SB than at the FGB. Frequency at the FGB appears to be cyclical, alternating between periods of low and higher frequency.

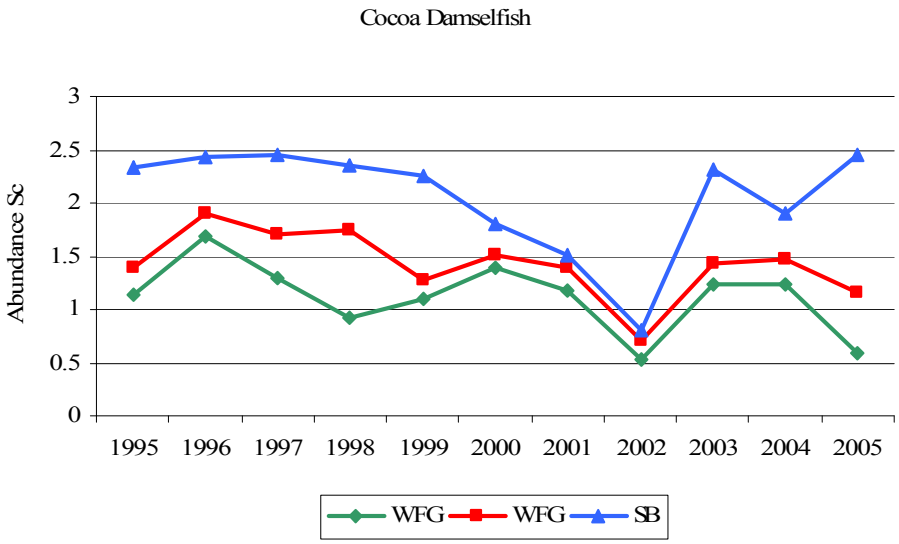

Figure 7. Abundance Score of Cocoa Damselfish (*Stegastes variabiliss*) at the FGBNMS over a 10-year period. This is one of the most common damselfish in the Sanctuary. While it's abundance was relatively steady throughout most of the time period, a significant decline was noted at all three banks in 2002.

several oil platforms in the northwest Gulf (including some nearby the banks as well as a few closer inshore and one blue water platform), the Florida panhandle, central west coast Florida, southwest Florida, and Veracruz, Mexico. Data from 1995 to September 2006 was used in this analysis and included a total of 4,931 REEF surveys from 339 sites in the Gulf of Mexico. Abundance Score data for the top 100 most frequently sighted species for each region was calculated and used in a similarity analysis. Results of the similarity analysis was then used to develop a Multi-Dimension Scaling Analysis plot (Figure 11). Sites generally clustered by geographic location and followed a west to east and nearshore to offshore/coral reef gradient. The oil platforms scattered throughout the plot, representing the varying locations of the rigs from inshore to offshore to bluewater. A similar Multi-Dimensional Scaling Analysis was done using only data from the FGBNMS and Sonnier Bank (Figure 12). Sites clustered by bank. Additional partitioning was seen between the EFG/WFG and SB/Sonnier.

CONCLUSION

Since 1995, over 5,000 visual fish surveys have been conducted by volunteers at hundreds of reef sites throughout the Gulf of Mexico as part of the REEF Volunteer Survey Project. This dataset represents a valuable source of

information over a wide geographic and temporal scale that would otherwise not be available. This fish assemblage data were used to evaluate the overall faunal similarity between the different reef regions of the Gulf of Mexico. Species-specific trends and patterns of species richness were also evaluated using 10 years of data from the FGBNMS. In addition to the descriptive analyses presented here, this dataset will serve as a useful baseline of information to evaluate future change in regional reef fish assemblages. Furthermore, because these data are part of the larger REEF database, larger regional analyses can be conducted.

