

Final Report

Biscayne Cryptic Reef Fish Inventory

March 2005 - September 2006

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March 18, 2005 through September 22, 2006

Abstract

Between March, 2005 and September 2006 teams of REEF expert volunteers conducted 337 visual fish censuses at 158 sites among 9 habitat types within the Biscayne National Park (BNP) near Miami, Florida. 276 species were documented during the biannual surveys from 10,728 sightings records, adding 66 species to the BNP inventory list of fishes present in the park. This effort resulted in significant increases to the BNP fish species list utilizing a cost effective, volunteer-based, non-extractive method. These data may also be of considerable value in other education/outreach efforts and as baselines for future studies.

Background

Need - In order to more effectively understand and manage National Park resources, comprehensive natural and biological inventories are needed. Establishing comprehensive inventories or species lists in marine environments has been difficult, expensive and in most cases extractive. As part of a new partnership between the National Park Service (NPS) and the Reef Environmental Education Foundation (REEF), the South Florida and Caribbean Network (SFCN) contracted REEF to conduct a two-year inventory project of reef fishes within Biscayne National Park. SFCN and REEF anticipate that the project will serve as an example for future surveys utilizing volunteer experts for visual identification, and non-extractive methods for dataset augmentation.

History (other data sets in BNP, elsewhere) – Prior to this effort, historical data sets for fishes within the BNP included 130 species reported from creel surveys (Creel) of fishers in the park, 150 species by trawl surveys (Trawl) conducted by BNP staff, and 180 species by reef fish visual census (RVC) surveys conducted by NMFS researchers. These species were reported from all habitat types found in the park and exact locations of many records were not available. Inventory efforts at other NPS locations have utilized rotenone-based collections or other extractive methods at specific sites and at a relatively small scale. While providing comprehensive collections, these methods have been met with some criticism for their use of chemicals and their non-repetitive, extractive nature.

Purpose (why REEF RDT) – As part of a priority to gather complete inventories of NPS biological resources in an ecologically sensitive manner, REEF was contracted to pilot a visual census of reef fishes in BNP waters to include all habitat types and depth ranges within park boundaries. The methods used in this survey were non-extractive (with the exception of 15 specimens collected for the BNP museum collection), utilized volunteer expert observers and included large spatial coverage of various BNP habitats.

REEF history – REEF is a Key Largo-based non-profit organization that was founded in 1990 to train recreation divers in visual fish identification and publish their observations for use by scientific, resource management, and education communities as well as the general public. Since the first data collection in 1993, volunteers have

generated more than 100,000 surveys from throughout the Tropical Western Atlantic, coastal North American, and Tropical Eastern Pacific and Hawaiian waters. The database is publicly accessible at www.reef.org and remains the world's largest sightings database of living marine resources. REEF divers are trained in visual identification of marine fishes in specific regions, and their expertise is categorized through 5 different experience levels. REEF experts (level 4 and 5) were utilized in this study and have passed comprehensive visual ID exams and shown considerable expertise in conducting visual censuses.

Methodology

Effort – The planned effort for this study included 288 surveys at 144 sites to be conducted during 4 semi-annual surveys. Actual effort was considerably higher including 332 surveys at 158 sites.

RDT description - This study employed the Roving Diver Technique (RDT), a non-point visual survey method specifically designed to generate a comprehensive species list along with frequency and abundance estimates. During RDT surveys, divers swim freely throughout a dive site (no more than 100m from a specified latitude/longitude position) actively searching for and recording every observed fish species. During the survey, divers assign, and periodically update, each recorded species into one of four log abundance categories, [single (1); few (2-10); many (11-100), and abundant (> 100)]. Data are collected in-situ on underwater slates and preformatted underwater paper, serving as a checklist of the most commonly sighted species. Unlisted species and reference notes are recorded on the blank, reverse side of the checklist. Following the dive, each surveyor transfers the species data along with survey time, depth, temperature and other environmental information to a REEF computer report form (scan sheet). These survey records are reviewed in the field before returning to REEF for QC/QA, scanning and processing to the REEF website (www.reef.org).

Site selection and frequency– Sites surveyed as part of this effort included those likely to harbor marine reef fishes within BNP park boundaries. In consultation with BNP and NPS staff, a list of 9 different habitat types were outlined for consideration. These included offshore hardbottom or reefs in the 60', 40' and 20' depth ranges, nearshore patch reefs, shallow hardbottom communities, seagrass, sand, mangrove-lined channels and artificial structures. During initial surveys, effort was spread somewhat evenly among habitat types; subsequent surveys modified effort according to results, increasing effort in the most productive habitats, while reducing effort in less productive habitats. For rounds 2 and 3 (September 05 and March 06), an excel maximizer program was utilized to determine optimal survey effort in each habitat type in an effort to increase species sighted in subsequent surveys. Combining information from prior surveys, local knowledge, NPS benthic habitat maps and satellite imagery, efforts were made to select spatially diverse sites incorporating the length and breadth of the park (See appendices for satellite imagery of sites surveyed).

