

# **Lighthouse Reef Atoll**

Conservation and Protection Project

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**PROARCA/CAPAS**

## **Acerca de esta publicación**

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## **About this publication**

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## 1.0 Background

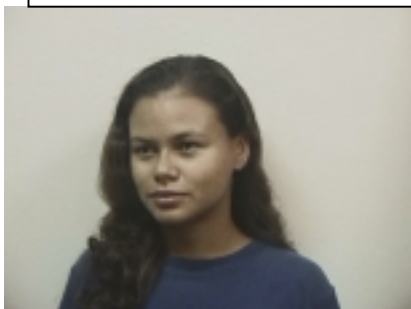
Lighthouse Reef is one of four true coral atolls in the Caribbean, and is the outermost of the three well-developed off-shelf atolls in Belize. This project was designed to lay the foundation for the sustainable management of the natural resources of Lighthouse Reef Atoll in order to conserve its globally significant biodiversity, in order to sustain tourism, fishing and other extractive activities while providing opportunities for education, research and public appreciation.

The project initially started in February with funding from The Summit Foundation in Washington, managed by Ms. Julianne Robinson working for the Belize Audubon Society (BAS). The project was then co-funded by PROARCA/CAPAS in June and has now been completed. Funding has been secured for the following three years to disseminate information to stakeholders and the general public, develop a multiple-use-zoning scheme for the atoll, which includes expansion of the total "no-take" area to approximately 50% of the atoll, improvement and expansion of current management activities, establishment of a marine education program, expand the marine research program and institute mechanisms to assist financial sustainability for The Belize Audubon Society.

In order to accomplish the objectives of the project, several factors were considered which included the condition of corals, fish populations and diversity, user impacts, conch and lobster populations. It was also the intention of the author to include water quality analysis. However, there were problems with equipment and qualified personnel to accomplish the intended monitoring.

There is not enough data present to make solid conclusions, however, initial results gathered during this project showed that Lighthouse Reef Atoll suffered the same damages received at other reefs but recovered well from stresses during the 1998 bleaching event and storms. Data gathered was compared to other reefs in Belize and Lighthouse Reef showed a high incidence of coral recruitment, however, fish biomass and diversity were low compared to the rest of the region and wider Caribbean area.

Julianne Robinson, MPA Coordinator



This project was coordinated by Ms. Robinson, a 24 year old Belizean who has been working in the field of marine research for the past four years and has now taken on the task of managing the marine protected areas for BAS. Ms. Robinson collected all the field data, compiled and analyzed them. She is now involved in the administrative work and has expanded BAS's marine program, which existed in an ad hoc manner prior to the establishment of this project. She now intends to continue her work with BAS by first expanding the capabilities through additional field staff to assist with the data collection, analysis and management.

The project has now entered its third phase and is scheduled to be completed in June 2003. It will be challenging and exciting for all those involved in accomplishing the objectives set forth in the program.

## 2.0 Focal Area / Significance

Lighthouse Reef Atoll (LHR) is internationally recognized as one of the world's premiere diving destinations and contains some of the most "pristine" reefs in the Caribbean. It is one of the most well developed atolls in the Western Atlantic, with an emergent fringing reef, sloping fore reef with a coral rimmed shelf edge, vertical coral walls, and numerous patch reefs in the shallow central lagoon. The atoll is approximately 38km (24 miles) in length and 10km (6miles) at its widest point and is located approximately 72 km (45miles) east of mainland Belize.



Lighthouse Reef Atoll includes Half Moon Caye Natural Monument (HMCNM), Belize's first marine protected area, and the famous Blue Hole Natural Monument (BHNM). The Belize Audubon Society has the management responsibility for both areas under an agreement with the Government of Belize. HMCNM and BHNM are two of the seven marine protected areas recognized by UNESCO as part of the Belize Barrier Reef Reserve System World Heritage Site.

