



Biodiversity Conservation at the Landscape Scale

A Program of the Wildlife Conservation Society

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

Annual Report

October 2004 – September 2005

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 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.

The Glover's Reef Living Seascape project remains on track for all activities planned, with the exception of the completion of the Conservation Strategy, which is underway and expected to be developed by mid 2006. Significant progress has been made on almost all aspects of the project's three objectives, namely to develop and adopt a participatory strategy to reduce threats to marine life at Glover's Reef, to develop and implement sustainable and adaptive mechanisms to strategically address threats across the seascape, and to learn and teach best practices in the Glover's Reef Seascape and beyond.

Under the first objective, both human and biological seascapes for each of our seven seascape species have been mapped. In addition the overlays and resulting draft models of these seascapes have been completed for three of the species, constituting their 'conservation seascapes'. These maps and models were presented to and discussed with the stakeholders, the Glover's Reef Advisory Committee (GRAC) and local experts, at a workshop held in Belize City on the 21st April 2005. In addition, the human seascapes or threats assessment maps have been shared with the National Protected Area and System Plan project and with the World Resources Institute, which has produced a coastal data CD and coastal threats atlas for Belize that incorporates these maps.

Under the second objective, training activities completed include a co-management workshop for the Glover's Reef Advisory Committee and also a Committee meeting held on site at Glover's Reef, where members were given a tour of the reserve and the associated cayes. The Committee continued to meet on a quarterly basis and maintain quorum for all meetings. Educational activities achieved include the preparation of the reserve brochure; completion and dissemination of the Spawning Aggregation newsletter; updating and airing of the TV spot on spawning aggregations; and the printing of pamphlets on conch and lobster for school children. Two

local fishermen who generally fish at Glover's were also hired to assist in the monitoring of the Nassau grouper spawning site on the northeast point of Glover's Reef in January 2005.

A notable achievement under this objective was the beginning of the collection of catch data for the Atoll in February 2005. Based on the data collection system designed during the first year of the project, a technical assistant at Glover's Reef is presently collecting data from fishermen on their catches of lobster, conch and reef fish. In addition, a fisherman has been hired to collect catch data from fishermen landing their catch on the beach at Hopkins. Fishermen who provide their catch data are compensated with a coupon that is redeemable for two gallons of fuel. This system, which was accepted by both the Fisheries Department and the fishing cooperatives, seems to be working well and we have already collected six months' of data. In May 2005, workshops were held in the fishing communities of Sarteneja and Hopkins to update fishermen on the program and to train them in the data collection methodology. For the meeting in Sarteneja, we partnered with the National Fishermen's Co-operative and the Belize Audubon Society, as they were also interested in offering similar training to the fishermen who fish the Lighthouse Reef Atoll. We were therefore able to share our data collection methodology, endorsed by the Fisheries Department, with our partners and over 50 fishermen. Twelve fishermen and three tour guides participated in the workshop held in Hopkins. The primary purposes of this participatory data collection are to foster a sense of responsibility amongst fishermen for sustaining fisheries, and to ultimately assess and demonstrate the benefits of the no-take or Conservation Zone of the Glover's Reef Marine Reserve in supporting their livelihood.

As the moratorium on co-management agreements has continued, and completion of the National Protected Areas Policy and System Plan has been delayed, we have decided to strengthen the GRAC with a view to this Committee becoming the potential co-manager of the Glover's Reef Marine Reserve. This is the preference of the Fisheries Department, which has also stated that it wishes to use the GRAC as an example for the other marine reserve advisory committees.