Bi-annual survey frequency was chosen to include both summer (warm water) and winter (cold water) differences. March and September were chosen as the most feasible months to incorporate this variability.

Field Operations – Surveys were conducted using SCUBA from small boats. Divers conducted surveys in pairs with two divers surveying each site. Quiescence Diving Services provided dive vessel support in the form of a 25' delta dive boat and captain. BNP staff provided surface support via small boats to watch over buddy teams in the water. 6 divers took part in each survey effort, including 5 days each in March 2005, September 2005, March 2006 and September 2006. Divers were dropped in buddy pairs on a site and stayed within visual range of each other during the dive. Divers attempted to survey the site, including various substrates found at the site, while staying within a 100m radius of their entry point. Bottoms times were standardized at 60 minutes (whenever possible, according to no-decompression diving limits) for each diver conducting their own individual survey. Species lists and relative abundances were recorded on underwater paper according to the REEF RDT method description.

Specimen/image collection – When rare, unusual or difficult to identify species were encountered, divers had the options of taking notes for further reference and future identification, capturing images via underwater camera or collecting specimens for further review on board the vessel. Specimens were collected with small hand nets and placed live, in plastic ziplock bags until the end of the dive. Often, live specimens on board the vessel could be closely observed, compared to on-board reference materials and identified. Most specimens identified in the field were released alive on site. Certain rare or unusual specimens or those requiring further examination were preserved according to NPS guidelines and placed in the South Florida Collection management Center at Everglades National Park (See appendices for lists of collected specimens and images).

Data management – As part of the REEF protocol, once data are collected in the field, they are transferred to a computer scannable, paper report form. These forms are reviewed for completeness and accuracy by the team leader, with questionable sightings confirmed or deleted after consultation with the surveyor. After passing review, they are optically and digitally scanned by Sourcecorp in Lexington KY and the optical and digital files returned to REEF. The digital files are then run through custom QC/A programs which flag any clerical errors (date, missing information, etc.) as well as any suspect species. The flagged species are then confirmed or rejected and the data submitted for final review. Once deemed clean, data are uploaded to the REEF website (www.reef.org) and made publicly accessible.

Data display – Once data are uploaded to the REEF website, they are available individually, and as part of the larger REEF dataset. Reports can be generated for specific sites which include a complete species list for that site, arranged by sighting frequency (SF) and an index measure of abundance (DEN). Sites are arranged by a geographic hierarchical code system with each digit of an 8-digit code representing a smaller spatial scale. For example, all east coast Florida data begins with the first digit 3,

the region from Jupiter Inlet to Key Biscayne begins with 33, and the data from Biscayne National Park begins with 3302. For this project, the 6th digit was also used to represent habitat type. The following key represents the habitats associated with the 6th digit of each code:

- 1 – Artificial
- 2 - 60' reef
- 3 - 40' reef
- 4 - 20' reef
- 5 - Patch reef
- 6 – Seagrass
- 7 - Shallow Hardbottom
- 8 - Sand
- 9 - Channel

Site names are also keyed to include abbreviations of habitat type (e.g., P for patch, HB for hardbottom) and timing of the survey effort (a or blank for the first effort in March of 2005, b for Sept 05, c for March 06, d for Sept 06). As an example, the code 33020532 “P4-c” represents BNP patch reef number 4 surveyed in March of 2006.

Additional reports can be generated by combining sites by using the selectable check boxes to the left of the site code, generating comparison reports of up to three sites side by side (<http://www.reef.org/data/twa/compare.htm>), a distribution report to include locations at which specific species have been reported (<http://www.reef.org/data/twa/diversity.htm>), and a diversity report which provides a quick view of number of species reported from a region (<http://www.reef.org/data/twa/diversity.htm>)

Finally, data (including subsets) are available in raw format from REEF HQ upon request. These data are suitable for input into Microsoft Excel, Access, or other spreadsheet or statistical programs.

Results

Sites by round- Survey effort, including number of sites, bottom time and days in the field, was similar for the four rounds of surveys conducted. Each effort consisted of at least 76 surveys conducted at 38 sites in either 8 or 9 habitats throughout the BNP. Artificial habitat was added as a habitat type following the first round of surveys. Bottom time for each round of surveys was approximately 80 hours (77, 87, 84 and 82 hours respectively). Number of species reported by round averaged 206 species with STDEV of 12.01. Actual counts by round were 211 (03/05), 188 (09/05), 215 (03/06) and 208 (09/06).

Sites by habitat – Of the 9 different habitat types surveyed, species richness was highest overall in the 60' and Patch reef habitats. Effort was not allocated evenly, but rather directed towards the highest potential for sighting new species. Artificial habitat varied considerably from offshore shallow water steel structures (light towers) to

nearshore concrete bulkheads and breakwaters, shallow water shipwrecks, dock pilings and channel markers. A number of sites were planned as hardbottom sites, but during the survey were found to be more indicative of a seagrass habitat resulting in higher than anticipated seagrass survey time. Of the 157 sites surveyed, 50 were within Biscayne Bay or its connecting keys and channels. 57 sites were on or adjacent to the offshore reef tract. The balance of the sites (50) were between 1 and 4 miles offshore of the barrier islands.

