Final Report: Ecological, Socioeconomic and Governance Evaluation of the Exuma Cays Land and Sea Park

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Executive summary
The Exuma Cays Land and Sea Park is the flagship National Park of the Bahamas. It is the oldest park in the country at 50 years and one of the largest. In 1986 the park was declared a no-take marine reserve and in 2006 the first management plan was developed for the park. Despite its long history, there have been no comprehensive studies of the park's effect on marine resources and human communities and there has been little evaluation of park governance. In this study we designed and implemented a monitoring program following established guidelines to periodically evaluate park success and allow for adaptive management when necessary to address critical needs.

Ecological evaluations centered around visual surveys of fish and benthic communities at baseline sites established in 2003 and surveyed again as part of this study in 2007. Few changes were observed over this time period, however several positive and negative changes were detected. Benthic communities showed the least change, however, there were some increases in coral coverage in forereef habitats over the 4 year period. This suggests that processes responsible for reef resilience are functioning at some level within the park. Changes to algal communities occurred in other habitats, but their overall effect on benthic community structure was relatively minor. In seagrass beds, some seagrass coverage was lost, but this may be due to natural disturbances or seasonal variability.

Fish communities also changed little over the study period, however there were some decreases in the abundance of small parrotfish in some habiats over the study period. This may be the result of either high levels of predation by naturally occurring piscivores such as grouper or snapper, or it may be the result of invasive Indo-Pacific lionfish which were not observed in 2003, but were observed at several sites in 2007. Other changes to fish communities were likely to be due to the occurrence of relatively rare species that were detected at some sites during one sampling period, but not the other.

Since there was no socioeconomic or governance data baselines for comparison, the current study used surveys to establish this baseline and assess how the park affects people and how the park is perceived by them. Surveys were administered to the two main stakeholder groups for the Exuma Park, local communities and foreign visitors to the park. While both stakeholder groups had similar values and use of the sea, their opinions of the park varied somewhat. While visitors highly rated park management, local residents were more critical of the park management and a smaller percentage of local respondents perceived the park to create benefits for the Bahamas and for themselves. Local residents also believed themselves to be alienated from the decision-making process for the park. Several local residents had not visited the park and several more had not been there in over 5 years. Finally, survey results suggest that more effective communication is also necessary.

While the Exuma Park appears to be providing some ecological protection, its reefs, as with much of the Bahamas, remain in poor to fair condition. Fishery resources appear to remain healthy, but the threat of invasive lionfish may cause dramatic changes in the future. The greatest needs for the park, however, relate to improving communication with local communities and involving these stakeholders in the park more. Local

residents must have their needs are being addressed by the park and must see benefits from the park if they are to support the park. This may be accomplished by engaging the local community in making management decisions and improving communications with local people.

Background

The Exuma Cays Land and Sea Park is the flagship of the Bahamian National Park System. It was created by the Bahamas National Trust Act in 1959, the same act of Parliament that created the Bahamas National Trust as a non-governmental organization responsible for designating and managing national parks in the Bahamas. More complete descriptions of the history of the Exuma Cays Land and Sea Park (also referred to as Exuma Park in this document) can be found elsewhere (e.g., Ray 1998, Dahlgren 2004). Briefly, the Exuma Park encompasses a total of 186 square miles (456 km^2), of which 167 square miles (409 km^2) are marine (Fig 1). This vast marine area includes shallow water seagrass, sand flat, mangrove, patch reef and other habitats on the Great Bahamas Banks, as well as offshore reefs and deepwater habitats (>400m) in Exuma Sound. While some subsistence level fishing was allowed in the park when it was created, in 1986 the entire park was made a no-take marine reserve. In 2005 the Exuma Park's first management plan was developed and adopted shortly thereafter.

Several scientific studies of marine ecosystems within the park have been conducted, including the initial qualitative assessment of marine environments in the area that was to become the Exuma Park (Ray 1958), as well as quantitative studies of queen conch populations (e.g., Stoner and Ray 1996, Stoner et al. 1998), spiny lobster (e.g., Lipcius et al. 1997), Nassau grouper (Sluka et al. 1994, 1996, Bolden 2000, 2002 Dahlgren in prep.) and coral reefs (e.g., Sluka et al. 1996, Mumby et al. 2006, 2007, Harborne et al. 2008). These studies demonstrate that populations of key fishery species (Nassau grouper, Caribbean Spiny Lobster and queen conch) have higher density, larger sizes and/or greater reproductive output within the park than outside the park, and that coral reef condition and/or ecosystem processes responsible for maintaining reef resiliency are healthier within the park than outside the park.

Even fewer studies have been done that address the socioeconomic impacts or governance of the Exuma Park. Perhaps the only study to address any of these issues was conducted by Mascia (2000). This study addresses some of the social and governance issues that have limited the success of the park from the perspective of people living in communities outside the park.

While these studies provide critical information on the ecological and social effects of the Exuma Park, they were designed to address very specific questions at only one point in time. Thus there is a need for a more comprehensive evaluation that can easily be repeated over time to provide information on the change in marine resources within the Exuma Park. The primary purposes of this study were to develop and implement a comprehensive monitoring program that could be repeated periodically to rapidly assess the status of the Exuma Park from ecological, social and governance perspectives. Essentially, the goal of the program is to provide a report card on park performance for a specific period of time to determine if the park is meeting its goals or at least headed in the right direction. Based on this report card, park management authorities to adapt management to better meet park goals and objectives. Here we present the first step in this comprehensive monitoring program, the collection of baseline data and, when possible an assessment of changes that have occurred over a 4-5 year period.

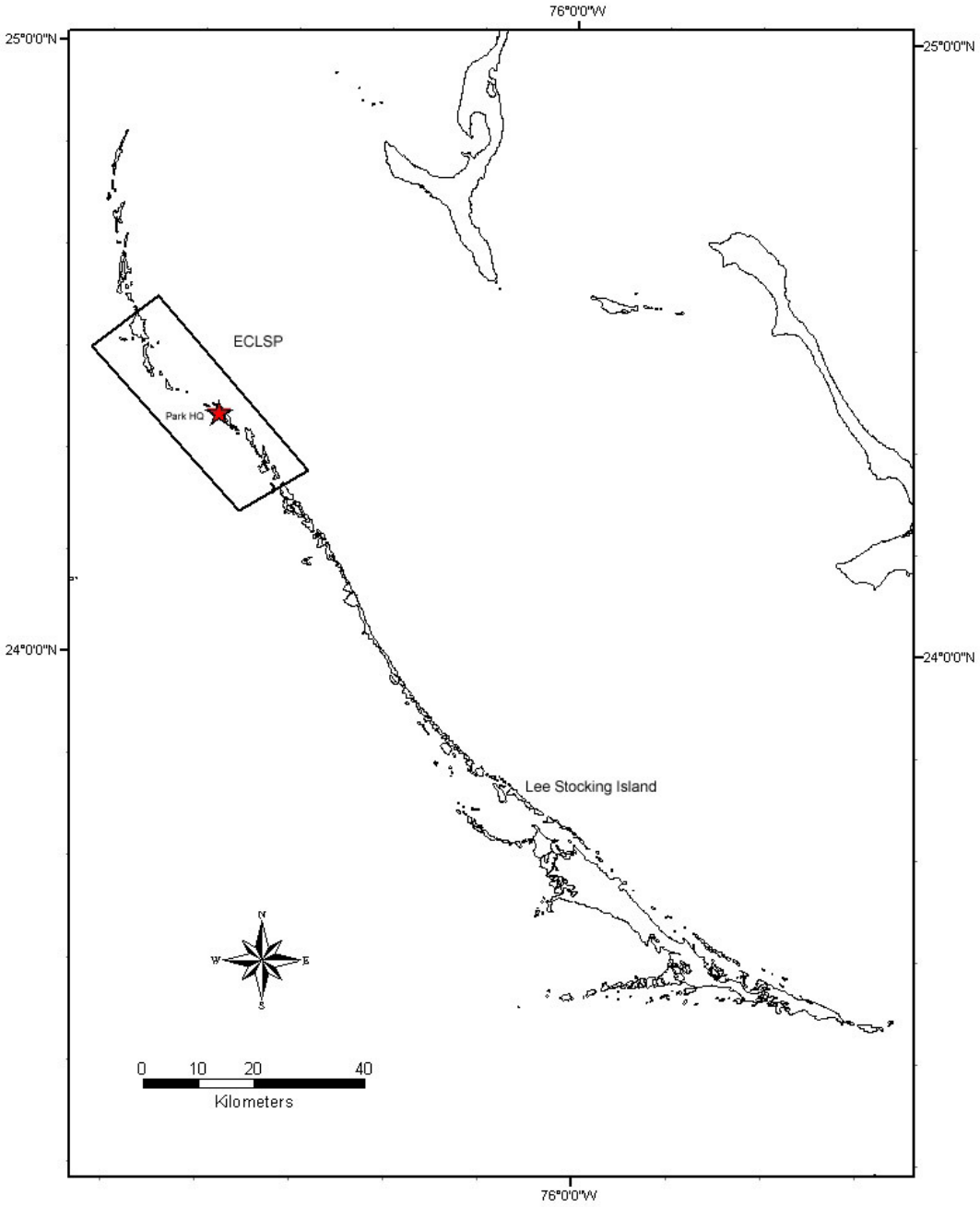

Figure 1. Map of the Exuma Sound area showing location of the Exuma Cays Land and Sea Park. The star near the center of the park marks the park Headquarters on Warderick Wells Cay.

Methods

This evaluation used a combination of ecological surveys and socioeconomic surveys to evaluate the effects and efficacy of the Exuma Cays Land and Sea Park, following the approach outlined in the *How is my MPA Doing?* guidebook (Pomeroy et al. 2004). For the ecological/ecological evaluation, comparisons were made between data collected in this study and data collected at the same sites using the same methodology in 2003 (table 1). This allowed for temporal comparisons to determine how the ecological health or status of marine resources in the Exuma Park has changed over a 4 year period. Since no comparable prior socioeconomic and governance data has been collected for the Exuma Park, data from our surveys are interpreted as a stand alone dataset and may be used as a baseline for future comparisons.

Ecological Surveys

Following the Pomeroy et al. (2004) guidebook several ecological (biophysical) indicators were selected for evaluation. The selection of specific ecological indicators was based on a number of factors including recommendations from local marine resource management authorities, compatibility with previously collected data, and logistics of conducting monitoring at a remote site with limited man power. As such, primary ecological indicators to be assessed quantitatively included: focal species abundance; focal species population structure; habitat distribution and complexity; and community composition and structure. Qualitative observations of several other ecological indicators were also made.

Assessments of the ecological indicators were conducted using *in situ* survey techniques at multiple replicate stratified by representative habitat types (i.e., seagrass, forereef, hardbottom and patch reef). Such stratification increased our ability to detect MPA affects on indicators by accounting for variability in indicators that may result from in variability in habitat. Seagrass beds were areas on the Bahama Banks with soft substrates and dominated by *Thalassia testudinum*, but contained a number of other seagrass and algae species, as well as small corals, sponges and other benthic organisms. Patch reefs were also found on the Bahama Banks and varied in location from those fringing islands, those found in high flow channels on the banks, and others surrounded by seagrass beds. All patch reefs were discrete areas that had at least 1 m of relief from living and/or dead coral colonies. Hardbottom areas occurred offshore of islands in Exuma Sound and were relatively low relief rock areas colonized by various benthic organisms at approximately 10 m depths. Forereef habitats were higher relief rock areas where living and dead coral colonies provided high levels of relief and structural complexity at 10-20 m depths.

Table 1. Sites surveyed in 2003 and again in 2007

Site	Latitude	Longitude
Fore Reef		
Danger Reef	24.42684	76.67566
REF-HB 51	24.53821	76.75832
REF-HB 53	24.55057	76.76717
Saddle Reef	24.42577	76.68704
Hardbottom		
Hardbottom 1	24.39037	76.61440
Hardbottom 12	24.42647	76.68574
Hardbottom 3	24.35636	76.56433
REEF 56	24.52514	76.75186
REF HB 43	24.45834	76.71909
REF-HB 41	24.47695	76.74249
REF-HB 52	24.56381	76.77520
South Cambridge	24.29775	76.52837
Patch Reef		
4 Fingers	24.41165	76.70686
Brad's Reef	24.40715	76.66127
Malobar Reef	24.36468	76.62988
Reef 6	24.34073	76.56914
Rocky Dundas	24.27795	76.53770
Seagrass		
Hammerhead Flats	24.34898	76.59431
Seagrass 1	24.30649	76.56989
Seagrass 11	24.41906	76.69450
Seagrass 14	24.51086	76.79457
Seagrass 17	24.42549	76.73430
Seagrass 18	24.45652	76.76617
Seagrass 5	24.37079	76.64316
Seagrass 6	24.30800	76.54803

Key indicators listed above were assessed during *in situ* visual diver surveys, following techniques that the PI and others have effectively used for MPA site assessments and the collection of data from MPAs in the Bahamas and throughout the Caribbean (e.g., Eggleston and Dahlgren 2001, Crosby et al. 2003, Dahlgren et al. 2003, Eggleston et al. 2004). Habitat stratification for these surveys relied on the lead investigator's knowledge of the area, satellite imagery and suggestions from park staff. Specific sites were selected at random using a 1km grid map of the area.