In addition to containing some of the healthiest reef in the Caribbean, Lighthouse Reef Atoll is home to several threatened species, including the endangered saltwater crocodile (*C. acutus*), Hawksbill (*E. imbricota*), Loggerhead (*C. caretta*) and Green (*C. Mydas*) sea turtles, the Belize endemic gecko (*P. insularis*), the anole lizard (*A. allisoni*) known only from Half Moon Caye and Cuba, and the threatened littoral forest habitat on Half Moon Caye which supports a colony of the rare white phase of the Red-footed Booby (*Sula sula*) and numerous neo-tropical migrants. Half Moon Caye Natural Monument was first recognized for its resident and nesting population of the Red-footed Booby. There is only one other island in the world that supports this rare species. For this reason, the nesting area on Half Moon Caye was declared a Crown Reserve in 1924.

The atoll includes five cayes, supporting a small resident population (approximately 25 people) including one resort, one fishing camp, two attended lighthouses, and one park management headquarters. Dive-based tourism, primarily from live-aboard vessels or day boats from Turneffe, San Pedro, Caye Caulker, and Belize City, is believed to be the primary economic interest on the atoll, followed by fisheries production.

There has been constant conflict between the tourism and fishing industries throughout Belize, more so at Lighthouse Reef Atoll for its significance to both industries. This project has identified specific areas of conflict, which have become priority for BAS to attempt to resolve. There has been little data collected on the socio-economic value of the atoll and there has been very little monitoring of the area. This project has set the stage to establish research programs on the atoll to address these areas. With the baseline data now collected, Ms. Robinson can assist BAS in determining which areas need monitoring. Areas have already been identified for diver impact studies. Project activities complemented the objectives of the Mesoamerican Caribbean Reef System Initiative, adopted under the Tulum Declaration, which aims to promote the conservation of the Belize Coralline Reef System.

### **3.0 Objectives / Accomplishments**

The first objective, assessing the level of impacts of various activities on ecosystems, was rather ambitious for a one-year project. Therefore Ms. Robinson focused primarily on the characterization of the status of the atoll's biological resources to develop baseline data that will help monitor impacts over time.

Eleven sites were surveyed on the reef using the Atlantic and Gulf Rapid Reef Assessment (AGRRA). This survey design is used to evaluate reef condition throughout the Caribbean and provides a regional perspective for the condition of the reef. The sites were chosen strategically in areas impacted and not impacted by divers and which were also representative of the reef habitat.

The second objective of this project was to determine the locations of heavy impacts and resource user conflicts at the Atoll. There are three areas of conflict and one area of potential future conflict that came to light while mapping the areas of interest to various user groups. Lack of functioning GIS equipment and changes in GIS technicians at supporting institutions have hindered the process of detailed mapping.

The third objective was to build the human capacity to assess the status of the marine resources of the Atoll by enhancing the management capabilities of the staff of the primary implementing agencies. A number of training activities were completed during the project. The Project Coordinator attended a regional workshop to learn the AGRRA methods and a Reef Ecology course at the Los Roques Scientific Foundation in Venezuela. This training was then extended to the staff and volunteers at HMCNM. Ms. Robinson also held a workshop in San Pedro, Ambergis Caye to train individuals from relevant agencies in utilizing the AGRRA methodology who would then further train their staff. This working group would then assist in the collection of data on Lighthouse Reef. Unfortunately, this never occurred.

Laying the foundation for the sustainable management of the natural resources of the Atoll by strengthening existing management initiatives at the HMCNM and BHNM was the fourth objective.

Major activities included the much-needed refurbishment and installation of engines on the existing patrol boat. A second boat to support research and monitoring activities was also purchased. Other activities on Half Moon Caye involved the expansion of living quarters for project staff, the construction of docking facilities for the Audubon fleet and extension of current docking to facilitate the increased number of tourist boats to the island. Other infrastructure activities included the construction of a multipurpose storage room for equipment and tools bought for project activities and increasing the potable water storage capacity on the island. Both natural monuments have now been clearly demarcated with the recent installation of marker buoys. All infrastructure work was completed in conjunction with a European Union funded BAS project.