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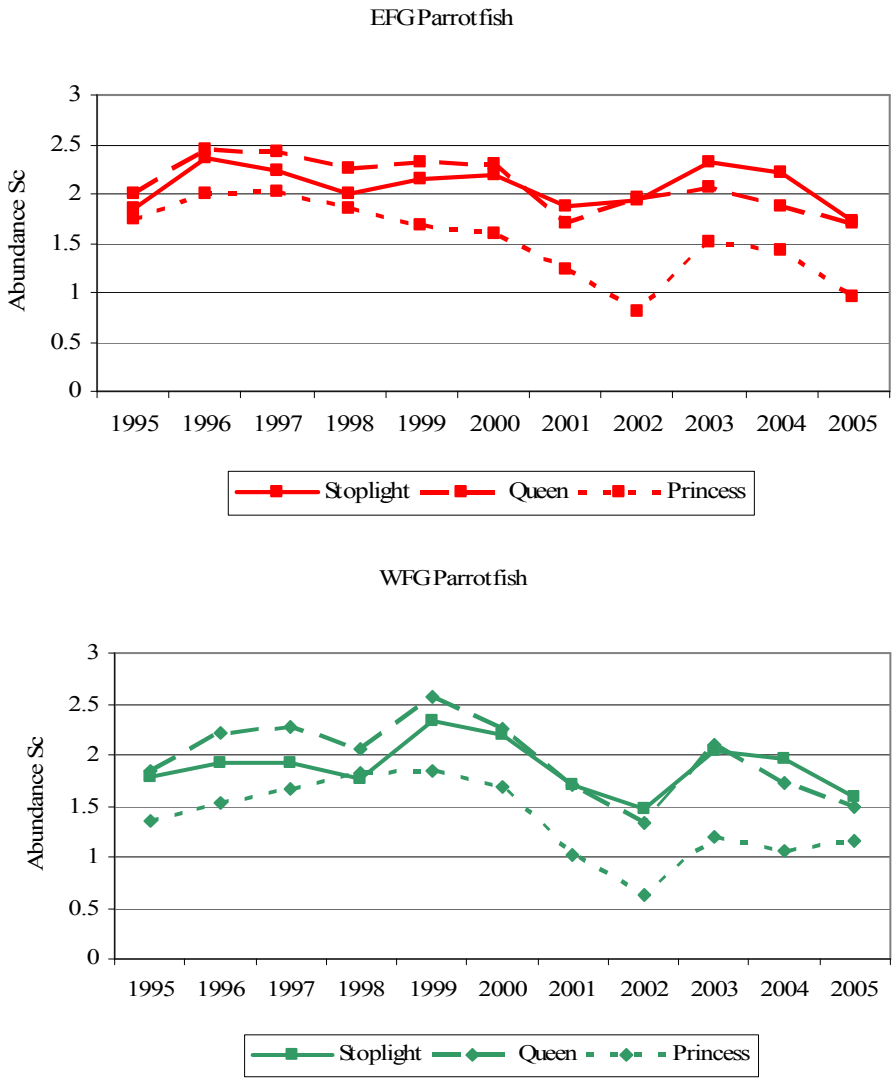

Figures 8a and 8b. Abundance Score of three species of parrotfish (Stoplight – *Sparisoma viride*; Queen – *Scarus vetula*; Princess – *Scarus taeniopterus*) at the EFG (Figure a) and WFG (Figure b) over a 10-year period. Overall abundance of queen parrotfish and princess parrotfish has been markedly lower since 2001 than it was between 1995-2000.

