



Biodiversity Conservation at the Landscape Scale

A Program of the Wildlife Conservation Society
Supported by the USAID/Global Conservation Program

Glover's Reef Living Seascape: Safeguarding Marine Resources and Rural Livelihoods in Belize

Annual Report
October 2007 – September 2008

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I. Summary of Activity Status and Progress

a. Introduction/Summary

The Glover's Reef Living Seascape project aims to conserve the outstanding biodiversity and natural beauty of Glover's Reef Atoll. It is one of the globally significant landscapes included in WCS' GCPII/USAID portfolio of conservation sites, and the first coral reef site to be adopted under the WCS Living Landscapes Program. This program seeks to develop and test wildlife-focused strategies that will resolve the conflicts between people and wildlife that threaten important wild places and the biodiversity they support. The approach is threats-based and highly participatory. Key threats to the Atoll's biodiversity include: unsustainable fishing, lack of alternatives for fishermen, impacts of global climate change, eutrophication and high turbidity of the Atoll's lagoon, lack of support for the marine reserve by some stakeholders, insufficient information for strategic conservation management, and lack of long-term financing. The objectives of the project are specifically geared towards reducing these threats through the development and implementation of a multi-partner conservation strategy.

A summary of our accomplishments for the past year is included below.

Training, capacity-building and outreach

Several important training workshops and successful public outreach programs were carried out in FY08.

During October and November 2007 we continued our one-on-one training for nine fishermen from Sarteneja and Hopkins in the use of marine radios and GPS units. These fishers are helping with monitoring and surveillance on the Atoll and reporting infractions to the marine reserve management team. Two fishermen from Hopkins who traditionally fish at Glover's Reef were hired to assist in the monitoring of the Northeast Point Nassau grouper spawning site in January and February 2008. A fisherman from Hopkins was also hired to assist with our LAMP (Long-term Atoll Monitoring Program) data collection in February, May and August 2008.

We supported a three-day rangers' law enforcement training workshop in March 2008. The 33 participants included rangers and managers from the marine reserves, staff of the Fisheries Department, the Belize Audubon Society, and the University of Belize. The training covered interpretation of regulations including the topics of arrest and detention, search of prisoners, dealing with juveniles, the judges' rule (i.e., Constitutional Rights), report writing, the importance of documentation, contents of case files, summons, and court procedures and practices. A very positive result of the workshop was that the participants recommended that the Fisheries Act and its subsidiary regulations be revised as soon as possible. During the workshop, the draft Enforcement Policy was also presented and discussed, and participants provided suggestions for amendments. The Policy can now be presented to the Fisheries Administrator for endorsement.

In May 2008, WCS sponsored Reef Check Training at the WCS Research Station at Glover's Reef for six fishermen from Hopkins and Sarteneja. The five day training workshop, an International Year of the Reef 2008 activity, provided the

fishermen with the skills required to assist in the regular monitoring and reporting on reef health. The training was led by Green Reef Environmental Institute, the Reef Check focal point for Belize. The training included Reef Check methods, fish, invertebrate, and substrate identification presentations, and field experience. Fishermen also received Open Water Dive certification to complement the reef monitoring training.

In September 2007 and April 2008, WCS turtle expert Dr. Cathi Campbell continued to provide training to staff of the Glover's Reef, Bacalar Chico, South Water Caye, and Sapodilla Cayes marine reserves in conducting in-water sea turtle surveys and tagging techniques.

We significantly expanded our educational campaign on the Nassau grouper, developing a special PowerPoint presentation on the ecology and management of this endangered species, publishing two articles in the local newspapers, broadcasting our TV and radio spots on the regulations protecting spawning aggregations, developing and broadcasting a special documentary film, and launching the Spawning Aggregation Working Group web site.

Monitoring

As part of our Seascape Species Approach, we are presently monitoring four of our suite of seven species on a direct basis. These include the queen conch, Nassau grouper, hawksbill turtle and the long-spined black sea urchin *Diadema*.

Both queen conch and the Nassau grouper are monitored as part of our fisheries catch data collection program. This program has been enormously successful, with over 200 fishermen from Sarteneja and Hopkins participating over the past four years. The results are revealing important information regarding the status of conch, lobster and finfish fisheries, and are providing the basis for recommendations that aim to ensure sustainable fishing on the atoll.

In addition, conch and Nassau grouper are included as part of our fishery-independent quarterly monitoring under the Long-term Atoll Monitoring Program (LAMP), which compares densities of key commercial species within and outside of the Conservation Zone (the no take area) of the marine reserve. This monitoring program is carried out jointly with marine reserve staff.

The status of the spawning aggregation of Nassau groupers at the Northeast Point on the atoll was also monitored during January and February 2008. We are pleased to report that the maximum count of groupers increased by 33% compared to the previous season. This is a wonderful result and provides tangible evidence that our conservation efforts are paying off.

Our sea turtle in-water surveys, with a focus on the hawksbill turtle, continued over the past year with the assistance of WCS turtle expert, Dr. Cathi Campbell. We conducted surveys, in partnership with the reserve staff, in September 2007 and April and July 2008. Preliminary results indicate that Glover's is a very important foraging ground for juvenile hawksbills. During the September and April surveys 75 turtles (66 hawksbills) were sighted. Thirty-five turtles (29 hawksbills) were tagged, and tissue samples were collected for genetic work. To date, we have recaptured one tagged hawksbill turtle. The data from the July 2008 survey are still being analyzed. The reserve staff also continue to work with atoll residents to collect nesting information on the cayes.

In March and June 2008, we partnered with the University of Belize on the monitoring of the long-spined black sea urchin, *Diadema*. The 29 sites that had been monitored in 2007 were re-surveyed. The data are currently being analyzed, but preliminary results indicate that *Diadema* are now present on some patch reefs of the atoll, a habitat in which they were previously completely absent. Though their density continues to be low and patchy, occupation of these new sites is a very positive conservation outcome.

Finally, we initiated monitoring of a fifth seascape species, the osprey, with the assistance of WCS ornithologist Dr. Nancy Clum. Dr. Clum conducted a survey of the atoll in January 2008 and confirmed that there are six active osprey nests on the atoll. With the addition of non-nesting birds, the total population is estimated to be 18 birds. Productivity is low and failure likely occurs at the egg stage. There are few naturally occurring nest sites, and this factor possibly limits

the population size. Dr. Clum has made recommendations for future work and plans to visit during the 2008/2009 nesting season to train reserve and station staff in nest monitoring techniques.

Management and Planning

In October 2007, the Fisheries Department officially endorsed the management plan that we helped develop for the Glover's Reef Marine Reserve. This document is now the major guide for the reserve management team over the next five years.

Although the business plan that we developed for the reserve has not been officially endorsed, we are moving ahead with some of its recommendations. The main activity has been designing a web site for the marine reserve, which is presently underway. This particular recommendation has received the full support of the Fisheries Department.

The draft report *Best Practices for the Cayes of Glover's Reef* has been finalized and approved by the *ad hoc* group of landowners and the Fisheries Department. Copies of the final version were printed and distributed to all landowners on the atoll. A summary pamphlet of the Best Practices that are applicable to all the cayes in Belize, based on the experience gained at Glover's Reef, was then prepared and printed. This pamphlet was widely distributed in July 2008.

Working with the Glover's Reef Advisory Committee (GRAC), we have made significant progress towards the acceptance of the concept of limited access to fishing on the atoll and the finalization of an enforcement policy for the Fisheries Department.

Core strategy

In June 2008 the final draft of the Conservation Strategy was shared with the Glover's Reef Advisory Committee. It was also reviewed and approved by the Fisheries Department. The document has now been formatted for printing, which will be carried out within the next few months, and copies will be distributed to our many partners.

The 24-page colorful document explains the steps we took in applying the seascape approach, including our threats assessment, conceptual model, and Seascape Species selection, as well as the subsequent construction of Conservation Seascapes for each species. It presents a 16-point strategy which includes recommendations for management, legislation, caye development, capacity building, alternative livelihoods, sustainable financing and economic valuation. The Conservation Strategy document concludes with a suggested monitoring and adaptive management program.

b. Highlights

- **Completion of Conservation Strategy and Best Practices for the Cayes**

Completing our Conservation Strategy for Glover's Reef was a major accomplishment and, to a large extent, represents our planning work and the successful implementation of many activities that we have achieved over the past five years. This Strategy was developed in a very participatory manner, is viewed as a product of the Glover's Reef Advisory Committee (GRAC) and has received endorsement from the major authority, the Fisheries Department. Given this, we have high expectations that the Strategy will be adopted and implemented over the next few years. It is expected to lead to improved management at Glover's Reef and, ultimately, to the conservation of our target Seascape Species and the wealth of biodiversity that they represent.