The establishment of a Park Director in November also improved communication and initiatives on the island, enhancing the day-to-day management of both HMCNM and BHNM. There has been a visible change to the general upkeep of the island and the routine enforcement of Fisheries regulations in the protected areas. The Ms. Robinson, formerly the

Project Coordinator has now been appointed as a Marine Protected Areas Manager with direct responsibility for the management of these areas and addressing marine conservation issues.

#### 4.0 Methodologies

Several methodologies were utilized to complete the project objectives, one of which was the AGRRA methodology. This well-developed and tested protocol was used to evaluate the condition of the reef at Lighthouse Reef. The methodology assessed the condition by using line and belt transects. The data collected included coral condition, fish populations and algal abundance. Several parameters were recorded for corals, which included coral cover, height, diameter, bleaching, overgrowths, diseases and predation with a minimum of one hundred coral heads counted for each site. This sample size was reduced on account of low coral cover. The number of Long-Spined Sea Urchins (*Diadema*) was also counted in a one-meter belt along the coral line transect. The parameters for fish populations were quantitative and involved counting indicator species for reef condition and placing them in a size category for biomass calculation during analysis. These fish surveys were done using 10 belt transects, each 30 meters long for each site. Algal abundance was determined using 25 cm quadrates placed below the coral transect line. The relative percent cover for turf, coralline and macro algae were determined along with the average height of the macro algae.



The Caribbean Spiny Lobster (*Panulirus argus*) and the Queen Conch (*Strombus gigas*) constitute the largest percentage of fisheries income. Populations were determined within and outside the protected areas of Lighthouse Reef. Using two-hour timed swims for each site, recorders collected data on lobster populations. Each recorder would use all their knowledge of lobster behavior and habitat to find, count and estimate the sizes of each lobster. Queen Conch populations were determined using belt transects. Each site would consist of five transects, each five meters wide and thirty meters long. Transects were placed in Seagram beds where the Queen Conch is known to forage. Again, surveyors would use all their knowledge of conch behavior and habitat to find and measure each conch as well as determining whether they were mature or juvenile.

Identifying areas of user conflicts were determined through consultations with the tourism and fishing sector. Standard surveys were completed for both sectors, and each identified areas of impact and conflict. Numbers of visitors were also monitored on a daily basis.

Capacity building of the institution was accomplished through infrastructure upgrade and training of field staff. This included attending workshops and courses, upgrading facilities, providing materials for patrol and monitoring and demarcation of park boundaries. This allowed for the strengthening of management initiatives.



## 5.0 Activities

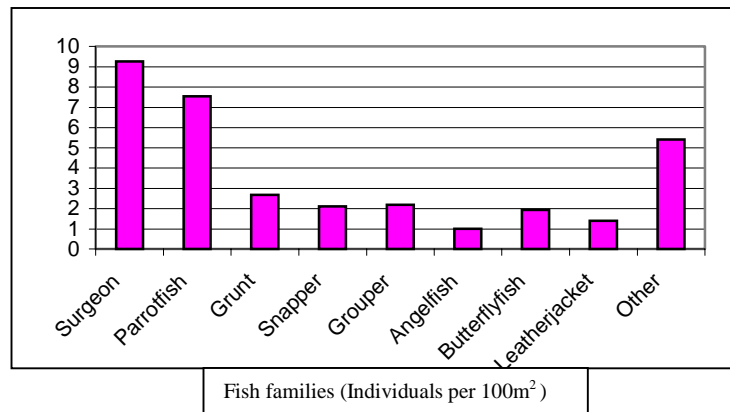
Activity	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1. Training of project staff in areas of diving, coral reef ecology, marine identification and survey methodologies	■	■										
2. Consultations with tourism sector	■	■	■	■	■	■						
3. Infrastructure upgrade including expansion of living quarters, expansion of docking facilities and storage building		■	■									
4. Sixteen conch sites completed in the lagoon areas of Lighthouse Reef		■	■									
5. Eleven AGRRA surveys completed on the forereef portions of the atoll			■	■	■							
6. Lobster counts using timed swims on patch reefs in the lagoon						■						
7. Written surveys with dive operators						■						
8. Data analysis							■	■				
9. Mapping of survey sites and areas of conflict								■				
10. Demarcation of park boundaries								■				
11. Synthesizing project reports									■	■		
12. Compiling project proposals for continued funding									■	■		
13. Dissemination of information gathered											■	■
14. Consultations with fishing communities											■	■
15. Establishment of Lighthouse Reef Advisory Committee												■