In relation to the third objective - sharing lessons, threats assessments for Turneffe Islands, Lighthouse Reef, and the Belize Barrier Reef region were carried out using the methodology developed for Glover's Reef. Furthermore, the seascape species approach to planning was shared with Biotropica, a group in Venezuela, who completed the process for cetaceans as a means of designing a marine sanctuary on the north east coast of that country. In addition, the monitoring framework we developed for Glover's Reef was used as an example in a technical manual of the WCS' Living Landscape Program entitled *Measuring our effectiveness: a framework for monitoring*, and the threats assessment process conducted was discussed as an example in the paper *A simple, cost-effective method for involving stakeholders in spatial assessments of threats to biodiversity* in the journal *Human Dimensions of Wildlife*. Finally, as mentioned earlier, we have shared our data collection methodology with Belize Audubon Society and the National Fishermen Co-operative.

b. Highlights

- **Launching of the Fisheries Catch Data Program**

The start of the fisheries catch data program on site at Glover's Reef and in the fishing village of Hopkins has engaged fishermen in the first step in managing their fishery and helping to ensure that it is sustainable. In the long-term, we hope that fishermen will continue to collect their own data in logbooks that can then be shared with the Fisheries Department. The training workshop for fishermen held in Sarteneja and Hopkins revealed that most fishermen are concerned about the management of fisheries and many are willing to take part in this data collection program. When data for the period of a year has been collected and analyzed, the results will be presented to fishermen at a similar forum. Sharing the data collection methodology with our partners, the Belize Audubon Society and National Fishermen Co-operative, will help in comparing catch and effort over a broader region.

- **Development of Conservation Seascapes for the Suite of Seascape Species**

With the assistance of WCS NY staff, the human and biological seascape maps for our suite of seascape species have been generated using GIS technology. From these human and biological seascapes, draft models of the conservation seascape for three seascape species have been developed using the specialized MARXAN software. Many of these models have been approved by the GRAC and local experts, and they will form the basis of our conservation strategy for the atoll. This planning approach has ensured that both human aspects and ecological attributes have been taken into account in the development of the strategy, increasing the likelihood that management measures chosen will be the most acceptable and successful in the long-term.

- **Training and Revitalizing the Glover’s Reef Advisory Committee**

The Glover’s Reef Advisory Committee has continued to meet on a regular quarterly basis over the past year and quorum has been maintained at each meeting. A highlight this year was the two-day meeting held at the WCS research facility at Middle Caye, Glover’s Reef in January during which members were given a tour of the marine reserve and met with stakeholders who reside on the cayes. Although currently acting in an advisory capacity to the Fisheries Department in relation to the management of the Glover’s Reef Marine Reserve, the Committee is in theory acting at the basic level of consultative co-management for this marine protected area. The Fisheries Department, however, has indicated its interest in having the GRAC assume more responsibility, increasing its involvement towards more collaborative management. The Department has also expressed its approval of the progress the GRAC has made over the last year and wishes to use it as an example for the other marine reserve advisory committees across the nation’s coastline.

c. Table of Activity Status

Activity Number	Activity Title	Status	Page number for more information
Obj. 1	Develop and adopt a participatory strategy to reduce threats to marine life in the Glover’s Reef seascape		4
1.1	Complete threats and stakeholder analyses	Completed	4
1.2	Complete a Seascape Species Analysis	On track	5
1.3	Identify high priority interventions	Expected to be completed by mid 2006	6
Obj. 2	Develop and implement sustainable and adaptive mechanisms to strategically address threats across the seascape		6
2.1	Implement Seascape Conservation Strategy	On track	6
2.2	Provide technical support and training	On track	7
2.3	Strengthen and expand stakeholder support for the Seascape Conservation Strategy	On track	8
2.4	Introduce innovative co-management arrangements	In process, but with some changes	9
2.5	Develop new and strengthen ongoing long-term monitoring programs	On track	9
Obj. 3	Learn and teach best practices in the Glover’s Reef Seascape and beyond		10
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3.2	Extract and share best practices	On track	10
Obj.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		11
4.1	Provide technical assistance to site-based conservation	On track	11
4.2	Design, implementation, and testing of decision support tools	On track	12
4.3	Catalyze cross-site and cross-organizational learning, and communication	On track	13
4.4	Application of Living Landscapes Program tools beyond core sites	On track	14
4.5	Ensure coordination and communication services for the program	On track	15

II. Detailed Description of Progress

a. Key short and long-term program objectives for the reporting period (October 2004 – September 2005)

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 will build on the in-depth practical conservation knowledge of WCS’ long-term field program at the site, facilitating the implementation of strategic site-based conservation tools developed through its Living Landscapes Program. We also aim to refine this planning approach as to the manner in which it is applied to tropical marine areas.