We have also completed the process of preparing best practices for the development of the cayes of the Atoll, in consultation with the GRAC and a landowners working group. We identified the best practices that would be useful in guiding development on Belizean cayes in general, and prepared a pamphlet for wide distribution. Coastal development, particularly in the fragile environments of the cayes, is a major threat to the surrounding marine ecosystems, and we hope that this user-friendly guide will help to stimulate more eco-friendly practices in this vulnerable area. Our participatory approach to the development of these best practices has been key to bringing landowners on board, and has significantly

enhanced their willingness to adopt our collective proposals for the conservation of the cayes, their biodiversity and the livelihoods dependent upon their health.

- **Exciting results from our hawksbill in-water surveys and assessment of osprey population**

In FY08 we conducted three in-water hawksbill turtle surveys; preliminary results reveal the importance of the atoll as a foraging area for this critically endangered species. Initially, we had planned to monitor turtle nesting activity; however, anecdotal reports indicated the prevalence of juveniles and very little nesting on the cayes. We therefore decided to conduct in-water surveys on an exploratory basis and learned that the atoll indeed has a high population of juveniles. The program includes tagging and collection of tissue samples, and fosters a close working relationship with reserve staff. We have also used this opportunity to train a wide range of marine reserve biologists in sea turtle biology and survey techniques. We have now instituted a regular schedule of surveys three times each year, which should address any seasonal differences which may exist.

We were very pleased to receive the assistance of WCS expert Dr. Nancy Clum to begin assessing the osprey population at Glover's Reef. The osprey, one of our Seascape Species, nests primarily in trees on the cayes and feeds in the atoll lagoon, thus bridging both terrestrial and marine environments. The ospreys in Belize are a non-migratory race of the species (*Pandion haliaetus ridgwayi*), which is believed to number only between 100 – 150 pairs of birds. No current information exists on the status of the population in Belize, and we hope to continue working with Dr. Clum in monitoring the population at Glover's over the coming years, refining our Biological and Conservation Seascapes for the species, and contributing to the body of knowledge on this unique endemic Caribbean species.

- **Continued support for an active Glover's Reef Advisory Committee**

We continue to support the Glover's Reef Advisory Committee (GRAC), which meets on a quarterly basis and provides significant input to fisheries and marine reserve policy and management. We are delighted to report that the GRAC's recommendation to the Fisheries Administrator, to limit access to fishing on the atoll to only traditional fishermen, was accepted. To this end, in January 2008 the Department began issuing special licenses to fish at Glover's only to fishermen who had a previous record of fishing on the atoll. This license program did suffer a hitch, however, when, during a subsequent meeting of the Department and fishermen from the village of Sarteneja to discuss this program and other concerns, a member of the executive committee of one of the fishing co-operatives objected to the special license program and the Fisheries Department decided to put it on hold until further consultation with stakeholders. Nevertheless, the Department is supportive of the concept and hopes to re-institute the program in the near future. The recommendation of the GRAC with regard to the need for an enforcement policy has also been taken up by the Department, and a draft policy has been prepared and recently reviewed by enforcement personnel within the Department. The policy has been submitted to the Fisheries Administrator for endorsement.

- **Conservation action and support to halt the decline of the Nassau grouper**

We are pleased to report that our monitoring results for the 2007–2008 spawning season revealed that the numbers of Nassau groupers at Northeast Point increased by 33%, from a maximum count of only 800 in the 2006 – 2007 season to 1,150 groupers this past season. Though we do not know if this trend will be sustained, we are optimistic that the numbers will continue to improve if strengthened enforcement is maintained. We continued to provide the secretariat of the National Spawning Aggregation Working Group, and the Group's final recommendations for the protection of the Nassau grouper were formally submitted to the Fisheries Administrator in October 2007. Members of the Group met with the new Minister of Fisheries in June 2008 to discuss these recommendations. We have spearheaded the public outreach campaign to raise awareness about the urgent need for action to protect this species, as mentioned earlier, and we have also focused our efforts in supporting improved enforcement by reserve staff at the spawning site.

c. Table of Activity Status

Activity No.	Activity Title	Status	Page No.
Objective 1	Develop and adopt a participatory strategy to reduce threats to marine life in the Glover's Reef seascape		
1.1	Complete threats and stakeholder analyses	Completed	6
1.2	Complete a Seascape Species Analysis	Completed	6
1.3	Identify high priority interventions	Completed	7
Objective 2	Develop and implement sustainable and adaptive mechanisms to strategically address threats across the seascape		
2.1	Implement Seascape Conservation Strategy	On track	7
2.2	Provide technical support and training	On track	10
2.3	Strengthen and expand stakeholder support for the Seascape Conservation Strategy	On track	11
2.4	Introduce innovative co-management arrangements	On track	13
2.5	Develop new and strengthen ongoing long-term monitoring programs	On track, with exception of reef recovery study which remains to be addressed	13
Objective 3	Learn and teach best practices in the Glover's Reef Seascape and beyond		
3.1	Document the lessons learned	On track	15
3.2	Extract and share best practices	On track	16
Objective 4	New York Coordination Unit Strategy: Guide the design and testing of wildlife-focused planning, implementation, and evaluation tools for effective conservation at a landscape scale, and promote learning across sites and beyond		
4.1	Provide technical assistance to site-based conservation	On track	17
4.2	Design, implementation, and testing of decision support tools	On track	17
4.3	Catalyze cross-site and cross-organizational learning, and communication	On track	18
4.4	Application of Living Landscapes Program tools beyond core sites	On track	19
4.5	Ensure coordination and communication services for the program	On track	19
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II. Detailed Description of Progress**a. Key short and long-term program objectives for the reporting period (October 2007 – September 2008)**

Glover's Reef Atoll is an integral part of the Belize Barrier Reef system, one of the world's outstanding coral reef systems. WCS has a long-term commitment to this site, having established a marine research station at the Atoll in 1995. The project is building on the in-depth practical conservation knowledge of WCS's long-term field program at the site, while facilitating the implementation of strategic site-based conservation tools developed through its Living Landscapes Program. We are also refining this planning approach in relation to its application to tropical marine areas.

During this reporting period we applied this planning approach and developed the associated conservation action plan along with a monitoring and evaluation program as part of our *Conservation Strategy for the Living Seascape of Glover's Reef*. In summary, we will continue to monitor the status of our suite of Seascape Species and implement interventions that will reduce threats to their populations on the atoll, according to our conceptual model. These interventions have included training and capacity building, providing support to the GRAC and Spawning Aggregation Working Group, providing support to the marine reserve team, assisting with alternative livelihoods, and conducting our environmental monitoring programs. We have carried out our activities in partnership with the reserve staff and Fisheries Department,

the GRAC, and the many local and international NGOs involved in marine conservation in Belize, and will continue to do so. We also continue to share the results of our ongoing program with our partners.

In the longer term (over the next five years and beyond), our objective is to carry out adaptive management, making necessary adjustments to the reserve's management programs; disseminate materials we have developed and share the lessons learned across other marine protected areas in the network; assist in efforts to strengthen enforcement; finalize the economic valuation for Glover's Reef; add coral reef monitoring to our ongoing monitoring program, particularly focusing on the reef's response to climate change; conduct training sessions for our partners in data analysis and interpretation; work with our partners to promote more sustainable fishing; and continue to monitor the status of our Seascape Species to assess the effectiveness of our conservation actions.

b. Activity Description

OBJECTIVE 1: Develop and adopt a participatory strategy to reduce threats to marine life in the Glover's Reef Seascape.

Activity 1.1 Complete threats and stakeholder analyses through a series of focused meetings in consultation with the Glover's Reef Reserve Advisory Committee.

This activity has been completed, as reported in our first annual report and the associated workshop report that was included as Appendix 1 to that report. The information from the threats assessment has been used to update our conceptual model and, in turn, to revise some of our proposed interventions or activities.

Activity 1.2 Create a "roadmap" for conservation intervention by completing a Seascape Species Analysis.

During FY08 we finalized our *Conservation Strategy for the Living Seascape of Glover's Reef* (Appendix A1). This practical guide, developed in partnership with the GRAC, first outlines the steps in the Seascape Species Approach as applied to the coral reef site of Glover's. These include:

- Assessing the threats.
- Developing a Conceptual Model.
- Selecting our suite of seven Seascape Species (hawksbill turtle, Nassau grouper, Caribbean reef shark, star coral, queen conch, long-spined black sea urchin, and osprey).
- Building Human Seascapes for each species, using the coral bleaching and fishing threats maps to illustrate the process.
- Building Biological Seascapes or a habitat suitability index for each species, using the Nassau grouper and queen conch to illustrate the process.
- Building the Conservation Seascapes, again using the Nassau grouper and queen conch as examples. This process involved using the Biological Seascape to generate target abundance and current abundance maps, the difference between the two yielding the basis for the Conservation Seascape. In both examples, the stark difference between the target abundance and the current abundance graphically demonstrated the large extent to which fishing has reduced the numbers of Nassau grouper and conch.
- Developing benefit-cost models by determining the cost of conservation based on two scenarios: the use of threats or human impacts as a proxy of cost (assuming that the highly threatened areas will be the most expensive to conserve), and the use of the indicative cost of conservation management on the atoll (taking into account mainly enforcement costs). The benefit-cost models were derived by dividing the potential conservation impact by each of the cost models, resulting in maps depicting the areas where the highest potential conservation impact can be obtained for the least cost. For both the conch and Nassau grouper, the process highlighted the importance of the continued protection of the Conservation Zone and the Spawning Aggregation Marine Reserve, and also the stretch of eastern reef that connects the Northeast Point with the Conservation Zone.