The abundance and population structure of focal species (ecologically or commercially important species, endemic species and/or threatened species; e.g., Nassau grouper and snapper species, lobster, *Diadema antillarum*), and other indicators were assessed in different habitat types using belt transect surveys (2 per site) and timed 10 minute roving diver surveys (2 per site). Roving diver surveys were used to improve diversity estimates and supplement data on the population structure (e.g., size distribution) of several key species at each site. During surveys, all fish species and focal invertebrate species (e.g. lobster, urchins) were identified to species, and individual sizes and abundance quantified within belt transects.

Benthic substrate complexity and community composition surveys were conducted by divers use point-intercept transect survey techniques along the same transect lines used for fish surveys, following protocols adapted from AGRRA surveys. Benthic surveys included identifying substrate type and community composition to the finest taxonomic resolution possible (species in most cases) at 25-50 cm intervals along transects (25 cm increments were used in 2003, but this was changed to 50 cm increments in 2007 to make surveys more rapid). In 2007, benthic surveys also incorporated key quantitative characteristics of different habitats (e.g., coral reef rugosity, percent of coral colonies that are alive, seagrass shoot density) that may influence ecological indicators.

Specific analyses include ANOVA comparisons of fish species richness, commercial species abundance, and abundance of key species of groups, such as snappers, groupers, and parrotfish. Too few *Diadema antillarum* and Caribbean spiny lobsters (*Panulirus argus*) were observed for statistical comparisons, but a qualitative assessment of these species was conducted. ANOVA comparisons of benthic coverage for corals, macroalgae, turf algae, all algae (macroalgae + turf algae), sponges, gorgonians, seagrass (for seagrass habitats only), bare substrate, crustose coralline algae, and open substrate for colonization (bare plus crustose coralline algae) were conducted for each habitat type. To account for the effect of variability in substrate the amount of hard substrate (rubble, boulders and hard pavement) at each site was used as a blocking factor.

In addition, Bray Curtis similarity indices were calculated for sites within each habitat sampled at the two different times to assess changes in community structure for fish and benthic communities Similarity matrices were then used in cluster analyses and multi-dimensional scaling (MDS) analyses to determine how community structure changed over time. Analyses of benthic communities focused on changes in the percent cover of various benthic community components within each habitat type and fish community analyses used biomass data (calculated from abundance and length estimates using conversion equations and parameters adapted from Bohnsack and Harper 1988 or other sources available from www.fishbase.org). In both cases, data were fourth root transformed to lessen the effect of infrequently occurring species on community structure.

Socioeconomic and Governance

A broad range of Socioeconomic and Governance Indicators suggested by Pomeroy et al. were addressed this study. Socioeconomic indicators addressed include:

Local marine use patterns
Local values and beliefs about marine resources
Level of understanding of human impacts on marine resources
Perceptions of seafood availability
Perceptions of local seafood harvest
Perceptions of non-market and non-use value
Household income distribution by source
Household occupational structure

Nature of markets
Distribution of knowledge to the community.

Governance indicators addressed include:

Existence of a decision-making and management body
Existence and adoption of management plan
Local understanding of MPA rules and regulations
Existence and adequacy of enabling legislation
Existence and application of scientific research and input
Existence and activity level of community organizations
Degree of interaction between the manager and stakeholders
Level of stakeholder involvement in surveillance
Enforcement coverage
Information dissemination

All socioeconomic indicators and many of the governance indicators were addressed by surveying stakeholders. Information on governance indicators was also supplemented by conversations with past and present (at the time of the study) park wardens. Stakeholder surveys were developed based on examples from Pomeroy et al. 2004. Because the Exuma Park has two distinctly different stakeholder groups, local communities outside the park and visitors who come to stay in the park (which may include some Bahamians, but is dominated by foreign tourists who sail through the Exuma Cays on their own boats), two versions of the survey were developed to tailor questions to better assess indicators based on the responses of each stakeholder group.

Results

Ecological Indicators – Benthic

Bray Curtis Similarity analysis and Multi-Dimensional Scaling (MDS) analysis on the frequency of occurrence of various benthic organism shows that overall benthic community structure in the Exuma Cays Land and Sea Park changed over time in several habitats. In seagrass habitats, similarity between all sites surveyed in all years was quite high (>45% Bray-Curtis Similarity Index; Fig 2a), however there was a division between years as evident from the MDS plot. Two sites, Hammerhead flats and Seagrass 1 show tight grouping with eachother during both years, but other sites show greater differences (Fig2b). At sites that showed a greater change from 2003 to 2007, this change was most likely due to a decrease in seagrass coverage and increase in detritus and bare substrate. Because these changes varied from site to site, however, there was no significant difference in benthic percent cover from one sampling period to the next.

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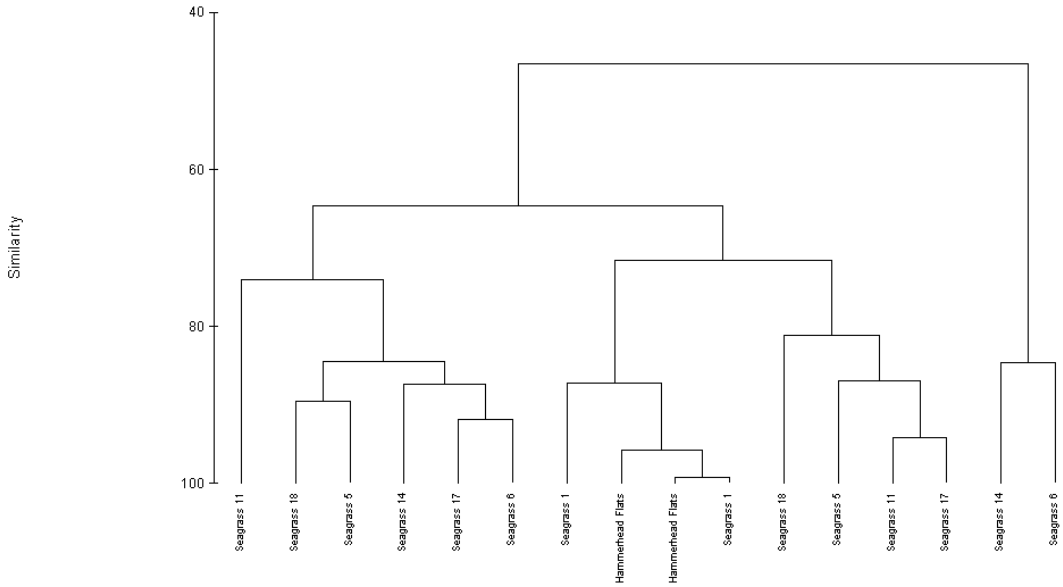

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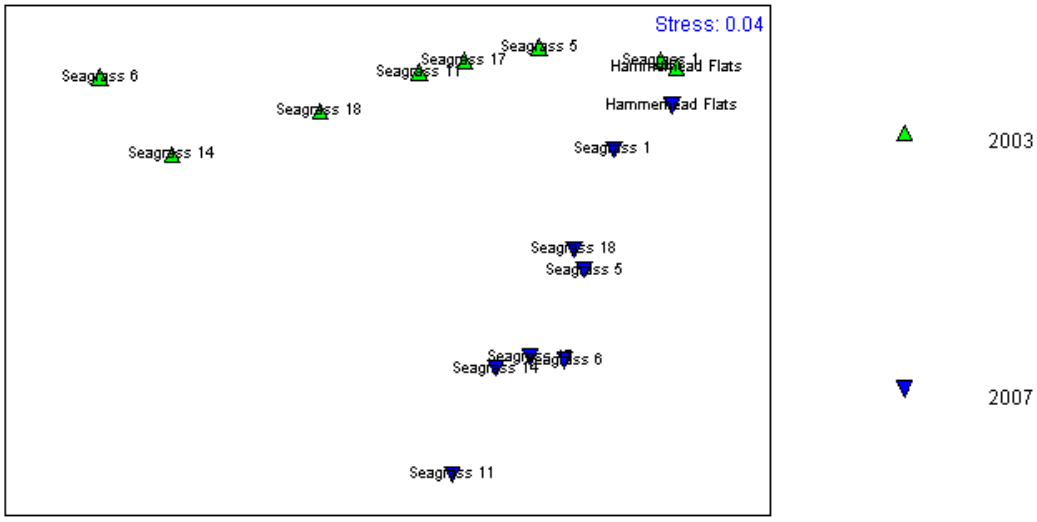

Figure 2. Bray-Curtis similarity cluster analysis (A) and MDS plot (B) showing degree of similarity between seagrass sites in the Exuma Cays Land and Sea Park sampled in 2003 and 2007.

For Forereef habitats, a similar pattern emerges where similarity between all sites in both years is quite high (>50% Bray Curtis Similarity Index; Fig 3a), but similarities of all sites within each year is greater than similarities for each site from one year to the next. This is seen in the MDS plot as two distinct clusters of points based on year of sampling (Fig. 3b). Changes in community structure of Forereef sites is likely due to a significant increase in the percent cover of live coral in this habitat ($p = 0.023$; Fig. 4). While coral coverage was quite low during both sampling periods, the percent cover of *Montastraea* spp. and *Porites* spp. nearly doubled between 2003 and 2007. Most other corals showed a very patchy distribution so it is difficult to assess their change over time.

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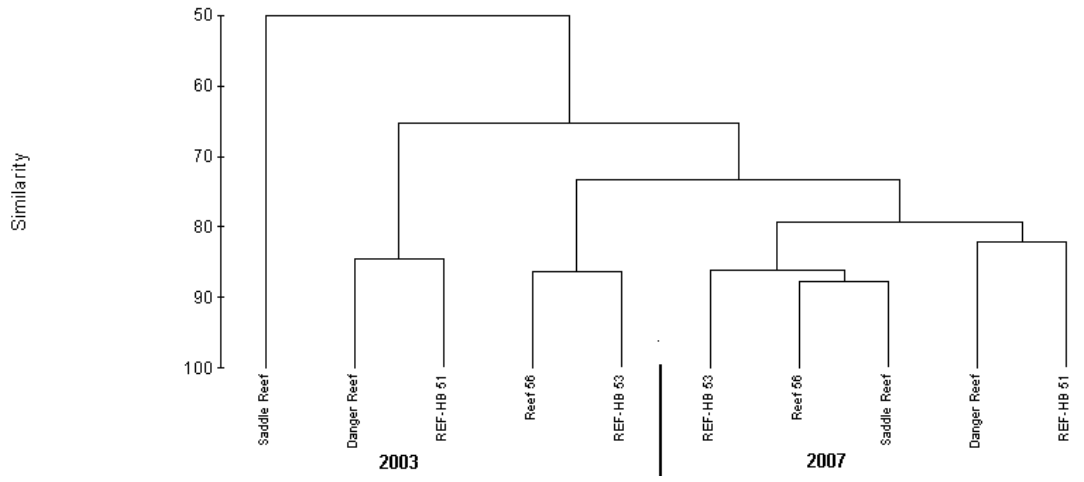

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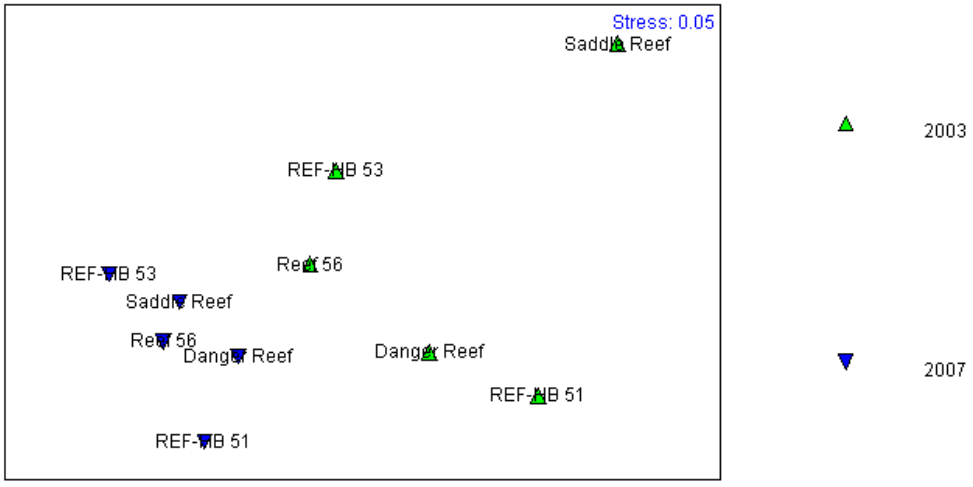

Figure 3. Bray-Curtis similarity cluster analysis (A) and MDS plot (B) showing degree of similarity between benthic communities of Forereef sites in the Exuma Cays Land and Sea Park sampled in 2003 and 2007. Note the dark vertical line in the cluster diagram (A) denoting a distinct division in community structure from 2003 to 2007.