## 6.0 Results:

Several methodologies were used to collect data for the duration of the project; therefore, the analysis would be determined by the method in which the data was collected. Most of the data consisted of varying sample sizes and analysis was done to determine the variance between specific factors. This was done using T-Tests: Two-Sample Assuming Unequal variances. Other standard analyses included calculation of means and standard deviation. All the data was analyzed in Microsoft Excel Sheets.

In attempting to complete the first objective, which was to assess the level of impacts, the data collected reflected reef condition in areas exposed to anthropogenic as opposed to those only affected by natural impacts. Other methods used included invertebrate censusing to determine the populations of the Queen Conch and the Caribbean Spiny Lobster, which would give an indication of fishing pressures. Also included were general observations of Half Moon Caye Natural Monument to determine how visitation would affect the natural resources of the island.

**6.1 AGRRA:** AGRRA surveys were done on both the West and Eastern side of the atoll. Results showed that there was no significant difference in coral cover from West (21.7%) to East (17.8%), the former receiving considerably more divers than the latter. The West side also suffered more stresses from



fishing as well as damage due to anchors and pollution from boats. There is also a significantly higher number of *Diadema* on the West (24.7) vs. the East (7.4) /100m<sup>2</sup>. There is a significantly higher average number of groupers and snappers on the West (6.4) vs. East (2.5) side of the atoll. However, the most striking find was that only one individual of a larger grouper species, (*Epinephelus striatus*), was found during the entire survey covering 6.6 km<sup>2</sup>. When this data was added to the regional database, Lighthouse Reef showed the lowest biomass for fish in the area.

The utilization of Fisheries and University staff trained in AGRRA methods would have enabled the completion of more sites. Unfortunately, this group was unable to assist with the surveys and volunteers from varying backgrounds were utilized to do as much as was physically possible.

**6.2 Lobster & Conch:** Belize's annual fisheries production is valued at approximately US\$10 million. The Caribbean Spiny Lobster and Queen Conch are the main contributors to this figure and are the most heavily exploited species in Belize.

Lobster and Conch counts were completed in a short period of time primarily utilizing volunteers. Results from surveys show that there are significantly higher numbers of conch



and larger lobsters inside Half Moon Caye Natural Monument. Many areas outside the monument boundaries lack the presence of these species, which would indicate that the populations are not able to sustain themselves in the areas that are fished on a regular basis. Given enough time and continued enforcement the population of these species should increase within the monuments and repopulate areas outside the boundaries that would benefit the fishing industry.

**6.3 Natural Monument:** Another area of impact has been Half Moon Caye. With over seven thousand visitors last year, Half Moon Caye has undergone some obvious impacts. The pollution on the island is a constant problem on account of the prevailing winds and sea surface currents that wash garbage on the shores of Half Moon Caye. With increased presence and regular clean ups, the problem is being addressed more efficiently. Another impact was the erosion of the beach in some areas due to the constant walking of visitors. Trails were diverted to cut through the littoral forest and obstacles placed in these areas of erosion. Amazingly within two weeks the vegetation regenerated and has stopped the erosion in that area.

**6.4 Areas of conflict:** Determining areas of heavy impacts and resource user conflicts were accomplished through consultations with all major stakeholders. Outlined below are the areas identified by the author, based on results of the surveys conducted.

#### Blue Hole Natural Monument

At the Blue Hole Natural Monument there is a conflict between dive operators in favor of shark feeding and those opposed to it. The way in which this activity was conducted was unsafe, not to mention the potential negative effects on the sharks' diet and behavior. Dive operators were surveyed regarding this issue. Results showed that over 60% of the operators surveyed were opposed to the practice and only 25% supported shark feeding in the Blue Hole. The BAS Board of Directors has decided that this activity should not take place at BHNM and operators are now looking for an alternative area. The other conflict among dive operators is the competition for space and available moorings. The number is limited by the size of the Blue Hole and presently, operators need to wait their turn before dropping off their divers.