The Strategy then presents a 16-point plan that includes our priority actions to address needs or identified threats related to management, legislation, caye development, capacity building, alternative livelihoods, sustainable financing, and

economic valuation. The ultimate purpose of these actions is to maintain healthy populations of our Seascape Species and, by extension, all the species and habitats of the atoll. The document concludes with a monitoring and adaptive management program that details the monitoring required to measure the success of the action plan. We are delighted that the GRAC and the Fisheries Department have endorsed this Strategy, and look forward to their implementation of this Strategy as their guide, to ensure the future conservation of the atoll.

The Strategy document has been formatted for printing. Once printed, it will be distributed widely to the GRAC members, associated government agencies, other marine protected areas and co-managers, and our national and international NGO partners.

Activity 1.3 Identify high priority interventions

Our high priority interventions are described in the 16-point Conservation Strategy, as explained above. We have been systematically implementing many of these actions over the past year, in collaboration with our partners, particularly the Fisheries Department and the reserve management team.

Many of our recent activities have focused on strengthening enforcement and involving fishermen in monitoring, advocating for legislative changes, working with stakeholders through the GRAC and Spawning Aggregation Working Group, promoting low-impact development of the cayes, capacity building, improving marine reserve management, assisting with an economic valuation of the marine reserve, and providing support for alternatives economic activities for fishermen in the fishing community of Sarteneja.

We have monitored the status of many of our Seascape Species (namely conch, Nassau grouper, hawksbill, osprey and *Diadema* populations) through our ongoing programs with the reserve management team and other partners such as the University of Belize and international experts. These investigations show the success of our strategic interventions, fill knowledge gaps and also assess the severity of some of the threats identified, particularly over-fishing. Our progress on these activities is reported under objective two.

OBJECTIVE 2: Develop and implement sustainable and adaptive mechanisms to strategically address threats across the seascape.

Activity 2.1 Implement Seascape Conservation Strategy in cooperation with Glover's Reef Marine Reserve staff and Advisory Committee.

Over the past year we have continued to implement our priority interventions, aimed at reducing the identified threats and achieving our conservation targets.

Alternative livelihoods

During FY08 we planned to work with the Hopkins Fishermen Association (HFA) on an alternative livelihood activity. Sadly, the Chairman of the HFA advised us that, as the Board of the Association was no longer functioning, it was not wise to proceed with our project. We therefore continued to provide support to the NGO in the fishing community of Sarteneja, SWEET (Sarteneja Wildlife, Environment and Ecotourism Team), for a capacity-building project entitled *Institutional strengthening of SWEET and the Sarteneja Tour Guide Association, towards environmentally-sensitive tourism in Sarteneja*. As mentioned in our previous annual report, one of the results of our earlier project with SWEET was the formation of the tour guide association. This follow-up project has the following goals: to upgrade SWEET's centre with displays, signs and internet access for tour guides and fishermen; to provide training in basic computer skills, project reporting, accounting, monitoring and evaluation, and presentation skills to at least 16 participants from the main NGOs operating in the village; and to offer four planning meetings to produce a Strategic Plan for the Sarteneja Tour Guide Association, as well as four planning meetings to finalize the Sarteneja Tourism Development Plan.

The project is currently underway; an interim progress report, and a report on the first planning workshop for the Tourism Development Plan, is included in Appendix A2. At the request of WCS, SWEET also carried out a survey of the participants of the tour guide training projects in Sarteneja, one of which was supported by WCS and involved the training

of fishermen who fish Glover's Reef. The results show that of the 60 participants in tour guide training (21 supported by WCS), 12 are presently licensed guides. Five of these are full time guides with 100% of their household income derived entirely from guiding. Another five of the guides still supplement a portion of their income with fishing. Five of the 12 licensed tour guides were Glover's fishermen; three of these guides now derive 75% to 100% of their income from guiding, and two obtain about 50% of their income from guiding. The report (see Appendix A3) shows that many more of the trained guides would be able to find jobs if Sarteneja became a more developed tourist destination. This underscores the importance of completing the Tourism Development Plan for the village, which can then be presented to the Belize Tourism Board (BTB) for further action. During a meeting that WCS had with BTB, the CEO in the Ministry of Tourism explained that a plan from the community is a prerequisite for the BTB to start including the site in their tourism marketing products. He also explained that Sarteneja can attract Mexican tourists and the government could help facilitate this by making Sarteneja an official border entrance point. These are all exceedingly positive outcomes that bode well for transition of additional fishermen to alternative livelihoods.

Most fishermen at Glover's Reef are from the community of Sarteneja, a village that is particularly vulnerable as most of the villagers rely solely on fishing as their source of income. Our vision is that these projects assist in providing a viable alternative to fishing activities (ecotourism), thus addressing two issues at once by making their livelihoods more secure while reducing the fishing effort at Glover's Reef.

We again hired two fishermen from Hopkins to assist with the monitoring of the spawning site at Glover's Reef in January and February 2008. These fishermen used to fish the spawning bank, so offering them a job helps to offset some of the losses incurred by foregoing fishing at the site. At the same time, their participation in this program allows them to become very knowledgeable about the monitoring program and the decline in numbers of Nassau grouper at the site. One of these fishermen has also been assisting us with our LAMP monitoring and participated in the LAMP training in August 2008. The other fisherman is now a representative on the Spawning Aggregation Working Group.

Support to the Spawning Aggregation Working Group

We continued as the secretariat of the Spawning Aggregation Working Group, organizing meetings, recording minutes, and generally keeping members well-informed. The Working Group held six meetings over the past year, and these were well-attended; on average, about 70% of members participated. In April 2008 the representative from Friends of Nature was voted in as the new Chair. Importantly, the final recommendations of the Working Group for the protection of the Nassau grouper were formally submitted to the Fisheries Administrator by the Chair and the Secretary (Janet Gibson) in October 2007, and a copy is provided in Appendix A4. All members of the Group signed these recommendations, with the exception of the Belize Fishermen Co-operative Association, who refused to sign because they did not support the recommended moratorium on Nassau grouper. As the Fisheries Administrator had also requested the Group's recommendation on a size limit for the Nassau grouper, WCS researched the matter and suggested both minimum and maximum size limits of 20 and 30 inches standard length, respectively. These limits were endorsed by the Group, and the additional recommendation was submitted to the Fisheries Administrator in December 2007. The Group prepared its Work Plan for 2007-2008, which focused primarily on the development of educational materials and consultations with local stakeholders (mainly fishermen), as reported below. General elections were held in Belize in February 2008, and a new government took office. We organized a meeting of six members of the Working Group and the new Minister of Fisheries in late June 2008 to brief him on the goals of the Group, its achievements, and its recommendations for stronger measures to conserve the Nassau grouper. We took the opportunity to present the Minister with some of our public awareness materials, such as our Nassau grouper poster and brochure, our newsletter, and a DVD of our Nassau grouper documentary. He was very receptive, listened carefully and said that he would discuss our recommendations with his personnel at the Fisheries Department.