Table 1. Species richness by habitat and survey time

Habitat	# species documented	Survey time (hours)
60'	178	49
Patch	173	69
Artificial	155	35
20'	147	30
40'	143	33
Hardbottom	142	37
Channels	107	29
Seagrass	91	42
Sand	43	10

Species by habitat - Of the 276 species documented, 62 species were found in only a single habitat type, while 14 species* were found in all 9 habitats. An additional 25 species were found in 8 of the 9 habitats. Species uniqueness was found to be highest at the artificial sites with 18 species unique to only that habitat, followed by the 60' habitat with 13 species found only there.

Table 2. Species unique to single habitat

Artificial	18
60'	13
Patch	8
Seagrass	6
Hardbottom	5
20'	4
Channel	3
40'	3
Sand	2

* juvenile grunts not identified to the species level were not included in this number though they were recorded in all 9 habitats.

List 1. Species found in all 9 habitat types:

French angelfish
 Scrawled Cowfish
 Highat
 Bar jack

Blue Runner
 Bluelip Parrotfish
 Greenblotch Parrotfish
 Redband Parrotfish
 Rosy Razorfish
 Ocean Surgeonfish
 Bluehead
 Clown Wrasse
 Slippery Dick
 Chub

Species by site – Of the sites surveyed, 6 of the top 10 sites for species richness were found in the 60' sites. The 40' sites provided 2 of the top ten species richness sites including the highest overall at site 40-1d with 81 species. 44 species were found at only a single site, while another 32 species were found at two sites. No species were found at all 158 sites.

Table 3. Top ten sites for species richness

Site name	Code	Species
40-1d	33020308	81
P-12b	33020525	80
20-a	33020401	80
60-3d	33020220	75
60-7c	33020214	75
60-9c	33020213	75
40-a	33020301	75
60-4c	33020211	74
60-4b	33020208	73
60-2d	33020219	73

Species overall – During this survey, 276 species of fish were documented from 10,728 sightings records. The REEF protocol utilized in this study also allows inclusion of certain fish identified only to the family level, including silversides, triplefin sp., pipefish sp., juvenile grunt, juvenile hamlet, hybrid hamlet, Townsend Angel, and both Green and Loggerhead Turtles. These data are included in the accompanying spreadsheet (highlighted in orange or pink), but have been excluded from this summary report.

Comparison to other data – No one method can provide a complete inventory of fishes. In preparation for conducting surveys in this project, BNP provided species lists from three other data gathering projects including a University of Miami Reef Visual Census (RVC), BNP initiated trawl surveys (Trawl) of shallow water habitats, and recreational fishing landings surveys (Creel) conducted by BNP. No information was available regarding survey effort of these three methods. Additionally, each of these three methods included data on species other than fish including blue crab, stone crab, queen conch, pink shrimp, shovelnose lobster, spotted spiny lobster and spiny lobster.

These species are omitted from any data comparisons and highlighted in the accompanying spreadsheet in pink.

Table 4. Comparison of species by method

	Total Species reported	Species unique to method
REEF	276	66
RVC	180	9
Trawl	150	51
Creel	130	37
Total	384	

Attachments

Summary of species (excel on CD)

Comparison of REEF data to other BNP species data (excel on CD)

Site names, codes and coordinates (excel on CD and included here as appendix 1)

CD of images (.jpg and .tiff)

Appendix of collections (included here appendix 2)

Appendix 2. Species collected and forwarded to the NPS South Florida Collection Management Center

Coral blenny	9/19/06	A-1d (Concrete barge)	33020109	BISC-4931
Marbled blenny	3/31/05	SG-2	33020602	BISC-4932
Pearl blenny (a)	9/28/05	A-1b (Fowey Light)	33020104	BISC-4933
Pearl blenny (b)	9/28/05	A-1b (Fowey Light)	33020104	BISC-4934
Roughhead blenny	9/29/05	SG-2b	33020605	BISC-4935
Sailfin blenny	9/28/05	P-1b	33020514	BISC-4936
Tesselated blenny	9/28/05	A-1b (Fowey Light)	33020104	BISC-4937
Black brotula	3/30/05	60-a	33020201	BISC-4938
Eyed flounder	3/31/05	SG-2	33020602	BISC-4939
Spottail	3/30/05	CH-2	33020902	BISC-

goby		(Sands Cut)		4940
Tiger goby	09/19/06	A-1d (Concrete barge)	33020109	BISC-4941
Dusky pipefish	4/1/05	SG-3	33020603	BISC-4942
Chain pipefish	03/18/06	A-2c (Boca Chita Pier)	33020106	BISC-4943
Juvenile razorfish (a)	9/29/05	S-1b	33020803	BISC-4944
Juvenile razorfish (b)	9/28/05	20-2b	33020406	BISC-4945

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