#### West Long Caye

Moorings near Long Caye are sometimes used for activities other than diving. Fishermen will sometimes tie up to these moorings and fish the marine life that is already comfortable with the presence of people. Therefore, there is the possibility of depleting fish stocks more quickly, taking away the dive operators livelihood as well. There are currently no regulations to prevent this.



#### Half Moon Caye Natural Monument

There is constant conflict between conservation groups and fishermen. Fishermen may sometimes enter the protected areas on Lighthouse Reef and take advantage of the available

resources by illegally fishing the area. This has been lessened due to more regular patrols and the installation of clearly visible boundary marker buoys.

#### East Long Caye

Diving on Lighthouse Reef has expanded and now includes the East side of Long Caye with more regular visits. Approximately five moorings were installed in this area, fifteen in total for the atoll. Presently there is no conflict. However, this area is sometimes used for fishing and conflicts may then arise between dive operators and fishermen. This area is being closely monitored for diver impact by establishing video transects.

### **7.0 Conclusions:**

As mentioned before, this project was the initial phase to gather baseline data and conduct a rapid assessment of the status of the natural resources of Lighthouse Reef Atoll. Considering the constraints of time and personnel available, there is still much data to be collected. It is also very difficult to make conclusions based on this preliminary data; however, certain theories may be developed as a result of the present information at hand. The reason that the author does not want to make any conclusions at this stage is that it would take years of data collection in order to have a valid set of information with enough controls to make solid conclusions. However, certain trends have been observed which are being presented in this report.

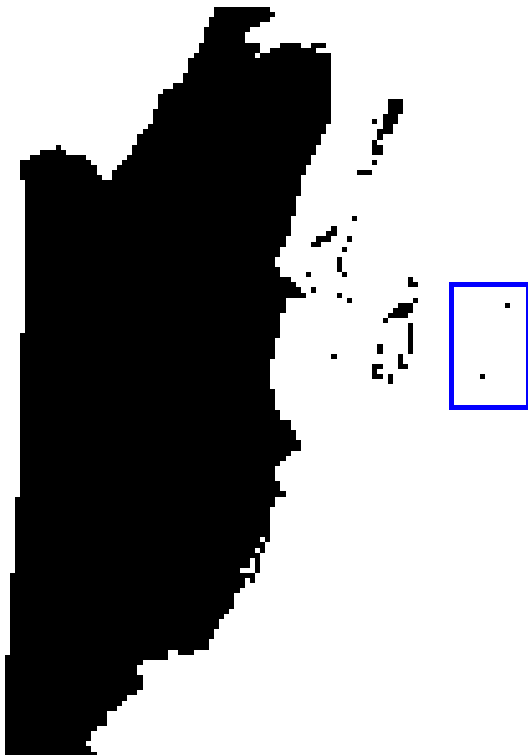
Overall, the findings were surprising in that this atoll appears to be suffering many of the same ecological problems as other parts of Belize, and the Caribbean. The reefs within the Caribbean have shown signs of degradation through ecological and human factors. The bleaching event in 1998 and strong storms experienced that year has undermined the condition of the reefs. However, there are signs of recovery. Surveys were carried out looking at the percentage of bleaching and recruitment of young corals one year after the bleaching event and a major hurricane hit the Western Caribbean coast. It was observed that many of the reefs including Lighthouse Reef Atoll suffered severe damage from breakage. The surveys also showed that there was a high incidence of coral recruitment on Lighthouse Reef as well as reattachment of the broken pieces of coral, which are now growing in an upright position again. In general, the surveys showed relatively low coral cover, high algal cover, low fish and invertebrate populations outside the protected areas. High numbers of Queen Conch within the protected area (Mean 30.25/750m<sup>2</sup>) and low numbers outside (Mean 4.6/750m<sup>2</sup>) seem to show that the conch are being harvested heavily outside the protected area and there remains a healthy population within HMCNM.