Public Awareness and Education

As mentioned earlier, the Spawning Aggregation Working Group's efforts focused on the public awareness campaign for the Nassau grouper, and we facilitated these efforts. As the Group was tasked by the Fisheries Administrator with consulting with stakeholders on recommendations for additional management measures for Nassau grouper, we first recognized the need to develop materials that raise awareness of the dire state of this species and the urgent need for action (by both the general public and fishermen). We addressed this need in various ways. In December 2007 through February 2008 we continued to broadcast our television and radio spots informing the public of the protected Nassau

grouper spawning sites and the four-month closed season. We shared the costs of these broadcasts with The Nature Conservancy and World Wildlife Fund. We developed a PowerPoint presentation on the biology and management of the Nassau grouper and our recommendations for stronger conservation measures for this species (see Appendix A5). Copies of the presentation, on CD, were distributed to all Working Group members to use in their consultations in their respective communities. This PowerPoint presentation was presented by the Fisheries Department, on our behalf, at a meeting with fishermen in Sarteneja and we also presented it to the Executive Committee and several fishermen of the Northern Fishermen Co-operative. In March and April 2008 we published two articles on the Nassau grouper in the widest-circulating local newspaper. The titles of these articles were *Another endangered species in Belize: the Nassau grouper, Epinephelus striatus* and *Fish da fu rich man unly now?* Working with well-known local film producers Richard and Carol Foster, we developed a documentary on the Nassau grouper which was endorsed by the Working Group, and distributed on DVD to Group members to use in their consultations (Appendix A6). To date, the film was shown twice on Channel 5 in May 2008 and several times in May and June 2008 on Channel 7 (Channel 7 did not charge for broadcasting the documentary due to its very high quality and educational and public interest). We have received very good feedback from viewers of the film. We launched the Working Group's web site (<http://collaborations.wcs.org/spag>) in early 2008; WCS has assumed responsibility for managing the web site and keeping it updated on behalf of the Group. The site includes details on the goals and composition of the Group, our monitoring protocol, and educational material, which can be downloaded. We are in the process of adding a page with the spawning aggregation literature pertinent to Belize. Finally, we spearheaded the drafting of the Group's annual newsletter with the assistance of a couple of the other members. It was finalized in early July and was printed for distribution in early August 2008. The newsletter (Appendix A7) includes the monitoring results for the 2007-2008 season at the various spawning sites, our recommendations for Nassau grouper management measures that are under consideration by the Fisheries Department, an update on our public outreach campaign, and information on the Nassau grouper tagging project at Lighthouse Reef.

Implementation of Management and Business Plans

In FY07, we completed a new management plan for the Glover's Reef Marine Reserve, and the plan, which was rated as 'outstanding' by the Fisheries Department, was formally approved as the official plan for the reserve in October 2008. During FY08 we worked closely with the reserve management team to implement aspects of the plan, particularly the strengthening of enforcement (e.g., we supported a training workshop for rangers, as reported under Activity 2.5). We have also provided the marine reserve team with fuel to conduct patrols, and with equipment to enhance their surveillance and enforcement capabilities, such as flares and a flare gun, two spotlights, waterproof notebooks, a digital camera, marine binoculars, and an ice box (to hold evidence). Many of the items provided should help the reserve staff to implement more effective night patrols, as illegal fishing at night is one of the major threats. Furthermore, we continue to work in partnership with the reserve staff to conduct environmental monitoring and provide support to the GRAC.

In FY07 we partnered with a team of four MBA students from the Haas Business School, University of Berkeley to develop a business plan for the reserve, which was submitted to the Fisheries Department for approval. Although the Department has not yet approved the plan, during FY08 we began implementation of one of the recommendations, to develop a website for the marine reserve in an effort to enhance visitation. The Department approved this activity and is working with us to prepare the content of the various pages for the site. The website includes the following pages: Home page, About the Glover's Reef Marine Reserve, Northeast Point, Regulations, the Team, Management Zones, Reserve Services, Service Providers, Publications, and Contact Us. The general design has been completed and we have almost finished uploading the text. The next step will be to provide the necessary maps and photographs. The site is on track to be finalized and online before the end of 2008.

Economic Valuation

Over the past year, we have been working with the World Resources Institute (WRI) to carry out an economic valuation of the Glover' Reef Marine Reserve, specifically in relation to tourism and fisheries. We have supplied information on fisheries production, based on the results of our catch data collection program, which has provided possibly the most accurate estimate of fisheries data of the marine protected areas participating in the valuation. We have also supplied information on visitation as far as was possible, and the business plan completed last year was a valuable source of information for the valuation process. The data are used in a template developed by WRI, which uses a financial analysis approach to calculate the fisheries and tourism/recreation value of the site. It involves identifying the net revenues of reef-associated activities in these sectors, as well as "pass throughs" that benefit the government (such as taxes), and the

multiplier effect in the wider economy (through wages, service charges and spending). We expect that the final valuation report will be completed in late 2008. We believe that the results will clearly demonstrate, to key decision makers, the significant value of the marine reserve to these two major industries, fisheries and tourism, the losses likely to be incurred from its degradation and the long-term benefits of investing in the reserve.

Activity 2.2 Provide technical support and training to the Glover's Reef Marine Reserve staff, the Belize Fisheries Department, and the CZMAI to improve management of the reserve and enforcement of fisheries and land-use regulations

Support to the Glover's Reef Advisory Committee (GRAC)

The GRAC met on a regular quarterly basis during this period, in September and December 2007, and in March and June 2008. Two of these meetings were held in Belize City, one in Dangriga and one on-site at Glover's Reef. Quorum was maintained at a reasonably high level (73% on average), indicating the sustained interest by members to serve on the Committee. WCS serves as the secretariat to the Committee, supplying minutes of the meetings, arranging meeting logistics, covering travel costs for members, providing material required for the meetings and training sessions, and generally keeping members updated on the progress and results of various projects related to the marine reserve. We arranged for the March 2008 meeting to be held at the marine reserve, and members were hosted overnight by WCS' research station on Middle Caye. As many members had not visited Glover's for a long time, the visit gave them the opportunity to get a fresh view of the site and the challenges of managing the reserve. The reserve manager led members on a tour which included showing the area where turtles had nested on Long Caye, demonstrating the boundary markers along the Conservation Zone and the difficulties of keeping the markers aligned, and visiting the area on the western reef at Baking Swash where a large percentage of the illegal fishing takes place.

Over the past year, the main focus of the GRAC continued to be enforcement and the need to reduce fishing effort on the atoll. As a result of the Committee's recommendations, limited access (i.e., to traditional fishermen only) was introduced at Glover's Reef Marine Reserve in January 2008. This action was a result of much discussion and a submission to the Fisheries Administrator via the minutes of the GRAC September meeting, which outlined how this measure could be implemented. The rationale for such a measure is to reduce fishing effort over time, to ensure that the benefits of the no-take zone are reaped by those traditional fishers who in essence 'gave up' part of their fishing ground for the no-take zone, and to foster ownership of the resources by these fishers, in the hopes that this will lead to better stewardship. Unfortunately, we experienced a set-back in April 2008 when an influential fishing co-operative spokesperson decided not to support the special license program. Because of this resistance, and due to the fact that it is quite a novel step to limit fishing access in such a large area, the Fisheries Department decided it was best to put the measure on hold. Nevertheless, we will continue to pursue this measure and feel confident that it will be reinstated in the near future, as we have the support of the GRAC and the Fisheries Department.

Previously, the Fisheries Department had no written policy to guide their enforcement activities, and so the GRAC made a recommendation for such a policy to be developed. As a result of the work of the GRAC, a final draft of this enforcement policy has been completed and presented to the Fisheries Administrator for approval. The policy provides clear guidance on topics such as how to approach fishermen, the general conduct of the fishery officer, when to give a warning, when and how to carry out an arrest, how to handle evidence, and how to escort those arrested; these factors can be very important in ensuring that cases hold up in a court of law.

The continued involvement of the GRAC in the management of the reserve is extremely important in ensuring stakeholder participation and fostering a sense of ownership of the protected area and a desire for it to successfully meet its objectives.

Preparation of development guidelines

We met with the *ad hoc* group of Glover's Reef landowners in November 2007 to finalize the best practices proposed for the development of the cayes of the atoll. Eight landowners attended the meeting, which was held in Dangriga. Several comments on the draft document were discussed, with a focus on amending the section outlining the specific guidelines being proposed. The majority of the landowners were supportive of the best practices, but one family representative was still very concerned that the best practices would become law and restrict their activities; they agreed that the document should be finalized with the revisions discussed and requested that the final document only be shared with the Glover's

landowners. They also agreed, however, that a more general summary guide that includes those best practices that have broad application to other cayes in Belize could be produced for wider distribution. The draft final document was subsequently sent out for comment to those agencies that had been consulted at the outset of the process, such as the Department of Environment, Fisheries Department, Forest Department, Lands Department, and Belize Tourism Board. The document was then finalized, printed and distributed to the 10 major landowners. The best practices section was summarized and formatted as a colorful, fold-out design pamphlet for wide distribution, entitled *Recommended Best Practices for the Cayes of Belize – based on the lesson learned at Glover’s Reef Atoll* (Appendix A8). The pamphlet includes background information on the process and the methodology used, and then details the recommended best practices to follow on the topics of land ownership, conservation (specifically in relation to vegetation, turtle nesting areas, and insect control), tourism, infrastructure, piers, energy, solid and liquid waste disposal, and water. We had 1,000 copies of the pamphlet printed and, after receiving them in late June 2008, copies were distributed to government agencies (Fisheries Department, Forest Department, Lands Department, Department of the Environment), the marine reserves, NGO co-managers of MPAs, Belize Tourism Board, Belize Tourist Industry Association, and our international NGO partners. Copies were also given to the GRAC members at the September 2008 meeting of the Committee.