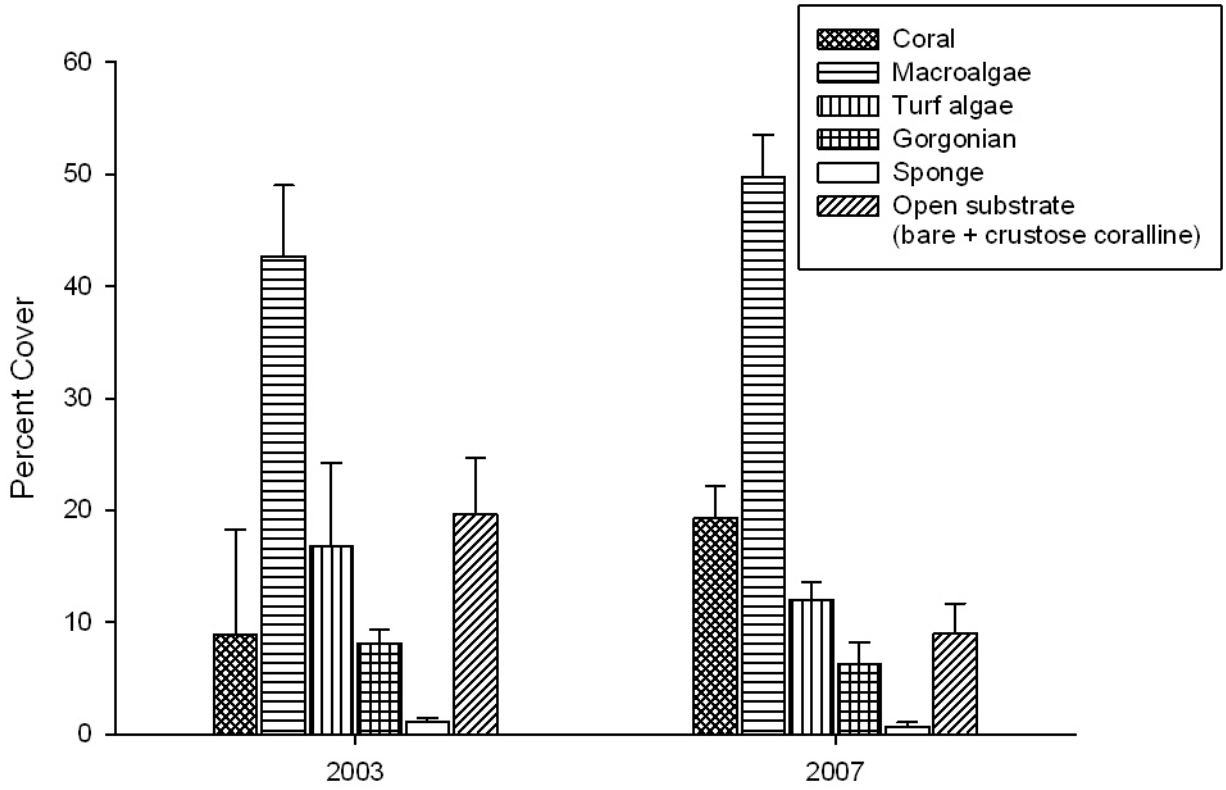

Figure 4. Percent cover of various benthic components for Forereef sites

Surveys in 2007 included a more detailed examination of the species composition, and population demographics of corals (Table 2). Of the dominant coral groups, *Porites astreoides* was among the most abundant, averaging over 14 colonies per transect and among the healthiest with an average of over 92% living tissue on each colony. *P. astreoides* colonies tended to be relatively small, however, averaging less than 19 cm in diameter. *Montastraea* spp. (primarily *M. annularis*, and *M. faveolata*) were also quite abundant, with an average of 14 colonies per transect. While the average size of these colonies was quite large at 118.9 cm in diameter, living coral coverage was low at only 26.9%. Of the *Montastraea* spp. colonies that were larger than 50 cm in diameter, live coral tissue covered less than 15% of the colony. Only one *Colpophylia natans* colony was observed and it was in very poor health despite the overall large size of the colony.

Although not statistically significant, it is also worth noting that macroalgae in Forereef habitats showed an increasing trend ($p = 0.06$) and turf algae showed a decreasing trend ($p = 0.06$) over time (Fig. 4). This was particularly evident at Parrotfish Reef off Saddle Cay, which was dominated by turf algae in 2003 but had high levels of *Microdictyon* sp. in 2007. Such observed differences may, in part reflect surveyor bias and slight seasonal differences; however, so further monitoring is needed before conclusions may be drawn.

Table 2. Summary of coral colonies observed under transect lines (at any point) in Forereef habitats.

Species	Mean no. per transect	Mean size (cm)	Mean % of colony alive
Agaricia agaricites	2.00	13.46	98.46
Colpophylia natans	0.17	300.00	5.00
Diploria labrinthyformes	1.00	22.50	90.83
D. stokesii	0.33	5.00	100.00
D. strigosa	0.67	34.00	83.00
Dendrogyra cylindrus	0.33	65.00	25.00
Eusmilia fastigiata	0.50	8.33	73.33
Favia fragum	0.33	5.00	100.00
Montastraea annularis	5.33	135.91	14.30
M. cavernosa	0.67	25.00	81.25
M. faveolata	5.33	119.85	26.09
M. franksi	2.50	91.00	43.80
Meandrina meandrites	0.83	9.60	100.00
Madracis mirabilis	0.20	60.00	30.00
Millepora spp.	0.33	5.00	100.00
Porites astreoides	14.17	18.16	92.20
P. furcata	0.50	43.33	70.00
P. porites	1.33	39.74	71.63
Siderastrea spp.	2.67	19.06	88.75

Patch reefs, showed a different pattern with greater variability among sites, but several sites showing relatively little change from 2003 to 2007 (Fig. 5). Some of the variability among sites may be due to differences in spatial positioning of the reefs. Malobar Reef, for example, showed high similarity from one sampling period to the next, but was different from most other reefs. This patch reef was unique in that it was located on the banks farthest from Exuma Sound and was surrounded by seagrass beds. Rocky Dundas and Brad's Reef also showed higher similarity between sampling periods than other reefs. These reefs are both fringing reefs along islands in close proximity to Exuma Sound. The other reefs were located in open channels linking Exuma Sound to the Bahama Banks and varied considerably from 2003 to 2007. This suggests that reefs in more stable environments (e.g., those primarily subject to either Exuma Sound of Bahama Bank conditions) are more stable than those in areas where environments may fluctuate between Exuma Sound and Bahama Bank conditions. Thus, these changes may be governed by natural processes unrelated to park protection. Overall benthic coverage on Patch reefs showed little changes, with the exception of a significant increase in percent cover of turf algae ($p = 0.034$, Fig 6).

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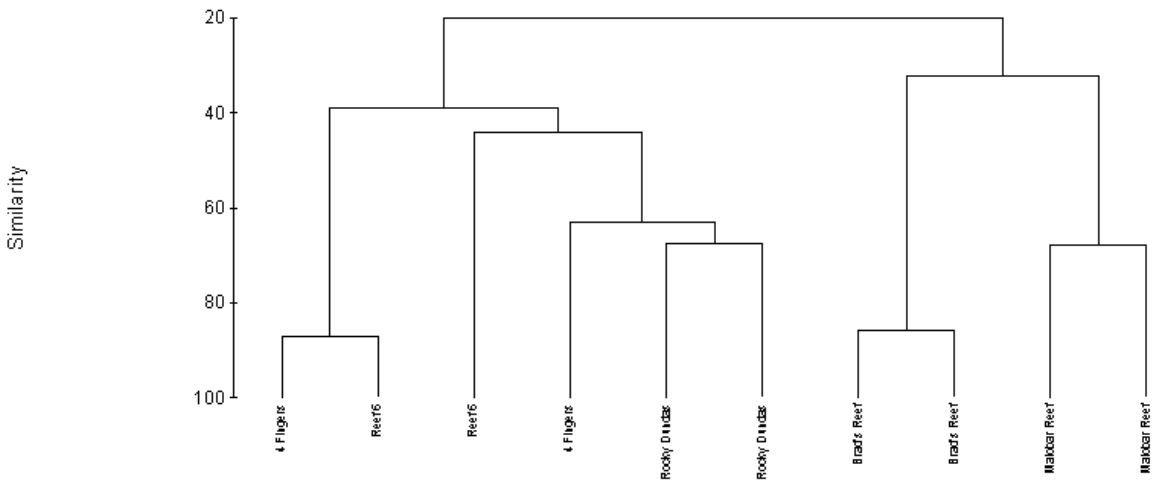

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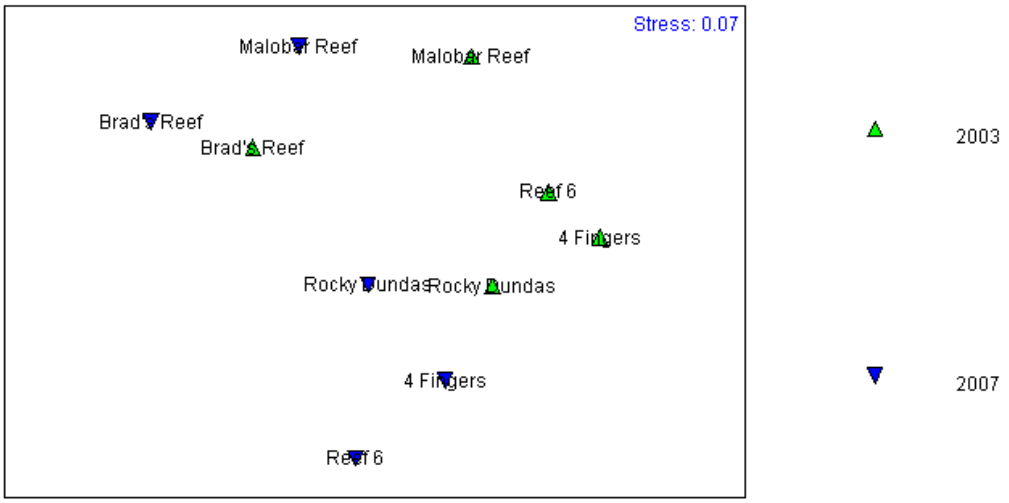


Figure 5. Bray-Curtis similarity cluster analysis (A) and MDS plot (B) showing degree of similarity between benthic communities of Patch Reef sites in the Exuma Cays Land and Sea Park sampled in 2003 and 2007.