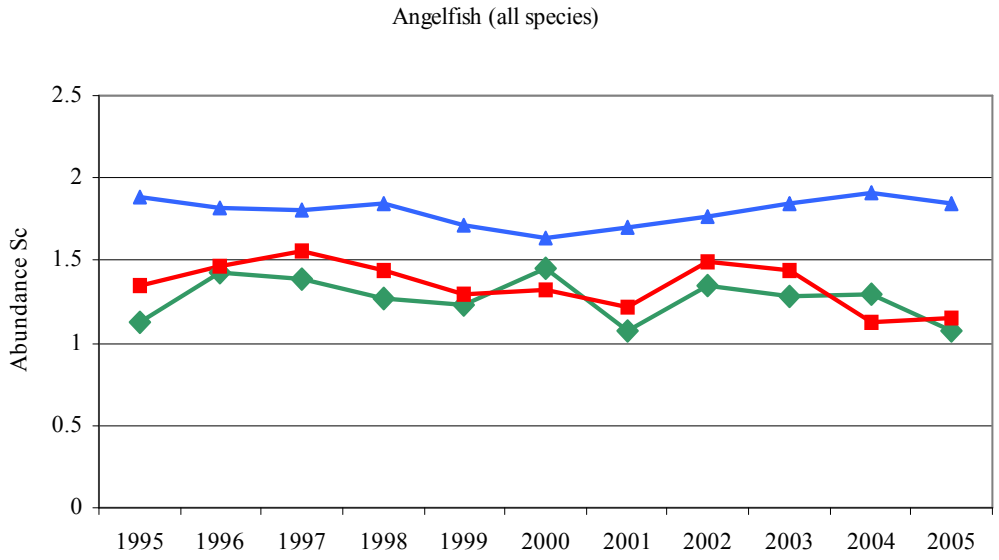

Figure 9. Abundance Score of angelfish (Pomacanthidae, all species combined) at the FGBNMS over a 10-year period. Angelfish populations have remained relatively stable during the time period. However, this family of fish, which are predominately spongivores, may exhibit future declines due to the recent spread of a sponge disease that is decimating many of the large sponges at the bank

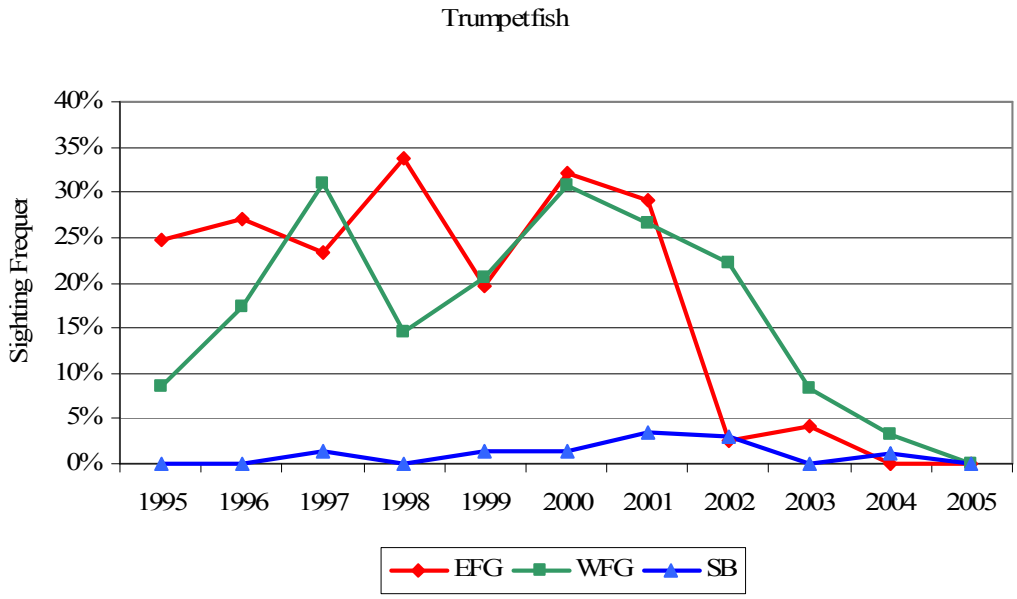

Figure 10. Sighting frequency of trumpetfish (*Aulostomus maculates*) at the FGBNMS over a 10-year period. This previously relatively frequently sighted species has dramatically declined at the FGB since 2002/2003. A similar pattern has been documented at other locations throughout the Caribbean. The species is rarely sighted at SB.