Although we encountered some initial resistance, particularly from the local landowners, in accepting the need to follow best practices in the development of their land on the cayes of Glover’s Reef, we feel that gradually this concept has become more and more acceptable to Belizeans. The Belize Tourism Board is supportive of eco-friendly tourism development and we hope that eventually the resorts at Glover’s will join the World Heritage Alliance for Sustainable Tourism that is being promoted by Expedia and the United Nations Foundation. Two hotels in Belize, located on the mainland, have already joined this Alliance; it would be very appropriate for resorts that lie within the boundary of an actual World Heritage Site to follow suit. We therefore believe that our project supporting sustainable tourism and best practices on Glover’s Reef is very timely and will help lead to a change in awareness amongst these cayes and resort owners.

Activity 2.3 Strengthen and expand stakeholder support for the Seascape Conservation Strategy – e.g. fishermen (divers for lobster, conch and finfish, as well as hand-line fishers), Atoll residents and tourism operators, as well as mainland communities that are highly dependent on the health of the reef (Hopkins, Sarteneja and Dangriga).

Fisheries catch data collection

The catch data collection program has been implemented over the past three and a half years, providing valuable information on level of catch and effort, types of species caught, and associated biological data such as the size and weight of the catch. The data collection is carried out by former fishermen at the landing beach in Hopkins and on-site at Glover’s Reef. In return for their participation, fishermen are given a fuel coupon for each round of data they provide, with each coupon redeemable for two gallons of gasoline. Over 200 fishermen have participated in the program; the majority of participants are from the fishing community of Sarteneja, many are from Hopkins village, and a few are from Belize City. The completed data forms are sent on a regular basis to the WCS Belize City office for entry into a special database. In 2006 we analyzed the first year of data and produced a booklet of the results that was widely distributed to fishermen, fishing cooperatives, the Fisheries Department, marine reserves, and our partners, including national and international NGOs. We have recently completed an analysis of the three-year (2005-2007) dataset, and the results can be seen in Appendix A9. We plan to present the results of this latest analysis to fishers later in the year, and the catch database has already been shared with the Fisheries Department. Importantly, the catch data program has provided critical information that supports the need to protect parrotfish and to ban spear fishing within the reserve. It has revealed that low numbers of Nassau grouper are being caught, which correlates with the very low numbers of aggregating groupers being observed at the spawning site. The recent analysis also showed that catch per unit effort declined in 2007 for lobster, conch and finfish, and that parrotfish are now the most common species caught on the atoll. Dr. Charles Acosta, a WCS research associate, is in the process of conducting a preliminary stock analysis of the biomass data, with the aim of developing a sustainable model for the conch and lobster fisheries.

When the initial results of the program were presented to fishermen at workshops held in Sarteneja and Hopkins, they expressed interest in seeing it continue. We therefore plan to continue the catch data collection over the next couple of years, building a larger data series to yield more robust and reliable results. The catch data collection program has also

been incorporated as part of our long-term conservation strategy for Glover's Reef and the data have been very useful in the ongoing economic valuation of the marine reserve.

Training for fishermen

Since supplying nine fishermen from Sarteneja and Hopkins with marine radios and GPS units to assist with monitoring and reporting of infractions on the atoll, we have followed up with one-on-one training for them in the use of this equipment. As the fishers were having problems charging their batteries, we have also supplied them with rectifiers through which their radio batteries can be charged via their outboard engines. The Sarteneja fishermen are using their radios on a regular basis, and the Reserve Manager routinely checks in with them. However, the fishers from Hopkins do not appear to be using their radios, and it seems that they are reluctant to do so as they have no suitable shelter on their smaller boats to house the equipment. Unfortunately, all fishers are reluctant to use the logbooks that we had prepared and supplied to them, mainly because they do not like to write (a few of them are almost illiterate) and find it very inconvenient to do so onboard their small boats. All participating fishermen were approved by their respective co-operatives, their participation was endorsed the Fisheries Department, and they also participate in our catch data collection program. They have each signed a special participation agreement, which details the conditions that they have agreed to in return for their use of the equipment. These conditions include: agreeing that they, and their crews, will abide by the fisheries laws; treating all surveillance information confidentially; keeping records in their logbooks; and caring for the equipment.

During the lobster closed season, we partnered with a local NGO, Green Reef, to train six fishermen (three from Sarteneja and three from Hopkins) in coral reef monitoring. The training was conducted at Glover's Reef from 19-23 May 2008. The fishermen were introduced to the Reef Check method and four of the fishers were certified as SCUBA divers (Open Water). The Reef Check monitoring involved the collection of data on the following: 1) a description of each reef site based on over 30 measures of environmental condition and expert rating of human impacts; 2) fish counts along an 800 m² section of shallow reef; 3) shellfish counts over the same area; and 4) a measure of the percentage of the seabed covered by different substrate types including live and dead coral. A brief report on the training session can be seen in Appendix A10. The training provided fishermen with an overview of what is involved in coral reef monitoring and also impressed on them the low numbers of some key species as a result of heavy fishing pressure. We hope that these fishers will help in future reef monitoring activities on the atoll.

Training for reserve staff

We supported a three-day rangers' enforcement training workshop which was held from 26-28 March 2008. This was a follow-up to last year's workshop for rangers sponsored by The Nature Conservancy. A total of 33 persons participated, including rangers and managers from the marine reserves and staff from the Fisheries Department, the Belize Audubon Society and the University of Belize. The first day was dedicated to the subject of Customer Service and was led by the Administrative Officer in the Ministry of Agriculture and Fisheries. This subject was very relevant, as many complaints have been received on the poor approach used by rangers and patrol officers. The second day began with an evaluation of the participants' knowledge of the fisheries regulations, which revealed a significant lack of understanding of the legislation. The Fisheries Inspector then led a session on the interpretation of the regulations, which resulted in the recommendation that the Fisheries Act and its subsidiary regulations be revised as soon as possible. The current Act is very outdated and cumbersome since many new pieces of legislation have been added over the years (and several of the new regulations that have been passed are not in tune with the parent Act): this, of course, means that law enforcement is very complicated for the rangers. Training then continued on the following components: arrest and detention, search of prisoners, dealing with juveniles, the judges' rule (constitutional rights), report writing, importance of documentation, contents of case files, summons, and court procedures and behavior. The final day focused on the rules and procedures of handling weapons, and was facilitated by the Police Department. During the workshop the draft Enforcement Policy was also presented and discussed and participants provided suggestions for amendments. The Policy has been presented to the Fisheries Administrator for endorsement.

Following consultation with a couple of the marine reserve co-managers, we decided that training in data analysis would be more productive on a one-on-one basis with individual reserve biologists rather than in a workshop setting with a group. We have contacted the biologists working at the Port Honduras, Sapodilla Cayes, and Gladden Spit marine reserves to offer assistance in data analysis. All co-managers have accepted our offer, but two of them are first working

towards organizing their databases and will indicate when they are ready for the analysis to proceed, and the third co-manager is waiting to have a new reserve biologist in place before proceeding with the training. We have also offered assistance to the Belize Audubon Society's (BAS) new marine reserve biologist on the use of the online spawning aggregation database; this training occurred in August 2008. BAS is responsible for managing the two Natural Monuments at Lighthouse Reef, Half Moon Caye and Blue Hole, and leading the monitoring of two spawning aggregation sites on this atoll.

We also hosted a training workshop on LAMP (Long-term Atoll Monitoring Protocol), led by WCS research associate Dr. Charles Acosta. Eight reserve biologists (from Sapodilla Cayes, Gladden Spit, Port Honduras, Bacalar Chico, Caye Caulker and South Water Caye marine reserves and the Half Moon Caye Natural Monument) and a fisherman from Hopkins attended. The workshop was held at WCS's research station at Glover's Reef from 12-14 August 2008.

Activity 2.4 Introduce innovative co-management arrangements with stakeholders to foster buy-in for conservation action.

With the election of a new government in February 2008, Belize's moratorium on co-management agreements appears to have been lifted, as the Ministry of Fisheries is actively in discussions with a local NGO on drafting an agreement for the management of the Bacalar Chico Marine Reserve. The Association of Protected Area Management Organizations (APAMO) is presently developing a co-management framework and revised agreement templates and has asked that any new agreements under discussion wait until this exercise has been completed in October 2008.

Nevertheless, as mentioned in previous reports, we do not expect a co-management agreement to be in place for the Glover's Reef Marine Reserve within the time frame of this project. The merger of two NGOs, Toledo Association for Sustainable Tourism and Empowerment (TASTE) and Friends of Nature, in southern Belize has not yet been successfully completed, and we are therefore unsure whether this alliance would be a viable co-manager of the Glover's Reef Marine Reserve. However, we will continue to ensure stakeholder involvement in management through our continued support of the GRAC, which over the past few years has proven to be an active group that has positively influenced management at the reserve.