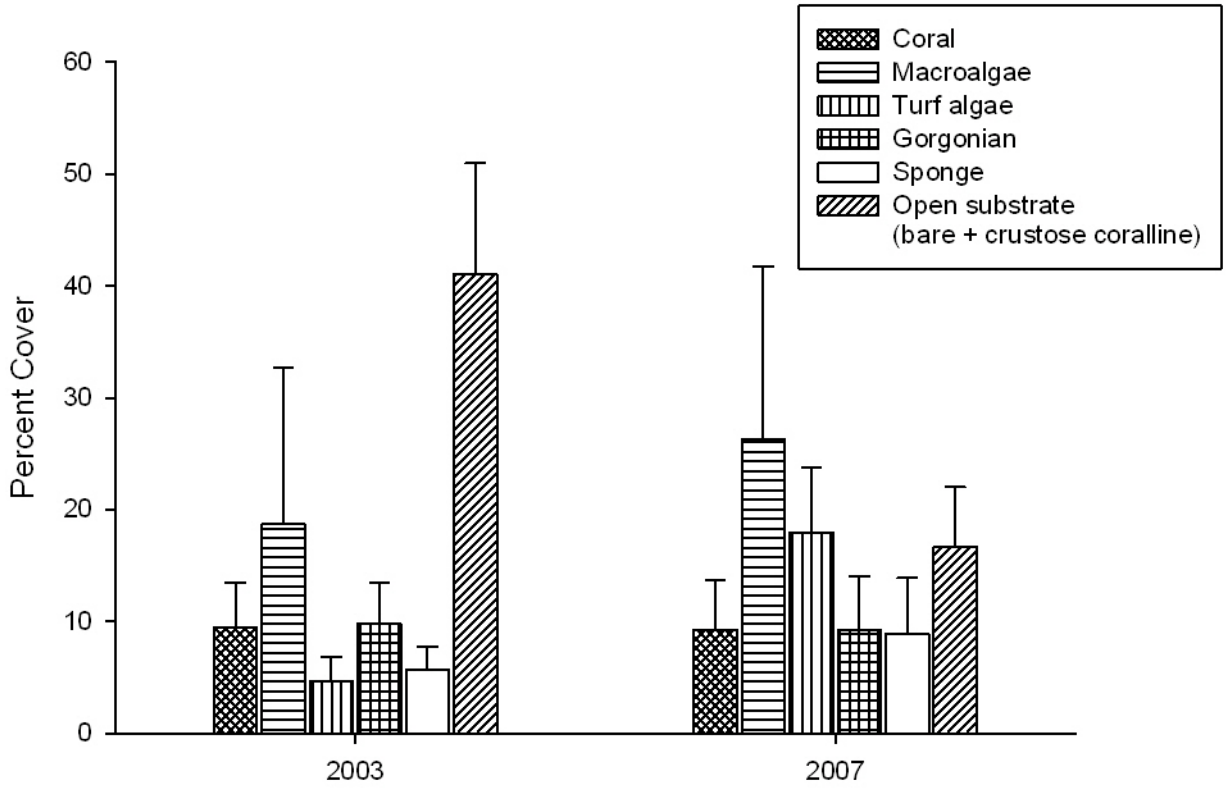
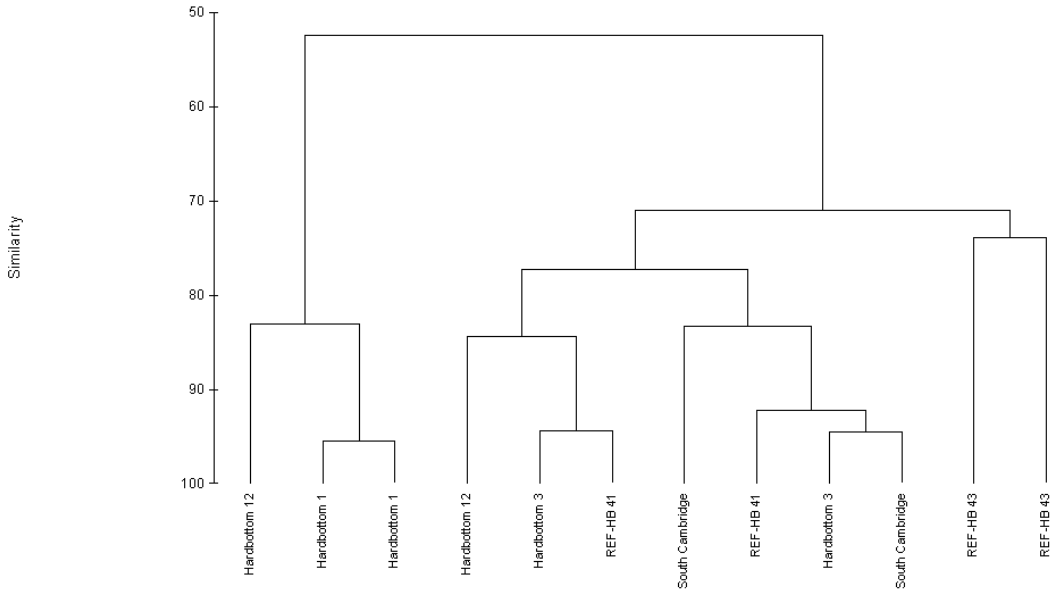


Figure 6. Percent cover of various benthic components for Patch Reef sites

Benthic communities of Hardbottom habitats had a relatively high similarity between sites and years, but the temporal changes differed among sites (Fig. 7). Some sites changed very little from one sampling period to the next, while others showed more differences. Overall benthic coverage in hardbottom areas showed an overall increase in all algae (macroalgae and turf algae combined) and a similar decrease in substrate available for colonization (bare substrate and crustose coralline algae combined; $p = 0.04$ Fig. 8).

A.



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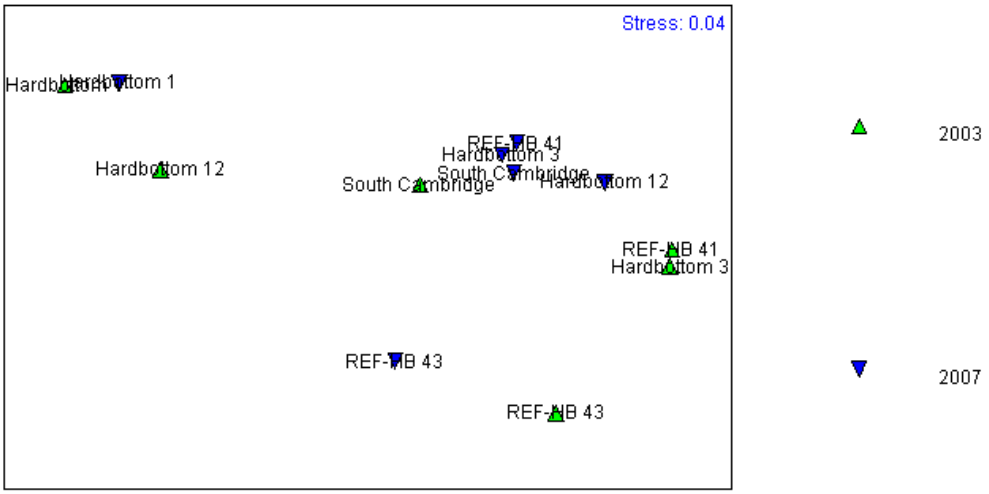

Figure 7. Bray-Curtis similarity cluster analysis (A) and MDS plot (B) showing degree of similarity between benthic communities of Hardbottom sites in the Exuma Cays Land and Sea Park sampled in 2003 and 2007.

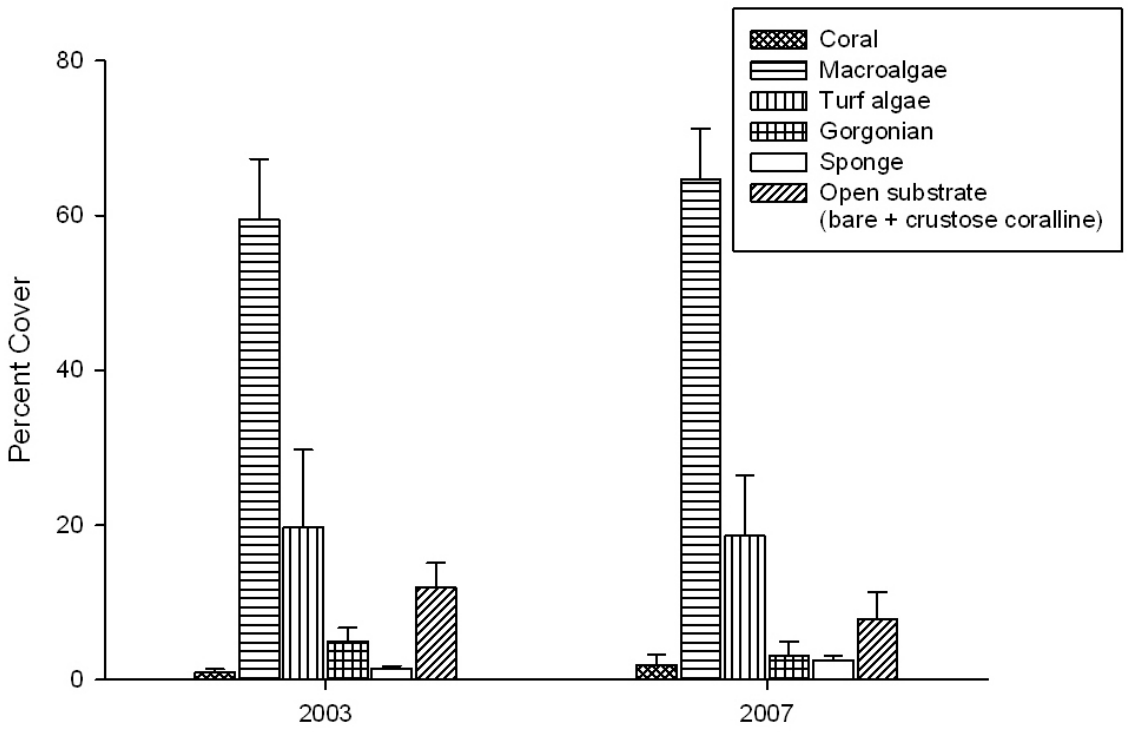

Figure 8. Percent cover of various benthic components for Hardbottom sites

Ecological Indicators - Reef Fish

Reef fish communities changed little during the study period and changes were inconsistent among sites. For example in Forereef habitats reef fish communities were at least 50% similar between all reefs and sampling periods, with fish communities at Danger Reef (R1) and Saddle Reef (R4) having approximately 70% similarity from one year to the next (Fig. 9). Both sites were the only one with moorings and visited by divers in this study. Other reef sites varied nearly 50% from one year to the next. These differences were largely the result of the occurrence of a few fish species one year, but not during the other sampling period, as opposed to changes in biomass of common species. For example at both reefs showing high variability from one year to the next, no Nassau grouper were observed in 2003, but an individual was observed at both sites in 2007.

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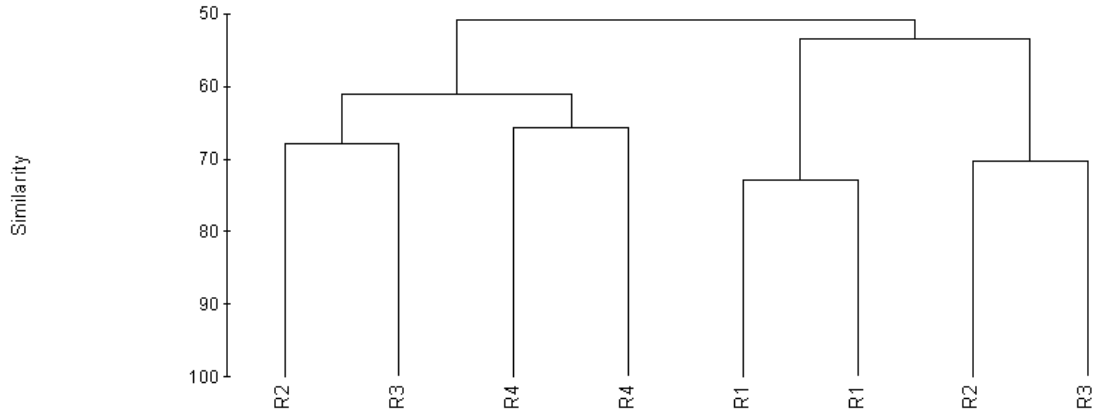

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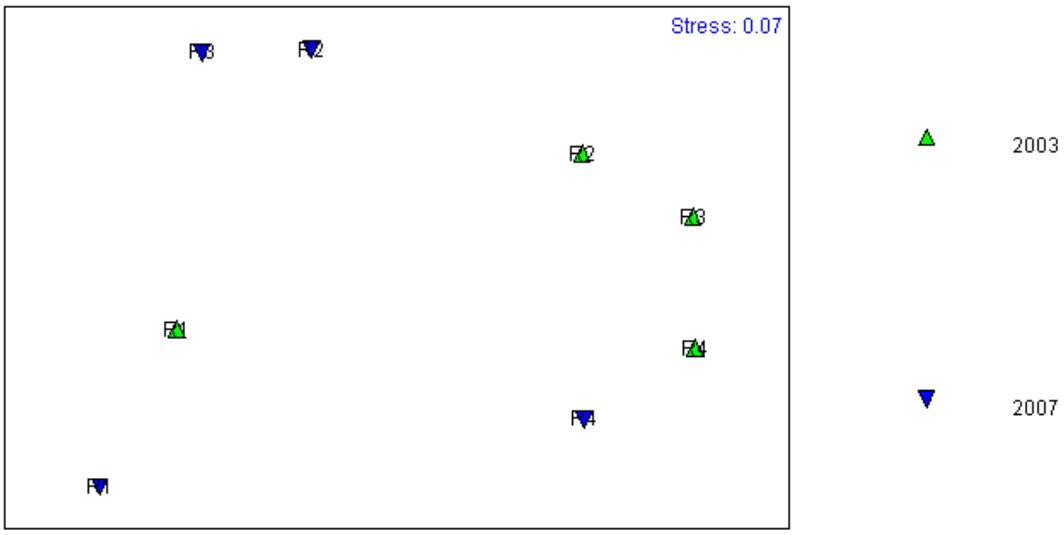

Figure 9. Bray-Curtis similarity cluster analysis (A) and MDS plot (B) showing degree of similarity between fish communities at Forereef sites in the Exuma Cays Land and Sea Park sampled in 2003 and 2007. R1 = Danger Reef, R2 = REF 51, R3 = REF 53, R4 = Saddle Reef.