Ms. Robinson received \$4000.00 from PROARCA/CAPAS of which \$3852.00 was used for training activities, support personnel, materials and travel expenses. The total cost of the project was \$165,775 of which The Summit Foundation provided \$124,245 and the remaining \$41,530 was funded by BAS. The additional funding from PROARCA was used to compliment the project, which had already begun in February 1999.

The history of establishing protected areas, whether marine or terrestrial has always been met with some controversy. The battle between protecting our environment while sustaining development and growth of the economy is continuous. In the past, a group of technical personnel would decide what areas need to be protected and the decision was made without any information as to the resources of the area or how it would affect those who depended on harvesting those resources. This practice is slowly fading away but animosity still lingers on account of decisions made without proper and full consultations. The most significant part of the Belize Audubon Society's mission is creating a balance between people and the environment. This is what this project is trying to accomplish and will continue doing so for the upcoming years.

The work completed to date has been vital in attempting to create this balance. If the Belize Government were to continue creating marine protected areas without sound scientific data and comprehensive consultations with all stakeholders, it would be inevitable that any such creating would be met with much animosity from the fishing community in particular. The fishing community has a strong lobby and have in the past been able to curv ministerial decisions. These decisions have made the work on conservationist useless. Regulations are in place but are not respected nor are they enforced. By working with the fishing community, providing sound information and keeping them abreast of changes and integrating them into decisions making, it is the hope of the author that illegal activities will decrease tremendously and all stakeholders will work together to achieve a common goal, that of continued income through sustainable management of Belize's marine resources.

It is difficult to determine what the impact on the environment would be if all the guidelines and regulations were abided to around Lighthouse Reef. It is the hope that with increased



knowledge of the status of commercially important species along with their increased protection, their numbers will increase significantly. This increase would become noticeable inside the protected areas and through the spillover effect the populations would increase outside the protected areas, increasing the sustainable yield for the commercial fisheries. This would eventually affect not only the atoll but also the rest of the region through spawning and oceanic currents. This is the ultimate goal and can only be accomplished by working hand in hand with the tourism and fishing communities.

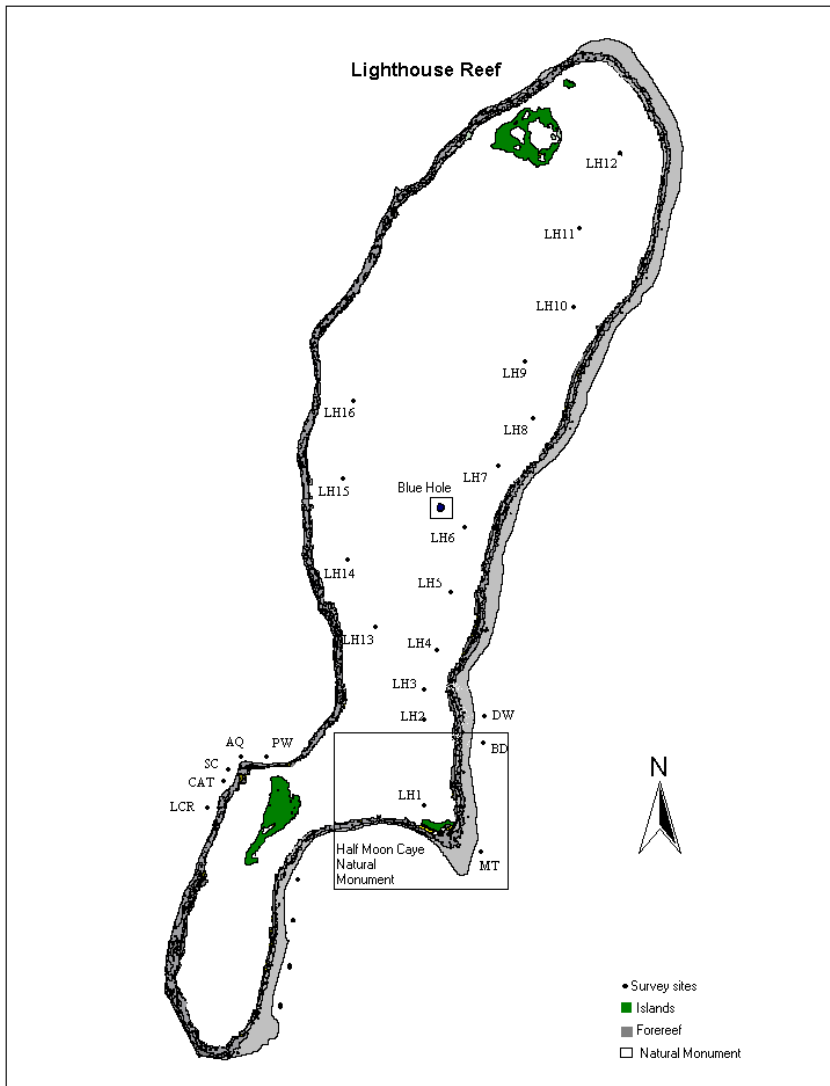
The information gathered will assist the stakeholders including BAS, fishers, the tourism industry, researchers and land owners in determining what areas