Several informal instances of co-management currently exist at Glover's, such as our partnership with fishermen in the catch data collection program, the involvement of a couple of resort owners in collecting turtle nesting data, and the assistance of fishermen in monitoring and reporting infractions to the reserve management.

Activity 2.5 Develop new, and strengthen ongoing, sustainable long-term programs to track reef health (e.g. coral cover, algal abundance, and coral species diversity), water quality, and population status of commercially and ecologically important reef species (e.g. groupers, sharks, snappers) by Reserve staff and staff of key agencies such as the Fisheries Department, CZMAI, and other NGOs involved in reef management.

Long term Atoll Monitoring Program (LAMP)

The LAMP is a fishery-independent monitoring program designed to collect information on the status of commercially fished species (lobster, conch, and selected species of finfish) and habitat quality, demonstrate the importance of the no-take areas, and determine the effectiveness of regulations in sustaining fish stocks. With reserve staff and assistance from a Hopkins fisherman, we collected an additional four sets of LAMP data at our 33 sampling sites at Glover's Reef over the past year, in August and November 2007 and February and May 2008. As we have been carrying out LAMP monitoring since 2004, the results reveal trends over time.

As in previous years, the density of conch and lobster remains higher in the Conservation Zone (CZ, or no-take area) than in the General Use Zone (GUZ, or area that is open to fishing). The total density of both conch and lobster was higher during 2007 than in previous years. In 2007, conch density was 28.7 conch per ha and lobsters averaged 6.6 lobster per ha. However, the observed conch density remains significantly lower than the benchmark target density of 50 – 300 conch per ha expected on a healthy reef, as suggested by the Healthy Reef guide.

Five species of finfish were also surveyed at the sampling sites: hogfish, Nassau grouper, mutton snapper, black grouper, and queen triggerfish. The hogfish had the highest average density, with 3.7 fish per ha. The Nassau grouper density was 1.9 fish per ha. As our fisheries catch data have shown that parrotfish are currently the second most common species caught, we added six species of this group to our monitoring program; the average parrotfish density was higher in the GUZ (117 fish per ha) than the CZ (102 fish per ha).

The results show that the Conservation Zone is acting as refuge for several commercial species. The higher densities of conch and lobster recorded in 2007 may be a reflection of the improved level of enforcement at the marine reserve. The full results are reported in Appendix A11. This report was shared with the Fisheries Department in September 2008, and the results discussed, emphasizing the areas where legislative changes are required (such as the need to protect parrotfish, introduce a ban on spear fishing in marine reserves, revise the size limit for conch, and generally reduce fishing effort by limiting entry).

We continue to meet with the Fisheries Department to advocate for the protection of parrotfish, and have been promoting this action at every opportunity, particularly as part of this International Year of the Reef '08. We arranged for Dr. Peter Mumby to give a presentation in February 2008 as part of the regular seminar series that we sponsor in partnership with the Coastal Zone Management Authority and Institute. Twenty-six persons attended the seminar, in which Dr. Mumby stressed the importance of parrotfish to coral reef health and called for their protection. We also invited the television media to attend, and Dr. Mumby gave an interview on the subject, which was shown on TV Channel 5. As mentioned earlier, we have also worked closely with the Spawning Aggregation Working Group to advocate for additional measures to protect the Nassau grouper, which includes a ban on spear fishing in the marine reserves. We have met with the new Minister of Fisheries to present these recommendations.

Turtle monitoring

Under the guidance of WCS sea turtle expert Dr. Cathi Campbell, and the assistance of marine reserve and WCS Station staff, we continued our in-water turtle monitoring with three surveys carried out over the past year, in September 2007 and April and July 2008. We plan to conduct these systematic surveys three times each year, and the third survey for 2008 is scheduled for November. During the September 2007 survey 26 turtles were sighted, and 23 of these were hawksbills (Appendix A12). The survey team captured 12 (10 hawksbills and 2 greens) of the 26 turtles sighted, which were measured, weighed, and tagged. A tissue sample was also extracted from each turtle for genetic analysis. During the April 2008 survey, the team sighted 49 turtles: 41 hawksbills, 3 green turtles, 3 loggerheads, and 2 were not identified (Appendix A13). The team captured 23 of these turtles, which were then measured, weighed, tagged and sampled; 19 were juvenile hawksbills (one of these hawksbill turtles was a recapture from the September 2007 surveys), 1 juvenile green, and 3 adult male loggerheads. All data are being archived in a specially designed database. The data for the July survey are being analyzed and a report will be forthcoming at a later date. During each survey, Dr. Campbell continued training the participants in monitoring techniques and we expect that within the next few survey sessions the core team will be able to continue the monitoring under the guidance of local WCS staff. We drafted a sea turtle monitoring protocol for in-water surveys, which is under review and should be finalized by the end of 2008.

The results suggest that juvenile hawksbill turtles reside in the area year-round, and that the atoll is likely an important foraging ground for this very endangered species, which is experiencing declining numbers and is under increased threat due to climate change. The information gained from this monitoring program will be valuable in assessing growth rates, habitat use, spatial and temporal distribution and genetic stock to determine origin of the population; all factors necessary for managing the recovery of hawksbill turtles at Glover's Reef. Our in-water surveys are also viewed as important by the authorities, as a contribution to fulfilling the country's obligations under the Inter-American Convention for the Conservation and Protection of Sea Turtles (IAC) that Belize has ratified.

Spawning aggregation monitoring

We carried out the annual monitoring of the Nassau grouper spawning site at Northeast Point, Glover's Reef in January and February 2008 in partnership with the marine reserve and WCS Station staff and with the assistance of two Hopkins fishermen who used to fish the bank. We are very pleased to report that results revealed that numbers of Nassau groupers increased by 33%, from a maximum count of only 800 in the 2006/2007 season to 1,150 groupers this past season. Although it is too early to tell whether this increase in number signifies a rebound of the species, if strengthened

enforcement is maintained, we are optimistic that the numbers will continue to improve. The results of the analysis of our monitoring data for Northeast Point for the past four spawning seasons (from 2005 to 2008) are reported in Appendix A14. The report also includes information on the numbers of other species that aggregate at this site. In addition, we have entered our monitoring data in the online database managed by the Spawning Aggregation Working Group.

Osprey monitoring

This past year we carried out an assessment of the osprey population on the Atoll for the first time, with the assistance of WCS ornithologist Dr. Nancy Clum. The osprey is one of our two Seascape Species, along with the hawksbill turtle, that forms a link between the terrestrial habitats of the cayes and the marine environment since the osprey feeds on fish in the atoll lagoon but nests on the cayes. The ospreys in Belize are a non-migratory race of the species (*Pandion haliaetus ridgwayi*), which is believed to number only 100 to 150 pairs of birds in the Caribbean; a quarter of these pairs occur off the coast of Belize. Dr. Clum's survey, which was carried out in January 2008, revealed that there were six active nests (12 birds) at Glover's. Two of these nests were located on artificial structures, three in the roots of overturned trees, and one in a live, upright tree. Natural nesting sites seem to be limited, indicating the need to protect certain trees on the cayes in an attempt to provide additional nesting habitat. Based on observations of the pair of ospreys that nest on Middle Caye, it appears that the birds are probably courting in November, incubating during December, hatching chicks in January, and fledging during February-March. The average clutch size for the four nests that were investigated was 1.5, which is considered low compared to other osprey populations. (Dr. Clum's report can be seen in Appendix A15.) Such low productivity is usually associated with low prey delivery rates or the presence of contaminants and therefore suggests the need for further studies on foraging and prey composition, and testing the eggs that fail to hatch for contaminants. We hope that, with training from Dr. Clum in FY09, nest monitoring can be carried out jointly by cayes residents and the reserve and WCS Station staff. As we continue to build our knowledge on this species, we will be able to refine our seascape model.

Coral reef monitoring

We have not yet been able to complete the exercise of mapping the geo-referenced data on the level of coral bleaching at Glover's Reef, collected over the past several years. We had hoped that this data would indicate which areas of the atoll are more resilient to bleaching and coincide with our model of predicted resilient and resistant areas. We plan to carry out this project in FY09.

Diadema monitoring

In FY08 we continued monitoring *Diadema antillarum* in partnership with the University of Belize (UB) under the leadership of Dr. Leandra Cho-Ricketts, along with two of her students. We completed surveys on this keystone species at 29 sampling sites in March and June 2008. The data are currently being analyzed and Dr. Cho-Ricketts will submit her report in November 2008. Preliminary results indicate that *Diadema* were present on several patch reefs this year; in 2007 no urchins were observed in this habitat. Overall, urchin density remained low and patchy. The two UB students are completing this study as an undergraduate thesis project, one requirement for their BSc in Natural Resource Management. We plan to continue collaborating with UB on monitoring *Diadema*, one of our Seascape Species and a key algae grazer on the reef. We hope to record its recovery at Glover's and link this to a reduction in macroalgae cover on the reef.