In patch reef habitats, there were mixed results similar to for reef habitats for fish communities. All sites and years showed at least 50% similarity in reef fish communities, but several sites showed high (>60%) similarity from one sampling period to the next (Fig. 10). Of the three patch reef sites that showed high temporal consistency in benthic communities, only one (Malobar Reef, PR3) showed high temporal consistency in fish communities. Sites that showed differences from one sampling period to the next in benthic community structure showed high consistency in fish communities.

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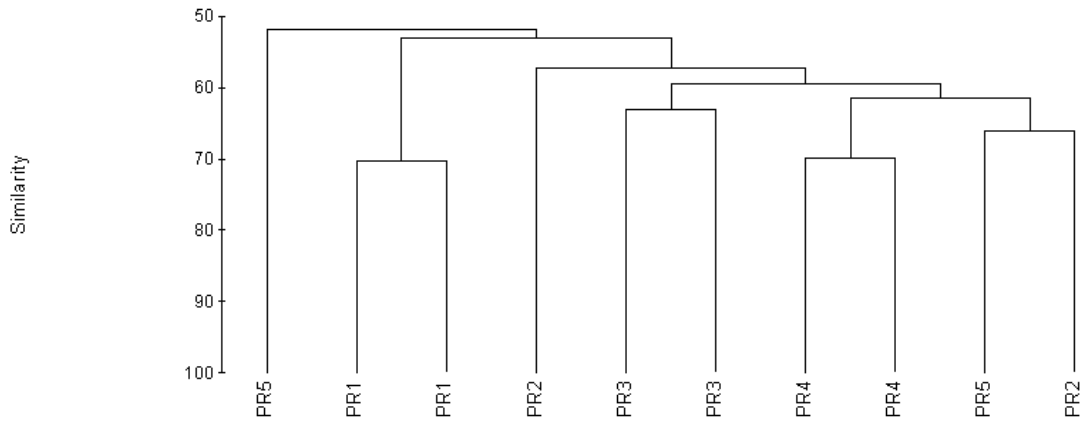

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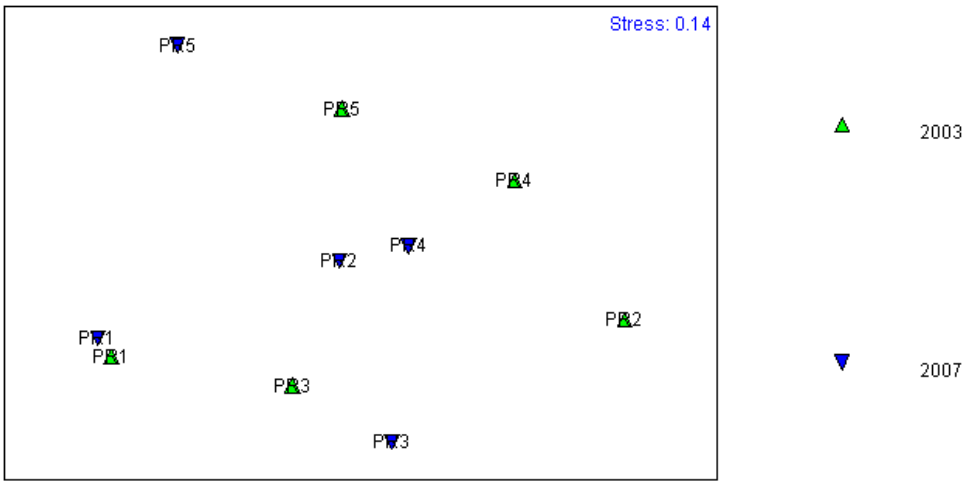
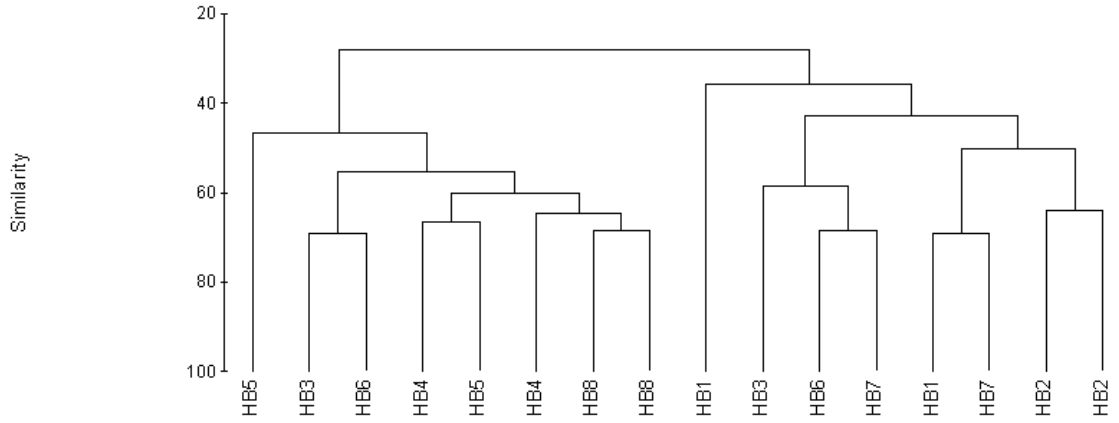


Figure 10. Bray-Curtis similarity cluster analysis (A) and MDS plot (B) showing degree of similarity between fish communities at Patch Reef sites in the Exuma Cays Land and Sea Park sampled in 2003 and 2007. PR1 = 4 Fingers, PR2 = Brad's Reef, PR3 = Malobar, PR4 = Reef 6, PR5 = Rocky Dundas.

Reef fish communities in hardbottom habitats formed two distinct groupings, but these groupings contained a mix of sites and years, with some sites showing temporal consistency and others not (Fig. 11). In seagrass beds, reef fish communities varied somewhat at each site with similarity between sampling periods ranging from approximately 40-65% at most sites (Fig 12). At one seagrass site (omitted from analyses), no fish were observed at the site in 2007. Low temporal consistency in both of these habitats may be due to the fact that their lack of structure prevents resident fish communities from establishing themselves and transient fish that range over greater areas

and may vary in their occurrence of surveys have a greater influence on community structure.

A.



B.

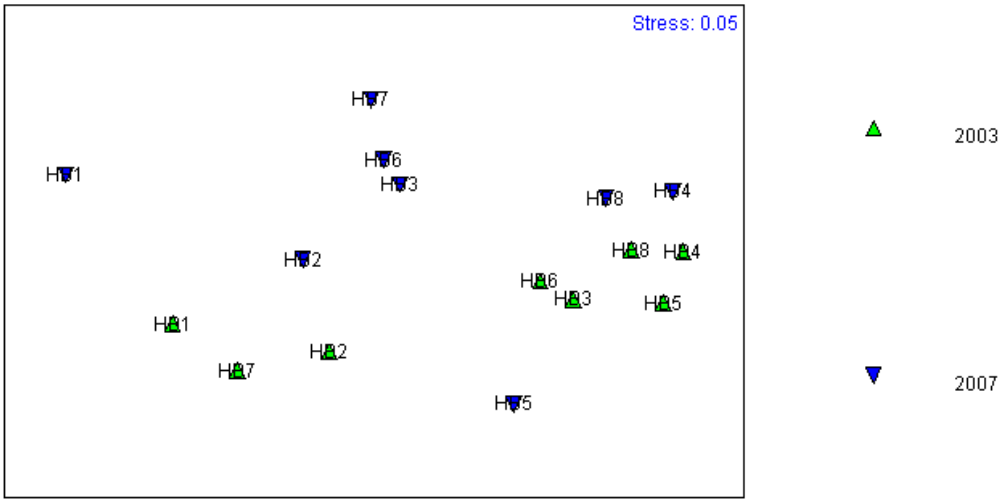
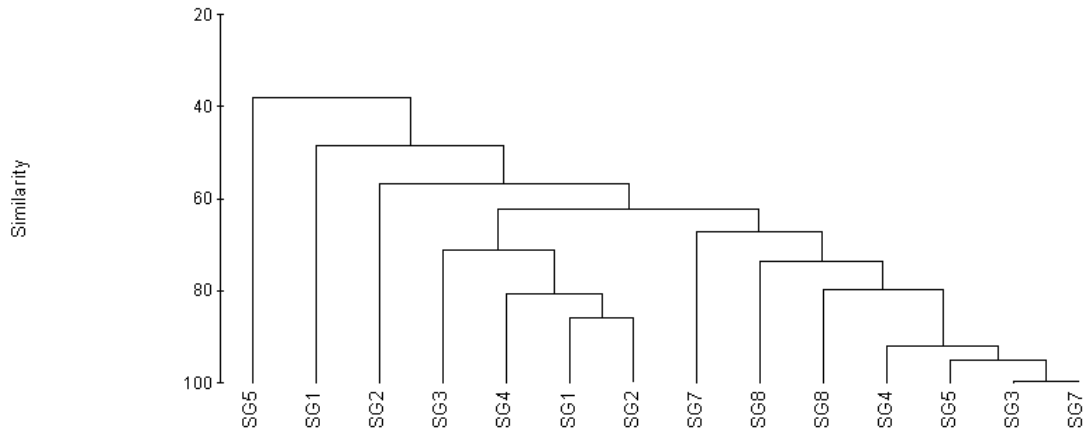


Figure 11. Bray-Curtis similarity cluster analysis (A) and MDS plot (B) showing degree of similarity between fish communities at Hardbottom sites in the Exuma Cays Land and Sea Park sampled in 2003 and 2007. HB1 =Hardbottom 1, HB2 = Hardbottom 12, HB3 = Hardbottom 3, HB4 = Reef 56, HB5 = REF HB 43, HB6 = REF HB 41, HB7 = REF HB 52, HB 8 = South Cambridge.

A.



B.

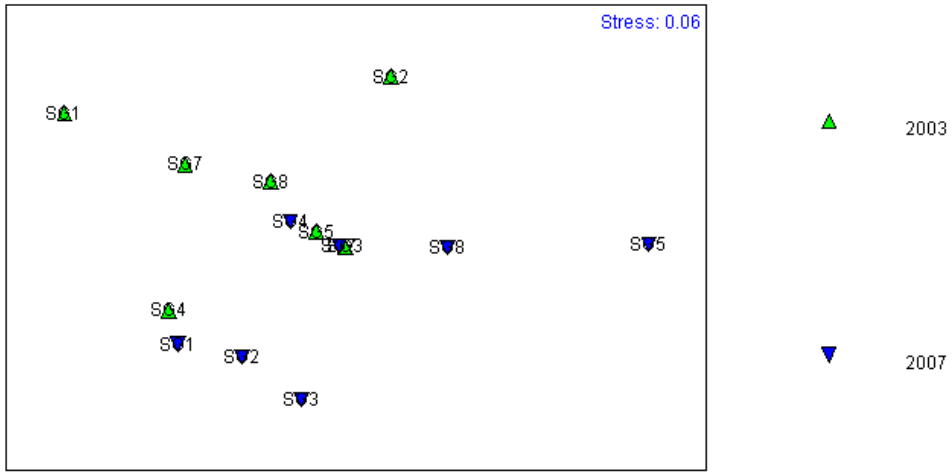


Figure 12. Bray-Curtis similarity cluster analysis (A) and MDS plot (B) showing degree of similarity between fish communities at Seagrass sites in the Exuma Cays Land and Sea Park sampled in 2003 and 2007. SG1 = Hammerhead Flats, SG2 = Seagrass 1, SG3 = Seagrass 11, SG4 = Seagrass 14, SG5 = Seagrass 17, SG6 = Seagrass 18, SG7 = Seagrass 5; SG8 = Seagrass 6.

While there were changes in overall reef fish communities at many sites in many habitats, overall the biomass of key species and functional groups were fairly constant from 2003 to 2007. There was no change in biomass ($p>0.05$) from 2003 to 2007 in any habitat type for any of the following groups: fishery species (includes several species of snapper and grouper plus barracuda, hogfish, and margate), all parrotfish, small parrotfish species, large parrotfish species, snappers, large grouper species, and small grouper species (Fig. 13).