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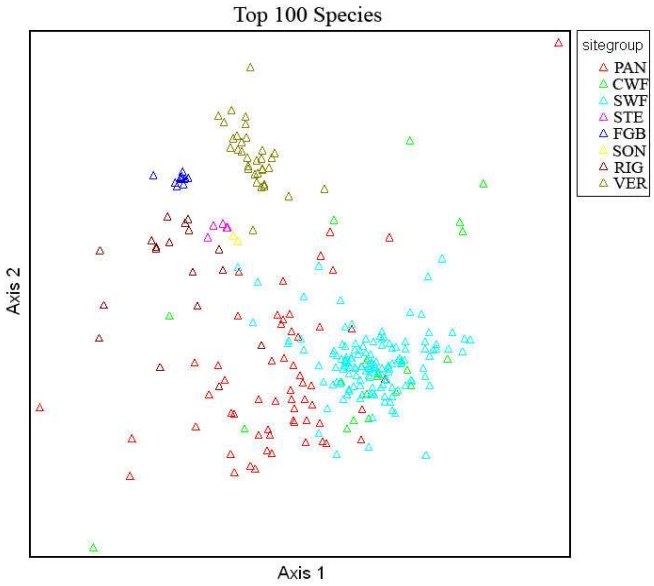

Figure 11. Multi-Dimensional Scaling Analysis Results. The plot shows the pattern of similarity in fish species assemblages by site, color-coded by region. Data included in the analysis were Abundance Score for the top100 most frequently sighted species. Region abbreviations are: PAN – Florida Panhandle, CWF – Central West Florida, SWF – Southwest Florida, STE – Stetson Bank, FGB – Flower Garden Banks, SON – Sonnier Bank, RIG – Oil Platforms, VER – Veracruz. Sites generally clustered by geographic location and followed a West to East and nearshore to offshore/coral reef gradient. Oil platforms scattered throughout the plot, representing the varying locations of rigs from

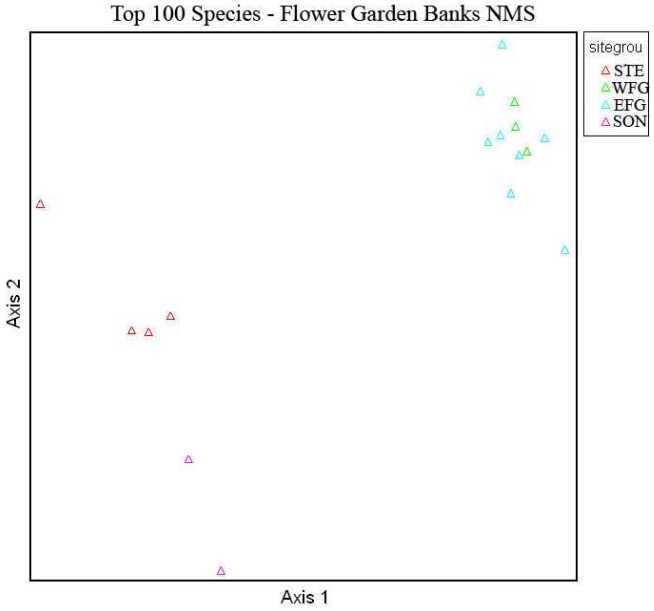

Figure 12. Multi-Dimensional Scaling Analysis Results. The plot shows the pattern of similarity in fish species assemblages by site within the FGBNMS and Sonnier Bank, color-coded by bank. Data included in the analysis were Abundance Score (a weighted average of RDT abundance categories) for the top100 most frequently sighted species. Sites clustered by bank. Additionally partitioning is seen between the East and West Flower Garden Banks and Stetson Bank with Sonnier Bank.