OBJECTIVE 3: Learn and teach best practices in the Glover's Reef Seascape and beyond.

Activity 3.1 Document the lessons learned from the application of the Living Landscapes approach to priority setting within a marine site.

We presented the Living Landscapes Program's planning process (the Seascape Species Approach) to many of our colleagues and partners at the 2nd Natural Resource Management Symposium that was convened by the University of Belize in June 2008. We gave a PowerPoint presentation (Appendix A16) at the conference and a paper (Appendix A17) was submitted for publication in the Journal of the Mesoamerican Society for Biology and Conservation, entitled *Biodiversity conservation at the landscape level: the development of a Conservation Strategy for the Glover's Reef Living Seascape*.

Also, at a WCS Marine Program meeting in July 2008, we shared our experience of applying the approach to a marine site with program managers from coral reef sites. We discussed the challenges posed when applying the approach to marine species, such as setting population targets for many species due to: the concern of shifting baselines and the general lack of historical data; the fact that the importance of different habitats at various life history stages is more pronounced for marine species; the difficulty in representing the processes of larval dispersal and recruitment, which are particularly critical in a marine system; and the fact that the approach may not apply very well to species that are very wide-ranging or migratory. Several species experience seasonal changes, which are difficult to map. Mapping future threats and determining the scale of threat severity and the interactions between threats is also a challenge. Nevertheless, the approach had many advantages, such as: providing an opportunity for participatory planning that was very helpful for building trust and a shared vision; building the conceptual model, which assisted in making it a threats-based approach that targeted and prioritized our interventions; generating maps to enhance visual communication and help raise awareness; identifying gaps in our knowledge; and providing orderly and logical steps that provide a solid basis and structure for a conservation program. Despite the shortfalls of applying the approach to marine sites, we felt that it helped us focus on wildlife and institute practical conservation actions by concentrating our efforts on a specific area or seascape where our actions had the greatest chance of having a measurable and tangible impact.

Activity 3.2 Extract and share best practices, in terms of management and monitoring.

We extracted the best practices that were common to all cayes from our exercise with the caye owners at Glover's Reef and prepared an attractive fold-out pamphlet that we have shared widely with our many stakeholders and partners (see Activity 2.2). The guide provides a framework for the environmentally-friendly development of the cayes of Belize, particularly those that fall within the boundaries of a protected area.

We have recently been approached by WWF to share our experience in supporting a successful marine reserve advisory committee. WWF is planning to support the advisory committee for the two spawning aggregation marine reserves established on Turneffe Islands. We will discuss our experience with their project manager, highlighting points which we think have led to the success of the GRAC over the past four years.

The in-water turtle survey monitoring protocol is almost completed and will be shared with many marine reserve managers who are interested in initiating similar monitoring programs in their respective reserves. Researchers from the Turneffe Islands, for example, are interested in launching in-water surveys on that atoll and have requested our advice.

Our fisheries catch data collection and our progress on limiting access to fishing were the basis for Glover's Reef being chosen as a possible pilot site for a market-based incentive fisheries project being proposed by the Environmental Defense Fund. If this project proves successful, then Glover's Reef Marine Reserve could serve as a model of sustainable fisheries management for the other marine reserves in Belize.

OBJECTIVE 4: New York Coordination Unit Strategy: Guide the design and testing of wildlife-focused planning, implementation, and evaluation tools for effective conservation at a landscape scale, and promote learning across sites and beyond

The NY-based Coordination Unit (CU) of the Living Landscapes Program (LLP) is designed to develop and test wildlife-focused, landscape-scale approaches to biological conservation across multiple sites. To ensure the widespread utility of these new conservation approaches, the program is testing them within landscapes or seascapes that encompass a diverse array of ecological features, land-uses, resource-use issues, and jurisdictional arrangements. The CU is charged with designing and managing the program to develop new approaches in close collaboration with WCS field-based staff, to facilitate and harmonize testing and implementation among these core sites, and to capture the synergistic benefits of their diverse experiences. It guides development of landscape-scale strategies, tools and techniques; assists in the design and development of cost-effective intervention and monitoring programs at these sites; promotes cross-site learning; and ensures communication among the sites, WCS staff (central and field), USAID (DC and missions), and the larger conservation community.

During FY08, the priority for the Coordination Unit continued to be working with field sites to promote adoption of best-practice tools for effective conservation at landscape scales, and to plan to consolidate lessons learned as the USAID GCP approaches its final year.

Activity 4.1 Provide technical assistance to site-based conservation

Members of the NY Coordination Unit worked closely with field sites to provide targeted technical input (punctual advice and informal and formal training in strategic conservation planning, monitoring the effectiveness of conservation actions, geographic and quantitative analysis, and specific conservation issues) throughout the year. In a number of cases, this involved trips to sites as reported in the previous sections of this and the other site-specific reports: Madidi (Bolivia), Maya (Guatemala), Glovers (Belize), and Eastern Steppe (Mongolia). As our LLP/GCP sites are at different stages of development or evolution, they have warranted (and requested) different levels of NY coordination unit assistance during this reporting period. This is to be expected and reflects our adaptive management approach to conservation investment.

Overall, LLP staff supported the 4 four sites through the following process:

- **Finalization of each site's suite of Landscape Species.** LLP-NY support included providing guidance on the candidate species and other data required for the target selection process, technical support for the software used to select Landscape Species, and review of draft Landscape Species suites in order to assist field staff in choosing the most appropriate conservation targets for their site.
- **Development of quantitative population targets for Landscape Species.** LLP-NY provided technical support and helped gather information from the literature. Setting appropriate population targets is pivotal to the strategic application of the Landscape Species Approach (LSA).
- **Creating draft Biological, Human, and Conservation Landscapes or Seascapes for Landscape/Seascape Species.** LLY-NY led on the development of several models and provided technical support to field staff to ensure the successful development of these models that are at the core of the LSA.

Dr. Karl Didier worked closed with WCS Mongolia staff to produce a spatial model of the distribution of Siberian marmot one of the Eastern Steppe's Landscape Species for which we previously had little information. The pelts and meat of Marmots contribute significantly to local economies though their populations have been severely depleted by over harvesting by non-local trappers. The model and map will be invaluable for focusing conservation attention on parts of the steppe critical for marmot conservation.

Dr. Karl Didier completed a technical manual entitled "Building Conservation Landscapes – Mapping the Possible Impacts of Your Conservation", which has been printed and will be shortly available for download from the Living Landscapes' web site (www.wcslivinglandscapes.org).

Monitoring highly elusive species scattered across vast geographic areas is a huge challenge and Dr. Samantha Strindberg of LLP-NY traveled to Belize City and to Flores, Guatemala in March 2008 to assist the Belize and Guatemalan field teams with the design and analysis of their biological monitoring data. In Belize the focus was on the LAMP (Long-term Atoll Monitoring Program) surveys, fisheries catch data collection program, spawning aggregation counts, and in-water sea turtle surveys, while in Guatemala the challenging species in terms of monitoring included the scarlet macaw and Central American river turtle with the decorative palm (xate), although stationary and fairly abundant, posing its own distinct monitoring challenges.

Activity 4.2 Design, implementation, and testing of decision support tools

Activity 4.2.1 Living Landscapes Program technical manuals

WCS/NY staff also wrote and published two more installments in its series of Technical Manuals and Bulletins: "Technical Manual 7: Building Conservation Landscapes – Mapping the Possible Impacts of your Conservation Actions" (Appendix B1), and "Summary: Landscape Species Approach – A Wildlife Based Strategy for Conservation" (Appendix B2).

Activity 4.2.2 Landscape Species Approach progress

As planned, in April of 2008, staff from the Living Landscapes Program developed and facilitated for the first time a 2-week intensive course entitled “Conservation Planning Using the Landscape Species Approach”. The course was designed for WCS field staff and was attended by 18 staff from 7 landscapes and 1 seascape. During the course, field staff members were trained in all steps of systematic conservation planning and specific LSA tools developed over the past 10 years of GCP funding, and were given the opportunity to apply those tools to their particular landscapes. The course also provided LLP-NY staff to expose field staff to the newly released strategic planning and adaptive management software program – Miradi – developed by the Conservation Measures Partnership with support from Benetech.

We plan to offer the course at least 2 more times for WCS staff, and may offer it to practitioners outside of WCS, depending on funding availability (i.e., a NASA grant for which we’ve recently applied). This training demonstrates how we are now extending the benefits of the LSA (and the GCP funding that allowed for its development) far beyond the 6 sites that directly received funding.