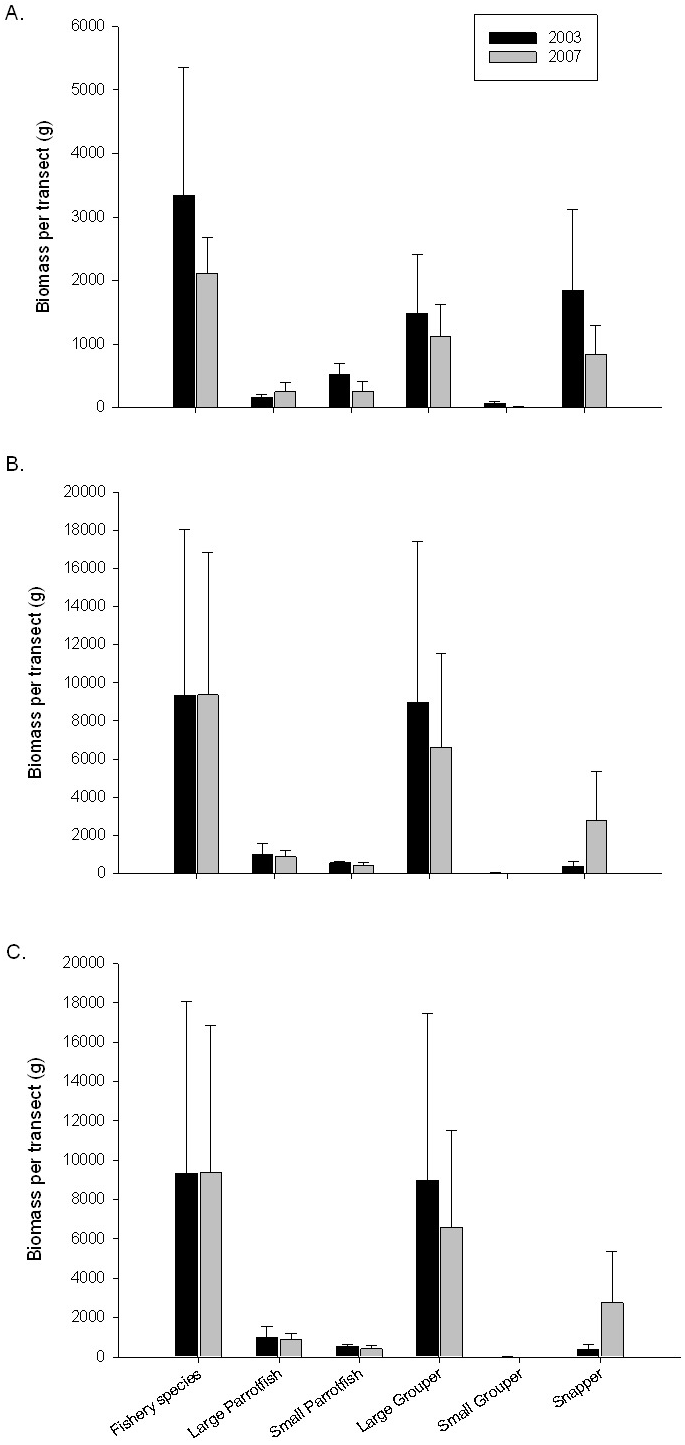


Figure 13. Biomass of fishery species, large parrotfish species, small parrotfish species, large grouper species, small grouper species and snapper from surveys in 2003 and 2007 in (A) patch reef, (B) forereef, and (C) hardbottom habitats. Seagrass beds are not included since they only had small amounts of small parrotfish.

A similar comparison of the density of fish in each key group indicated that fish densities also remained fairly constant from 2003 to 2007 with few exceptions. In forereef habitats, the abundance of small parrotfish species showed a significant decline ($p = 0.04$; Fig. 14), but observed declines were not statistically significant in other habitats.

One final note is that in 2003 surveys, no invasive Indo-Pacific lionfish (*Pterois volitans*) were observed, but in 2007 they were observed on 2 forereef transects and off transects at several patch reef sites. While observations of this species are not likely to have contributed much to differences in community composition, it is an important aspect of continued monitoring and may have direct and indirect (i.e., through predation on other fish species) impacts on reef fish communities in the future.

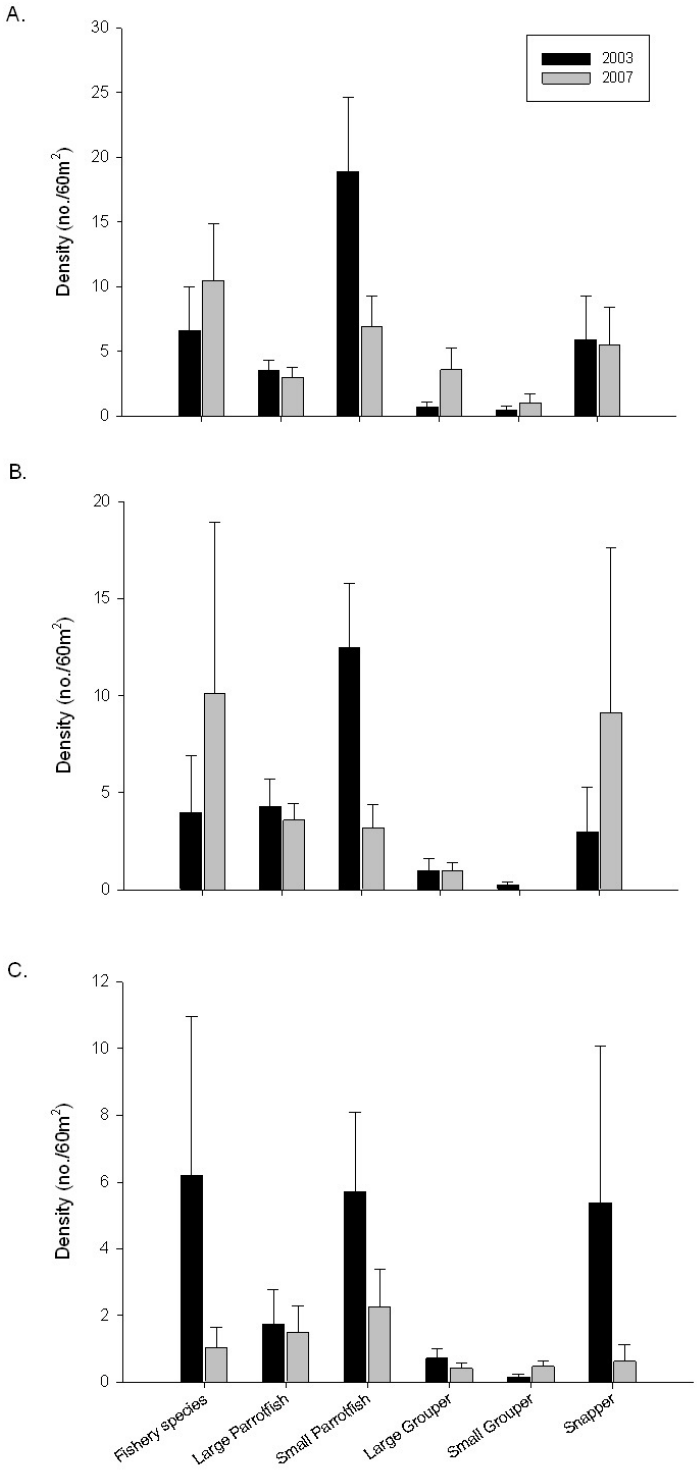


Figure 14. Density of fishery species, large parrotfish species, small parrotfish species, large grouper species, small grouper species and snapper from surveys in 2003 and 2007 in (A) patch reef, (B) forereef, and (C) hardbottom habitats. Seagrass beds are not included since they only had small amounts of small parrotfish.

Socioeconomic Evaluation

A total of 35 socioeconomic/governance surveys were conducted in and around the Exuma Cays Land and Sea Park in early 2009. These included 20 surveys of local residents near the park, primarily from the settlement of Black Point, but also from as far away as Farmer's Cay. Approximately half of the local respondents were males and ages of respondents ranged from people in their 20s to over 70 years old. Of local residents surveyed, 30% had not visited the Exuma Park in the past 5 years and several reported never having visited the park. Of the 70% who had visited the park in the past 5 years 25% of local residents surveyed had visited the park an average of once a year or less, 10% reported visiting an average of once a month, 10% an average of several visits each month, and one respondent indicated that he made daily visits to the park.

A total of 15 surveys were completed by foreign visitors to the park, primarily from the US (11), but also from South Africa, Bermuda and Canada. Visitors responding to questions were approximately half male and respondents ranged in age from their 40s to 70s (with some respondents not answering this question). All visitors surveyed were visiting the park on their own boat. Of the visitors surveyed, 27% indicated that it was their first visit to the Exuma Park, 40% were on their second visit, 13% were on their third of fourth visit and 13% had visited more than 4 times. Approximately two thirds of visitors surveyed had spent 1 week or less in the park on this visit and only one had spend more than 2 weeks. Two thirds of respondents had also visited other parks in the Bahamas.

Local resident surveys

Survey results indicated that while 40% of local resident respondents (primarily males) engage in subsistence fishing, only 20% engage in recreational fishing (defined as fishing with a primary purpose other than sale or consumption of catch) and 10% engage in commercial fishing activities. All of these activities were conducted in local waters (i.e., the Exuma Cays) and at a frequency that ranged from as often as weekly for some subsistence fishing, to one or two times a month for recreational and commercial fishing. Other uses of the sea included transportation between islands (75% of respondents), recreational boating or sightseeing (35%), and guiding tours (15%). Thus, the sea was primarily viewed as a source of food and recreation, or simply as a route of travel, rather than a source of income.

When asked about their occupation and source of income, only one local resident listed more than one occupation, which included both a fishing and construction. Three respondents listed their occupation as guides and one as a hotel/restaurant worker. Three respondents listed their primary occupation as construction work and the remainder of respondents had other occupations. When asked about sources of income the respondent that listed more than one occupation estimated 10% of their income to come from fishing and 90% from construction. Only 15% of respondents said that they owned their own business. While the impact that the Exuma Park might have on local employment opportunities, further monitoring of this factor may reveal changes that are influenced by the park.

Of those respondents that fished, seven harvested grouper and snapper, six harvested conch and crawfish, five harvested pelagic species (dolphin/wahoo) and three harvested other species. The majority of this harvest was for personal or family consumption, but for both conch and grouper there was one individual that sold fish locally and two individuals said that they sold snapper locally. Only one respondent sold crawfish and they sold it in Nassau for export. The fact that local markets may be limited and the volume and value of catches may not justify transporting them to larger markets in Nassau may explain why few respondents rely on the sea as a major source of income.

Surprisingly, only 30% of respondents indicated that they regularly ate seafood, with 40% indicating that they did not and 30% not answering the question. Of those that answered the question, only one respondent indicated that they ate seafood daily and 33% ate seafood once per week or more. When asked how often seafood was not available to them in the past month, nearly 30% of respondents indicated that seafood was not available on a daily basis, and over half of respondents said that seafood was not available at least once a week. Over 82% of respondents to this question indicated that seafood availability has changed in the past 10 years and all agreed that there has been a decrease in seafood availability. When asked if the Exuma Park affected seafood availability, 80% of those answering the question said that it did, however there was a split response on what this impact was with approximately half of respondents to the question indicating a positive impact and half indicating a negative impact.

Questions aimed at gauging local opinion of the value of the sea and the need for protection indicated that 70% of respondents believed that human actions could affect the sea and marine life and 80% of respondents believed that there was a need for people to take care of natural resources. Forty percent of respondents, however, believed that they did not have to worry about the sea and fish since god would provide for them. Half of respondents disagreed with this statement, however, with 40% strongly disagreeing. Fifty five percent of respondents believed that the sea provided more value than simply a place for fishing and diving. Nearly all respondents (95%) recognized the importance of mangroves as nursery areas and 60% of respondents believed that seagrass beds have value to people. When asked about restricting activities that might affect marine resources, 70% believed that fishing should be restricted in certain areas to allow fish and coral to grow and 80% believed that development should be restricted to preserve natural environments.

When asked about impacts to marine resources, respondents believed that using bleach to fish had the greatest impact to marine resources, with all respondents agreeing that use of bleach has a severe impact. Respondents also rated dumping trash, dredging, discharge from boats, cutting mangroves and compressor fishing to have a large to severe impact on marine resources. Coastal development and spear fishing were believed to have a moderate to large impact on marine resources; however views on spear fishing were quite varied among respondents. Activities that were generally believed to have no noticeable or only minor impacts included pot fishing, recreational diving and line fishing, although there was a range of responses with at least one respondent for each activity listing the impact as severe.

Beliefs about the status of marine resources in general and inside the park were fairly consistent with nearly all respondents believing that conch, grouper, snapper and crawfish abundance have decreased in the past 10 years and only 1 or 2 respondents believing that abundance of each species has not changed. No respondents indicated an increase in abundance for these species. The majority of respondents answering this question also believed that abundance of these species was either greater or much greater inside the Exuma Park than outside the park, with only one respondent believing that there were less of each species in the park.

Pelagic fishery species (dolphin and wahoo) were believed to have the same abundance as 10 years ago (35%) or have decreased (20%; with the remaining 45% of respondents not answering). Most respondents answering this question believed that abundances in the Exuma Park were the same as outside the park (70%), but a few respondents indicated that their abundance was less or much less in the park than outside the park (30%). One respondent offered that the only species increasing over the past 10 years was lionfish.