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Table 2. Top 25 most frequently sighted fish species at the FGBNMS during a 10-year period (1995-2005). Sighting Frequency and Density Score are given.

	WFG			EFG			SB		
Rank		**%SF**	**DEN**		**%SF**	**DEN**		**%SF**	**DEN**
1	Great Barrcuda	94.4%	2.7	Great Barrcuda	94.0%	2.7	French Angelfish	90.1%	2
2	Bluehead	88.4%	3	Stoplight Parrotfish	88.9%	2.4	Reef Butterflyfish	87.1%	2.3
3	Blue Chromis	86.1%	3.1	Blue Tang	88.5%	2.4	Smooth Trunkfish	87.1%	2
4	Blue Tang	85.7%	2.3	Brown Chromis	87.2%	3.6	Spanish Hogfish	83.5%	2.5
5	Stoplight Parrotfish	84.7%	2.2	Reef Butterfly-fish	87.1%	2.2	Bluehead	83.2%	2.9
6	Reef Butterfly-fish	84.5%	2.1	Blue Chromis	86.9%	3	Rock Hind	82.5%	2.7
7	Queen Parrot-fish	84.2%	2.4	Bluehead	85.9%	3.2	Brown Chromis	79.2%	3.5
8	Bicolor Dam-selfish	82.8%	2.6	Bicolor Dam-selfish	85.8%	2.8	Sharpnose Puffer	79.2%	2.3
9	Brown Chromis	82.0%	3.4	Queen Parrot-fish	85.4%	2.5	Great Barracuda	76.9%	2.3
10	Black Durgon	81.9%	2.4	Black Durgon	83.8%	2.3	Bermuda/Yellow Chub	76.2%	3
11	Bermuda/ Yellow Chub	80.5%	3	Bermuda/ Yellow Chub	81.4%	3.2	Creole-fish	76.2%	3.6
12	Sharpnose Puffer	74.6%	2.4	Sharpnose Puffer	79.7%	2.6	Spotted Goatfish	75.2%	2.3
13	Spanish Hog-fish	72.7%	2.4	Spanish Hog-fish	79.1%	2.4	Bicolor Damsel-fish	72.4%	2.5
14	Threespot Damselfish	72.5%	2.6	Threespot Damselfish	78.9%	2.8	Blue Angelfish	71.6%	1.7
15	Smooth Trunk-fish	69.9%	1.7	Smooth Trunk-fish	76.6%	1.7	Seaweed Blenny	68.6%	2.9
16	Creole-fish	68.6%	3.2	Yellowtail Damselfish	76.5%	2	Doctorfish	67.6%	2.1
17	Rock Beauty	67.9%	1.7	Creole-fish	73.7%	3.2	Cocoa Damselfish	67.1%	3
18	Longsnout But-terflyfish	66.6%	1.8	Rock Beauty	72.3%	1.8	Spotfin Butterfly-fish	66.8%	2
19	Princess Parrot-fish	64.9%	2.1	Princess Parrot-fish	72.0%	2.2	Squirrelfish	66.1%	1.7
20	Graysby	64.5%	1.7	Graysby	69.0%	1.8	Rock Beauty	63.6%	1.8
21	Yellowhead Wrasse	63.6%	2.3	Yellow Goat-fish	65.5%	2.3	Redband Parrot-fish	62.3%	2
22	Yellowtail Damselfish	58.5%	1.8	Cocoa Damsel-fish	64.8%	2.3	Ocean Surgeon-fish	62.2%	2.1
23	Yellow Goat-fish	57.8%	2.2	Yellowhead Wrasse	62.6%	2.3	Queen Angelfish	61.5%	1.7
24	Cocoa Damsel-fish	56.5%	2.1	Ocean Surgeonfish	61.7%	2.1	Redlip Blenny	55.8%	2.1
25	Ocean Trigger-fish	52.8%	1.9	Neon Goby	55.1%	2.1	Neon Goby	54.9%	2.2