Activity 4.2.3 Integrating strategic planning and project management

As WCS is going through an organizational transformation to more explicitly interconnect the living institutions (our zoos and aquarium) with the global conservation program progress on integrating strategic planning with operations planning and report was slow in FY08. LLP tools and approaches to conservation developed with the support of GCP continued to be enormously influential as WCS developed both its strategic goals – saving wildlife and wild places and connecting people to nature, and its operational systems for attaining these goals. LLP continued to work with the developers of Miradi to ensure that this desktop tool effectively integrates strategic planning and operations planning and reporting. WCS continues to be corporate sponsor of Miradi development.

Activity 4.3 Catalyze cross-site and cross-organizational learning, and communication

Activity 4.3.1 Annual meeting, cross-site and cross-organizational learning

In FY08, LLP-NY staff finished writing and producing a series of “Guidance Briefs” based on information gathered at the LLP Annual Meeting in May 2007 that brought together the 14 LLP sites, including the 4 currently funded by USAID (see Appendices B3-B10). The Briefs are intended to be an accessible, user-friendly way to introduce new sites to the Landscape Species Approach and to guide users in when and how the LSA works best. As soon as the new WCS website is finalized -- it is currently being completely redesigned – we will post the Guidance Briefs.

Cross-site learning

The third two-week LLP/WCS workshop on “Statistical Design and Analysis of Biological Monitoring Programs for Conservation Management”, designed and led by Drs. Samantha Strindberg and Fernanda Marques (WCS Brazil Program) was held in Manaus, Brazil in June 2008. This workshop significantly advanced the access of WCS field staff to the technical knowledge that they need to monitor elusive species. WCS field staff in attendance included Guido Ayala and Boris Rios Uzeda from the Greater Madidi Landscape, Bolivia, along with Eduardo Toral and Javier Torres (Yasuni-Napo Landscape, Ecuador). The Ecuadorian landscape site was supported by the first round of USAID/GCP funding and is continuing to apply the tools and build upon the success of their previous conservation work.

Dr. Strindberg continued to work closely with Dr. Emma Stokes to build spatial models using Generalized Additive Modeling techniques for two of their Landscape Species, namely elephants and chimpanzees, in the Ndoki-Likouala Landscape, Congo (supported by the previous round of USAID/GCP funding), thus building on USAID/GCP prior investments.

Cross-organizational learning

Drs. Didier and Wilkie continued their involvement with a GCP learning project to evaluate the different approaches that conservation NGOs use to select conservation targets (e.g. WCS's Landscape Species Approach).

Activity 4.3.2 CMP: leadership, design, writing and audits

LLP-NY staff continued to play a leadership role in the identification, design and implementation of Conservation Measures Partnership activities. David Wilkie worked closely with Nick Salafsky of FOS, Dan Slazer of TNC and Benetech a not-for-profit software developer to develop Miradi modules prior to its public release in February 2008. David Wilkie also work with Miradi developers to devise a financing model that would generate sufficient capital for continued evolution of Miradi and to ensure that prospective users from low-income countries could afford to purchase a Miradi license.

Activity 4.3.4 Preliminary assessment of the human welfare impacts of establishing national parks

Significant numbers of data entry errors were found in the Parks and People Access database requiring several additional person-months of investment to clean the dataset in preparation for analysis. The dataset is now accurate and ready for analysis.

Activity 4.4 Application of Living Landscapes Program tools beyond core sites

Activity 4.4.1 Training workshops and technical assistance in the use of LLP tools

LLP NY staff continued to provide assistance to WCS and reserve staff of the Amazon Andes Conservation Program in Brazil, Peru, Ecuador, and Bolivia during a week long workshop in Brazil.

The third two-week LLP/WCS workshop on "Statistical Design and Analysis of Biological Monitoring Programs for Conservation Management", designed and led by Drs. Samantha Strindberg and Fernanda Marques (WCS Brazil Program) was held in Manaus, Brazil in June 2008. This workshop significantly advanced the access of WCS field staff to the technical knowledge that they need to monitor elusive species. WCS field staff in attendance included Guido Ayala and Boris Rios Uzeda from the Greater Madidi Landscape, Bolivia, along with Eduardo Toral and Javier Torres (Yasuni-Napo Landscape, Ecuador). The Ecuadorian landscape site was supported by the first round of USAID/GCP funding and is continuing to apply the tools and build upon the success of their previous conservation work.

Activity 4.4.2 Technical Manuals

We continued to make our series of technical manuals available to conservation practitioners and decision makers on our website, as hard-copy booklets and on CD. Manuals are now available in English, French and Spanish.

Activity 4.5 Ensure coordination and communication services for the program

The program director and assistant director continued to meet with staff from the core sites and other WCS large-scale conservation sites to discuss the development of the program, on-the-ground implementation of the Landscape Species Approach, and further development of tools relevant to the approach. Program staff also continued to meet with collaborators, NGOs, governmental officers, and representatives of other stakeholder groups to promote use of the strategies and tools.

Throughout the year, the Coordination Unit has assisted field staff in completing annual Implementation Plans, reporting on Performance Monitoring forms, and submitting Annual Reports. The program director and assistant director and other staff have continued to contribute significantly to USAID/GCP quarterly and annual meetings in Washington DC and continue to provide regular reporting and updates to USAID.

III. Appendices

- A1. Conservation Strategy for the Living Seascape of Glover's Reef
- A2. Interim Report from SWEET (including a summary of the first workshop on the Tourism Development Plan: Planning for Tourism in Sarteneja)
- A3. Survey of Sarteneja Participants of Alternative Livelihood Tour Guide Training Projects
- A4. Recommendations to the Fisheries Administrator from the National Spawning Aggregation Working Group on Measures Needed to Protect the Nassau Grouper
- A5. PowerPoint presentation: The Ecology and Management of the Nassau Grouper
- A6. DVD on the Nassau Grouper
- A7. Spawning Aggregation Working Group newsletter
- A8. Pamphlet: *Recommended Best Practices for the Cayes of Belize – based on the lesson learned at Glover's Reef Atoll*
- A9. Report on fisheries catch data collection for period 2004 - 2007
- A10. Report on Reef Check Training
- A11. Report on LAMP monitoring
- A12. In-water Surveys of Marine Turtles at Glover's Reef Marine Reserve, September 2007
- A13. In-water Surveys of Marine Turtles at Glover's Reef Marine Reserve, April 2008
- A14. Nassau grouper spawning aggregation at Glover's Reef Marine Reserve, January 2005-February 2008
- A15. Status and Habitat Use of Osprey at Glover's Reef
- A16. PowerPoint presentation: *Biodiversity conservation at the landscape level: the development of a Conservation Strategy for the Glover's Reef Living Seascape*
- A17. Paper: *Biodiversity conservation at the landscape level: the development of a Conservation Strategy for the Glover's Reef Living Seascape*

- B1. LLP Technical Manual 7. Building Conservation Landscapes – Mapping the Possible Impact of Your Conservation Actions.
- B2. LLP Summary Manual. The Landscape Species Approach: A Wildlife-based Strategy for Conservation Developed by the Living Landscapes Program of the Wildlife Conservation Society.
- B3. Didier, K., V. Falabella, A. Johnson, V.H. Ramos, A. Rasphone, T. Siles and the L.L.P. 2008. Living Landscapes Field Guidance: Biological Landscapes. 4 pp.
- B4. Garcia, R., A. Johnson, A. Pattanavibool, H. Rainey, E. Suárez, A. Vedder and the L.L.P. 2008. Living Landscapes Field Guidance: Conceptual Models. 4 pp.
- B5. Bryja, G., V. Falabella, A. Fine, A. Novaro, A. Rasphone, F. Semanini and the L.L.P. 2008. Living Landscapes Field Guidance: Conservation Landscapes. 5 pp.
- B6. Bean, T., P. Coppolillo, E. Delattre, R. Garcia, H. Rainey, S. Strindberg and the L.L.P. 2008. Living Landscapes Field Guidance: Landscape Species Selection. 6 pp.
- B7. Clements, T., J. Gibson, A. Pattanavibool, E. Stokes, S. Strindberg, A. Vedder and the L.L.P. 2008. Living Landscapes Field Guidance: Monitoring Frameworks. 5 pp.
- B8. Bean, T., T. Clements, P. Coppolillo, A. Fine, A. Novaro, E. Stokes and the L.L.P. 2008. Living Landscapes Field Guidance: Setting Population Targets. 4 pp.
- B9. Bryja, G., E. Delattre, K. Didier, S. Hoare, O. Lkhamjav, V.H. Ramos, and the L.L.P. 2008. Living Landscapes Field Guidance: Threats Landscapes. 4 pp.
- B10. Gibson, J., S. Hoare, O. Lkhamjav, F. Semanini, T. Siles, E. Suárez and the L.L.P. 2008. Living Landscapes Field Guidance: Participatory Threats Assessment Workshop. 3 pp.