need what type of protection and why. This model can then be applied to the remaining protected areas in Belize including the terrestrial parks. This is the direction that most managers are choosing for its efficiency. Even the data, which has been collected, is compatible with sites around the Caribbean region from as far North as Bermuda and South to Brazil. Scientists all over the Caribbean are using the same methodologies to provide a regional perspective on the extent of declines of reef building corals and their associates.

Both PROARCA/CAPAS and Ms. Robinson are working towards achieving similar goals. Over the next few years, bold initiatives will be undertaken to conserve the resources of Lighthouse Reef as a follow-up to the initial data-gathering phase. Activities slated for the next three years fall under six main objectives.

1. In collaboration with relevant government agencies and stakeholders, develop and implement the most appropriate legal management option for the expansion of management authority over the entire atoll
2. To enhance and expand existing management activities for HMCNM and BHNM
3. To initiate a long-term research program, focused on collection of ecological and socio-economic data needed for management and zoning.
4. To initiate a marine education program with components targeted for: tourists, dive operators, fishermen, Belizean population and school children
5. To engage fishermen in research activities and integrate them into the project
6. To identify and establish long-term, self-sustaining financial mechanisms to help support management activities

The Belize Audubon Society has been the leading voice of conservation in Belize since 1969 and remains the only national membership-based environmental organization in Belize. There is no other organization in Belize with such a reputable track record and which is suited to take on such a project as that which is being proposed. BAS is at the forefront of promoting multiple stakeholder management of natural resources through a co-management project being funded by the European Union (EU), which focuses on two terrestrial protected areas and aims to involve relevant stakeholders in ecosystems management. This project will benefit from lessons learned by the EU co-management project. In December 1999 the organizational structure was expanded to include a position of Marine Protected Areas Manager reflecting the increased emphasis on marine protected areas management and conservation.



Through the successful implementation of the Lighthouse Reef Atoll Conservation and Protection Project, Ms. Robinson has expanded BAS's role has expanded to include marine issues on a national and regional level. The funding has played a key role in the development of a marine program and the development of in-house technical expertise for BAS. BAS with the assistance of Ms. Robinson is now more recognized as a leader in the field of conservation for both terrestrial and marine protected areas. In addition, the relations with stakeholders have improved and have resulted in more successful, coordinated logistical and conservation activities. A database now exists with the preliminary information needed for management decisions and is available to anyone who is interested. The complete results of this work are available to those interested

by writing directly to the author.

The project has also greatly enhanced the enforcement capabilities for HMCNM and BHNM. The higher populations of commercial species inside the protected areas demonstrate the effectiveness of management efforts. Although many of the threats to coral reefs are beyond the control of local managers, efficient management of local activities offers the best opportunity to protect the extraordinary biodiversity of these threatened ecosystems.