The majority of respondents believed that the park provided protection to fishery species and supported fisheries outside the park. 70% of all surveyed agreed that the park supports conch fisheries outside the park and that crawfish grow larger and produce more eggs in the park (only 10-15% disagreed with these statements). 60% of all respondents agreed that Nassau grouper leave the park to spawn, but 25% disagreed with this statement.

Finally, 80% of local respondents agreed that the park protects marine resources for present and future generations of Bahamians (15% disagreed) and 70% agreed that the park benefits Bahamians (10% disagree). Slightly less, 60%, believed that the Exuma Park benefited local communities and 35% believed that it did not benefit local communities. The significance of these results is discussed later in this report.

Visitor Surveys

Visitors were asked many of the same questions as local respondents or slight variations of these questions. Of the tourists surveyed, all respondents engaged in recreational boating and sightseeing and nearly all regularly engaged in snorkeling (87%) and subsistence fishing activities (93%). Only 20% of visitors would SCUBA dive and one respondent engaged in kayaking on their visit. No respondents engaged in recreational or commercial fishing. This agrees with the expectation of visitors using the sea for both recreation and as a source of food.

When asked about the value of marine resources and human impacts to marine systems, all visitors indicated that there is a need to take care of the sea or it will not provide for people in the future. Only one respondent believed that humans had no impact on the sea and marine life. When asked if coral reefs were only important for fishing and diving, 73% of visitors responded that coral reefs had other values and 27% did not know of any other values. Similarly, over 86% of respondents recognized the importance of seagrass beds in general and the importance of mangroves as nurseries. When asked if they agreed

that fishing should be restricted in some places, all but one respondent agreed and the one that did not agreed provided a neutral response. Similarly, all respondents agreed that development should be restricted in some coastal areas.

When asked about specific human impacts, coastal development, dumping trash, using bleach, cutting mangroves, and dredging were all viewed as having a large to severe impact on marine resources. Compressor fishing, pot fishing and discharge from boats were generally viewed as having a moderate to large impact, but the range of responses varied for each of these from no noticeable impact to severe impacts. Spear fishing, line fishing and recreational diving were viewed as generally having a minor to moderate impact, but again, the range in responses varied from no noticeable impact to severe impact for both forms of fishing while recreational diving responses ranged from no impact at all to large impact.

While many visitors did not have a baseline for assessing changes in abundance of marine resources over the past 10 years, all believed that grouper have declined, and nearly all agreed that conch and snapper had also declined (in each case, an answer of no change received a single response). While most responses for crawfish and dolphin/wahoo received indicated a perceived decline, each of those groups received one response of no change and one response of a slight increase over the past 10 years.

When asked to compare those same resources between the Exuma Park and areas outside the park, there was a mix of responses. For conch, 53% of visitors believed abundances to be greater or much greater inside the park, but 7% did not see a difference and 14% believed abundances to be greater outside the park than inside the park. For crawfish there were nearly identical results with 47% of visitors believing there are greater abundances in the park, but 14% believing abundances to be greater outside the park. Forty seven percent of visitors also believed that grouper abundance was greater or much greater in the park than outside the park, but 14% saw no difference in abundances. Thirty three percent of visitors thought snapper abundances were greater in the park than outside the park, but 20% believed there to be no difference or more snapper outside the park. For wahoo and dolphin, responses were split equally between more or much more in the park, less in the park, and no difference between the park and surrounding areas.

When asked about seafood consumption, all visitors responded that they consumed seafood regularly, with most consuming seafood at least 1 time every 2 weeks. Conch was consumed by 53% of visitors and not eaten by only 13% (the remainder of visitors did not respond), with more than half of those eating conch doing so at local restaurants and the rest either primarily collecting conch themselves (13% of visitors) or purchasing fresh conch from local vendors (7%). Sixty seven percent of visitors reported eating grouper, with 47% of visitors primarily eating grouper at local restaurants, 13% catching grouper themselves and 7% purchasing grouper from local vendors. Similarly Snapper were consumed by 67% of visitors, with 40% primarily eating snapper at local restaurants, 7% purchasing from local vendors, and 20% catching snapper themselves. Only 47% of visitors reported eating crawfish, with only 7% reporting primarily eating crawfish at local restaurants, 13% purchasing from local vendors and 27% catching

crawfish themselves. It should be noted that most surveys were conduced during the closed crawfish season, but the total timeframe for each response is unknown. Thus, it is unknown whether lower consumption of crawfish at restaurants is a result of the seasonal closure and/or high prices of crawfish drive more visitors to catch it on their own. Finally, 60% of respondents reported eating dolphin or wahoo with 40% catching it on their own and 20% of respondents eating dolphin or wahoo primarily at local restaurants. This is not surprising since these species may be caught in open water while visitors are transiting from one location to another and fishing for them is viewed as a means of helping to pass the time while in transit.

Over 53% of respondents reported that seafood was not available to them whenever they wanted it with over half of those responding indicating that this occurred on a weekly basis. Only 46% of visitors addressed the question of change of change in the availability of seafood over the past 10 years, this approximately half indicating that there was a change and half indicating no change. Of those indicating that there was a change, several indicated a negative change and none indicated a positive change. When asked if the Exuma Park influences seafood availability, 53% of visitors said no and 33% said yes. Of those indicating that they believed the park to influence seafood availability, most indicated a positive change.

Governance

The Exuma Cays Land and Sea Park was officially created by the Bahamas National Trust Act in 1959. The enabling legislation for the Bahamas National Trust (BNT) allows for the BNT, a non-governmental organization with the mandates for managing the Bahamian National Park System to determine all rules and regulations within park boundaries. The Bahamas National Trust is a membership organization governed by a Council comprised of elected members and appointed members from several institutions, including: The Bahamas Ministry of Agriculture and Marine Resources, the American Museum of Natural History, Wildlife Conservation Society, National Audubon Society, Ministry of Tourism, Smithsonian Institution, University of Miami, Governor General's Representative and the US National Park Service.

At the time it was created, limited harvesting of marine resources was allowed within the Exuma Cays Land and Sea Park. In 1986, however, the entire park area was made no-take. Despite these changes in management, there was no management plan for the park until 2006. This management plan reinforces no-take restrictions and outlines other rules and regulations regarding mooring and anchoring within the park, discharge from boats.

No formal scientific advisory committees or community advisory committees exist specifically for the Exuma Park. The Scientific Advisory Committee of the Bahamas National Trust provides guidance, advice, and recommendations on science-based issues within the park. There are a number of scientists on the Trust's Scientific Advisory Committee that are active researchers within the park. There is a staff of three people at the park headquarters located on Warderick Wells Cay, and the park enlists the extensive support of volunteers, primarily from visitors living on their boats and staying in the park. Financial support for the Exuma Park comes primarily from user fees (moorings),

donations, and operation of a gift shop at the Park Headquarters. Additional funds, as needed, are provided from the BNT's operating budget, including funding from the Bahamian government.

Enforcement of park rules and regulations is the responsibility of the Park Warden, with the assistance of members of the Royal Bahamas Defense Force (RBDF). Officers of the RBDF serve in pairs in the park on a 3 week rotational basis. They are armed while accompanying park staff on patrols and have the ability to make arrests for park violations. Patrols are varied, but generally occur daily. The central location of the Exuma Park Headquarters on Warderick Wells Cay enables efficient patrolling of the large park area. The drawback to the central location of the park headquarters, however, is that there is less interaction with local communities outside the park boundaries and it is difficult to monitor visitor entry and exit from park waters.

Governance Survey Results

Several questions on the socioeconomic survey were aimed at assessing public opinion of the Exuma Park's governance and management. The first set of questions was aimed at assessing people's basic knowledge of park boundaries and regulations. Of the local residents responding to these questions, 11 of 12 respondents answering this question knew the location of the southern park boundary (nearest to their homes) and the one who did not accurately identify the exact location of the boundary was inclusive of the boundary in his answer (i.e., their idea of where the boundary was lay outside the park, but the area that they considered to be inside the park included the actual park boundary). Nine of 11 respondents correctly identified the northern boundary of the park, but two incorrectly identified the boundary as being in areas that were well inside actual park boundaries. Of the visitors answering this question, five identified the correct boundaries, two identified boundaries that were outside the park but included the entire park area, and one was incorrect. One visitor did not identify the boundaries, but stated that they were available in guide books.

When asked what park rules were, only 60% of local residents responded, with the most common rule mentioned being prohibition of fishing (13 responses) and prohibition of collecting shells was mentioned by 2 respondents. Two respondents also mentioned that diving was prohibited, which is not correct; however, they may have meant that diving for conch or compressor diving for fish is prohibited. In citing rules against fishing, one local resident phrased his response as there was a rule against "getting a meal of fish". When asked the same question, 93% of visitors mentioned no fishing as a rule, 27% mentioned no shell collecting and 13% mentioned no dumping. One respondent also mentioned no hunting was allowed.

When asked if the rules of the park were clear to them, 85% of local respondents and 93% of visitors said that they were (one visitor surveyed did not respond). Only 10% of local respondents indicated that the rules were not clear to them and no visitors indicated that the rules were not clear. When asked if they agreed with these rules, all visitors responding indicated that they agreed with the rules, but only 75% of locals agreed with all rules. 20% of local residents indicated that they did not agree with the rule prohibiting

fishing, with one respondent indicating that they should be able to harvest a meal of food from the park. One local respondent thought shell collecting should be allowed and one respondent agreed with rules but thought that they should be "stiffer".

When asked if people follow the rules and regulations of the park, local responses were mixed with 20% of those surveyed saying yes, 35% saying no and several indicating incomplete compliance with rules. When asked the same question, 60% of visitors said yes, and 7% said no (with the rest not answering).

Several questions were aimed at assessing people's perceptions of how decisions were made regarding park rules and regulations. Of local respondents, the vast majority, 80%, felt alienated from or outside of the decision-making process. The majority of local respondents either had no idea how decisions were made with respect to park rules and regulations (45%) or believed that no local consultation occurs in decision-making (35%). Only 5% of those surveyed indicated that they have had input into decision-making for the Exuma Park. Another 5% indicated that they have not had input themselves, but their community has had input. Despite these results, when asked if they would like a greater role in making management decisions, only 40% said yes and 50% said no. When asked about the role of science in making management decisions, 65% of local respondents believed that science did play a role, but 15% believed that science did not. When asked about the role of science and local community input in making management decisions, 73% of visitors believed that science played a role in decision-making and no respondents believed that it did not, but only 47% of visitors believed that local communities had input into management decisions (with the rest of respondents indicating that they did not know the role of local communities in decision-making).

Visitors were not asked about their role in decision-making, but were asked to compare management of the Exuma Park to other parks they have visited. Over 50% of respondents believed that the Exuma Park was the best managed park that they have visited. Twenty percent believed that the Exuma Park had better management than most parks that they had visited and another 20% believed that the Exuma park was on a par with other parks. No visitors believed that the Exuma Park was not managed as well as other parks they have visited and 26% had no basis for comparison.

Further questions of locals and visitors were directed at assessing park management. Local respondents were divided over whether the park rules and regulations were well enforced with 45% indicating that they were and 40% indicating that they were not. When asked the same question, 53% of visitors indicated that rules and regulations were well enforced and 7% believed that they were not, with the remainder of respondents indicating that they did not know about the level of enforcement. Only one local respondent (and no visitors) indicated that they had ever reported a violation of park rules, and while the respondent indicated that there was adequate follow-up by park management, there was no resulting penalty (arrest, warning, fine, etc.).

The last set of questions was aimed at determining how to best communicate with stakeholders. When asked to list all of the ways in which they receive news and

information about the Bahamas, local respondents listed radio (80% of responses) as their top source of news by far. Other responses included television (25%), newspapers (20%) word of mouth (20%), internet, school, community meetings (10% each) and posters or flyers (5%). When asked about how they got their information about the Exuma Park, however, only 25% indicated that they got their information from radio. Word of mouth (35%) and newspapers (30%) both were greater sources of information than radio. Television (10%), posters (10%) schools (5%) and community meetings (5%) were also sources of information about the Exuma Park. One respondent also indicated that his information from the Exuma Park came from fishing and one other respondent indicated that they received information via other sources, but did not specify what the source was.

Visitors received most of their information about the Bahamas via word of mouth (67%) or internet (53%), with posters (33%), newspapers (20%) cruising guides and other sources (13%) radio (13%) and community meetings (7%) also playing a role. When specifically asked about where they get information about the Exuma Park, there was a similar response with 67% getting information via word of mouth and 40% via the internet, with posters (27%), cruising guides and other sources (27%) radio (20%) and community meetings (7%) also playing a role.

Discussion

Benthic communities within the Exuma Park have changed relatively little from 2003 to 2007. While they show signs of degradation (e.g. low coral coverage and low coverage of live tissue on large coral colonies), several studies have noted their condition as being healthier than benthic communities outside the park using a number of comparisons (e.g., Sluka et al. 1996, Sullivan Sealey 2004, Mumby et al. 2007). While inside versus outside comparisons were not included in this study (but will be included in future monitoring), these trends are likely to have continued. Of the changed noted in this study, the most encouraging change to benthic communities is the significant increase in coral cover in forereef habitats. This increase may be the result of both new coral recruits and growth or re-growth of corals that recruited prior to 2003. Since detailed population demographics of corals was not included in 2003 surveys, we cannot say for sure what caused the increase in coral cover, but there is some evidence of successful coral recruitment during this study period (P. Mumby personal communication). What we can say from the coral population demographic survey conducted in 2007 is that successful recruitment of some of the major reef building corals (e.g., *Montastraea* spp.) appears to be low, based on the low occurrence of small colonies (<10 cm), and older and larger colonies of these species are still in the early stage of recovery from partial mortality resulting from disease and/or bleaching. Some of the species more resistant to thermal stress and bleaching mortality, and those that brood their eggs (e.g., *Porites* spp.) appear to be healthy and are among the most abundant corals on reefs. While the occurrence of live corals is encouraging, we may be seeing a change in community structure from reefs from dominated by *Montastraea* spp. to those with increasing *Porites* spp. occurrence. Since *Porites* spp. do not contribute to reef formation and provide structure the way *Montastraea* spp. do, benthic community structure and fish community structure may both change over time.

Other observed changes in algae on Patch reefs, hardbottom and forereef habitats require further monitoring before conclusions may be drawn. Observed changes may be the result of seasonal or other environmental factors present during the specific survey periods. In seagrass communities changes observed at several sites were the result of small (not statistically significant) decreases in seagrass coverage, with accompanying changes in bare substrate and detritus. These may be due to natural seasonal variability (e.g., die-off and high growth periods) since sampling was conducted during different months in 2003 and 2007. These changes may be the result of the passage of storms that may increase detritus loads or expose new bare patches. Since these changes were inconsistent between habitats and often varied from site to site, we cannot draw robust conclusions at this time.

Fish communities were similar in their composition and structure from one year to the next at most sites; however several sites diverged from this pattern. Because there was no consistent trend in fish community change for any habitat, it is likely that the fish communities within the Exuma Cays Land and Sea Park were fairly stable from 2003 to 2007 and changes at individual sites may have been influenced by the occurrence of rare species, the passage of transient species or other local factors. Furthermore, consistency in the abundance and biomass of key taxonomic groups and functional groups further indicates stability in fish communities. The only taxonomic/functional group that decreased in abundance from 2003 to 2007 was that of small parrotfish species. Past research in the park has shown that these species are vulnerable to predation by large groupers that are found within the park, so their decrease may be a direct result of ongoing predation pressure by large grouper (Mumby et al. 2007). The disparity between results based on density of this group versus those based on biomass may be due to selective reduction of smaller size classes that are most vulnerable to predation. Small parrotfish are also vulnerable to predation by invasive lionfish (Albans et al. 2008), which were observed in the park during 2007 surveys but not during 2003 surveys. Thus, the decline in density of these species should be investigated further and the impact of these declines examined. The fact that overall biomass of this group did not decline and the fact that this group does not contribute to grazing as much as larger parrotfish, suggests that overall grazing pressure on benthic communities in the park is not likely to have changed much at present, but as lionfish and/or grouper populations within the park change, their impact on small parrotfish may result in more widespread indirect effects to benthic communities.

Socioeconomic surveys were conducted on a relatively small number of people, thus conclusions must take into account this small sample size. Nevertheless, even the small sample size used in this survey represents a significant percentage (>1%) of the local population in the study area, are representative of the sex distribution of the population, and cover a wide age range.

Clearly, the vast majority of respondents, whether visitors or local populations, have a strong connection to the sea and marine resources. All of the visitors are active in recreational boating and snorkeling. Most local respondents travel by boat frequently and over half of respondents rely on the sea as a source of food. While only 25% of local

respondents derived income from the sea, this may be attributed to the limited number and size of markets for seafood in the area (primarily few restaurants), which limit commercial fishing opportunities. Similarly, guiding opportunities may be limited for local residents based on the fact that the majority of tourists to the area come on their own vessel and seek out guide services infrequently.

What was somewhat surprising was that several of the local respondents had never been to the Exuma Park and others had only been there one time in the past five years. While it was encouraging that some respondents made frequent visits and were engaged in guiding activities, clearly the park is either not accessible or not seen as a desirable place for many in the local population to visit. In contrast, it was encouraging to see that a high percentage of foreign visitors were repeat visitors to the Exuma Park. These results are somewhat reflective of what appears to be a disparity between stakeholder views on park rules, park management and benefits that the park provides.

While values and beliefs vary somewhat among individuals, most agree that marine resources are threatened by some human activities and that people must do something to protect these resources. When it came to assessing the impact of human activities, visitors and local residents agreed that recreational diving, and line fishing had relatively low impacts to marine systems and that fishing using bleach was one of the more harmful impacts, but there was little further agreement. Visitors tended to view most activities that affected habitats (e.g., development, cutting mangroves) as having high impacts, while fishing and water quality (e.g., discharge from their boats) as having lower impacts. It is unclear whether these views reflect an attitude among visitors that activities that they engage in have little impact, while other activities are the source of problems in the marine environment, or whether there are other reasons for these views.

Local residents, however, had a mixed response to the same question with some forms of fishing being viewed as having higher impacts than others, and viewed as being nearly harmful or equally as harmful as some habitat altering activities. Local residents also viewed activities that affected water quality, such as discharge from boats and dumping trash as having higher impacts. While suggestions of restricting fishing and coastal development were polarizing for the local population, the majority of locals surveyed and all visitors agreed that these were necessary actions.

Seafood consumption in both groups varied, but consumption of seafood typically ranged from weekly to monthly. This was somewhat lower than expected in both groups. There was general agreement, however, that there has been a decrease in seafood availability and the landings of most species over the past 10 years. There was mixed responses regarding how the Exuma Park affects seafood availability in both groups. Because locals reported that they fish locally in the Exuma Cays for the most part, their split opinions of the impact of the park on seafood availability may be interpreted as some reporting on a positive impact on fishing via spillover from the park or enhanced larval replenishment from the park in areas where they fish. Others may believe that the park has a negative impact on fishing because it restricts their access to historic fishing grounds.

While local residents primarily get their seafood themselves, the majority of seafood consuming visitors reported buying seafood at local restaurants as their primary means of consuming seafood (with the exception of dolphin/wahoo and crawfish). This suggests that visitors are supporting local restaurants and fishers on some level. It is interesting to note that the timing of surveys, at the end of lobster season/start of the closed season, may affect visitor responses, particularly if fresh crawfish is not available to restaurants during the closed season. The prevalence of visitors catching their own crawfish at this time may reflect lack of availability from local vendors, the unwillingness to pay high market prices for crawfish, and/or a lack of compliance with closed season fishing regulations. Because this survey spanned the change in season and visitors may be reporting on their behavior throughout their entire visit (which may have been mostly during the open season), it is not possible to draw conclusions at present, but this issue should be investigated further.

The majority of respondents believed that the Exuma Park protected resources for future generations, benefited local communities and benefited the Bahamas, but local opinion of the benefits to local communities was somewhat lower than visitor opinions and was lower than local views on national benefits and benefits to future generations. This sentiment in local residents may be attributed to a number of factors. They may not receive adequate information about the park and the ecological research being conducted there. Better communication may alleviate this issue. On the other hand, they may not be experiencing benefits from the park on a personal level. Follow-up with local communities to learn more about what they expect from their park and how the park may benefit them may address this issue. Finally, there may be a philosophical divide here, where many local residents do not agree with the concept of the park or its management and, therefore, do not view the park as providing benefits. This sentiment may be rooted in the perception of a lack of consultation with local communities about park management.

Perhaps the greatest governance issue identified in this evaluation is the fact that there is little formal local community input into park management and the majority of local respondents indicated that they do not have input into any management decision-making process. Thus there is likely to be little sense of "ownership" of the park by local communities. This may help to explain why several local respondents disagreed with several park rules and regulations and some disagreement over the benefits that the park provides local communities. Half of local respondents did not show a desire to participate in decision-making. While this may reflect apathy towards the park, it may also reflect a belief that they have been excluded from the decision-making process and don't believe that this will change. Nevertheless, there were many local respondents who did express a desire to be more involved in management decisions for the Exuma Park and these individuals may be able to represent concerns of their community when it comes to park management decisions.

Other than the issue of local input into decision-making, the park does appear to show several positive signs in its management and governance. The Exuma Park has adequate

legislation allowing the Bahamas National Trust to manage it effectively and the recent completion of a management plan will help ensure adequate protection of resources within the park. While the Bahamas National Trust and Exuma Park staff appear to do a good job cultivating volunteer support from visitors and securing donations, it would probably benefit the park to further evaluate its funding goals and plans for sustainable financing.

While park management and enforcement of rules and regulations appears to be quite satisfactory to most visitor and local respondents, there is a sense that violations of park rules still do occur. This belief is strongest in local communities. This issue may be addressed by better communication of what park boundaries and rules are, as well as better communication about what the benefits of the park are. Confusion over boundaries and rules were identified in surveys, and may be alleviated by more effective communication about the park.

The issue of communication is evident in the fact that information about the park is not reaching local communities via the media that they receive most of their information about the Bahamas in general, the radio. Similarly, it may also be of concern that information about the Exuma Park is reaching a high percentage of people in both stakeholder groups via word of mouth and not necessarily directly from the Bahamas National Trust or staff of the Exuma Park itself. While word of mouth will always be a major means of communication in small island communities and among boaters, facts may often be distorted through this means of communication. The more that people can receive information via direct communication, the greater the chance that they will have a more complete understanding of the Exuma Park and its management.

Conclusions

This evaluation should be viewed as an assessment of the park at a specific point in time, and as a baseline for future assessments to determine whether the park has made improvements in ecosystem health, quality of life for constituents, and management of resources. Based on the current study, there does not appear to be any major ecological changes within the park. The Exuma Park does appear to be maintaining relatively healthy fish communities and improvements to coral coverage in the park is encouraging and suggests that processes responsible for reef resiliency are functioning on some level in the Exuma Park. It should be noted, however, that the fish and benthic communities within the park are by no means in pristine condition, and have a long recovery ahead of the, to reach this state. The increase in lionfish sightings, and the potential threat that this species poses, is also a major concern.

From a socioeconomic perspective, the park has two main constituent groups, foreign visitors that primarily visit by way of their own boats, and local communities. There were some disparities in how both groups viewed the park and its management. Local communities need to view the park as a resource for their use and they need to experience benefits of the park. This, in turn, is expected to increase support of the park by local communities. While this is not necessarily a new finding (Mascia 2000) it remains one of

the greatest needs facing the Exuma Park at present. Recommendations for addressing these issues are discussed in the Management Recommendations section below.

Management Recommendations

To address ecological, socioeconomic and governance issues identified during evaluations the several actions are recommended to improve management.

1. Continued monitoring of fish and benthic communities, as well as populations of key species is needed. This should be done on a 3-5 year basis (or more frequently if sudden and/or large scale issues, such as mass coral bleaching are observed) and should use sites and conditions from this report and other available data as a baseline.
2. While it may be impossible to eradicate invasive lionfish, efforts should be made to reduce their presence in the park when possible. This includes setting up a reporting system when visitors encounter lionfish while diving or snorkeling, and periodic removal of lionfish by park staff. Since this removal goes against park regulations, park regulations may need to be amended to accommodate this action or the Bahamas National Trust may want to adapt a non-native invasive species policy for parks in the Bahamas as a whole. Because opening the park to fishing for lionfish would make other no-take regulations more difficult to effectively enforce, it is recommended that the removal only be conducted by park staff or trained volunteers working under the direct supervision of park staff.
3. Greater efforts are needed to increase involvement of local communities in the park and to cultivate local communities as stakeholders. This includes increased education and Outreach efforts to communities at Staniel Cay, Black Point and Farmer's Cay. Efforts should include workshops, meetings and other activities in the communities themselves as well as bringing community members to the park.
4. From the governance perspective, increasing opportunities for local involvement in park management decisions is recommended. Local communities should be empowered to contribute to the management decision-making process (i.e., through a local advisory committee) to ensure that their needs and concerns are represented in the decision-making process.
5. Finally, it is recommended that a communication strategy be developed for the Exuma Park that uses media with the greatest probability of reaching constituents to disseminate information and increase awareness of the Exuma Park. This strategy does not need to be complicated and may simply be based on the findings included in this report for effectively reaching target audiences.

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