During this reporting period we have consolidated the information-gathering required to build the conservation strategy for the Atoll seascape. Activities have included collecting additional information on the threats and seascape species, refining the human and biological landscapes, developing the models for the conservation seascapes, and finalizing the conservation strategy (to be completed by mid 2006). Simultaneous to these planning activities, we also concentrated on strengthening and supporting the Glover’s Reef Advisory Committee, providing support for the marine reserve, training fishermen, and gathering management-related data on fisheries, reef health, and the status of the grouper spawning aggregation.

Over the longer term, in five years and beyond, our objective is to carry out adaptive management - making necessary adjustments to the reserve’s management programs, prepare development guidelines for the Atoll’s islands, complete a socio-economic survey of the atoll, put in place a sustainable financing program, and 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 the first half of the year, Glover’s Reef Living Seascape Project (GRLS) staff collected additional information on caye vegetation (mangroves, littoral forest, beach type, etc.) and land use of the cayes, which included factors such as location and type of buildings, sewage disposal, lighting, occupancy, and number of dogs. This is vital information that will serve as a baseline when monitoring habitat loss and the reduction of the severity of threats over time, in addition to feeding information into the biological and human seascapes. Biological data were also collected on osprey nesting sites and turtle nesting beaches to inform the biological seascape for these seascape species. Detailed bathymetry data is also being collected for the first time, which is vital to developing realistic biological seascapes for many of the seascape species (particularly Nassau grouper and Caribbean reef shark) and has other important applications for the Fisheries Department and other stakeholders. To develop an appropriate Conservation Strategy it needs to be crucially based on informative conservation seascapes that result from the overlay of realistic biological and human seascapes. In addition, data on the seascape species were obtained from WCS experts and from the literature by Dr. Caterina D’Agrosa of WCS Marine Program. By means of GIS technology Dr. D’Agrosa then used the data to refine the maps of the biological seascapes for each seascape species. These species include the hawksbill turtle, Nassau grouper, Caribbean reef shark, queen conch, star coral, black long-spined sea urchin and osprey. The human seascapes (areas of human influence), which include threats such as fishing, coral bleaching, chemical runoff, direct physical damage to coral, land development/habitat loss, introduced species, solid waste, liquid waste and sewage were also further refined. The biological seascape for each species was represented as a percent of carrying capacity K, with the excellent habitats given a value of 100% and good and marginal habitats given lower values. Similarly, the human seascapes were represented in terms of the percent reduction in carrying capacity, with more severe threats reducing carrying capacity of a particular species to a larger degree than less severe threats. Examples of these maps can be seen in Appendix 1.

Dr. D’Agrosa, with the assistance of Dr. Samantha Strindberg and Dr. Karl Didier from the WCS Living Landscapes Program and GRLS staff, then overlaid the updated human and biological seascapes to develop models of the conservation seascapes using the specialized MARXAN software. Models were prepared for conch (*Strombus gigas*), star coral (*Monstastrea* spp.) and black long-spined sea urchin (*Diadema antillarum*) (those for the remaining species will be prepared over the next 3 month). The MARXAN software package is a decision support tool usually used in the context of protected area network design, and we have applied it in a novel way to highlight where we should focus our conservation work within or beyond a marine protected area such as Glover’s Reef Atoll.¹ The results of the analysis for the set of three species importantly demonstrated, for example, that our conservation zones (Conservation Zone, Wilderness Zone, Spawning Aggregation Reserve – SPAG - Zone) in the marine reserve seem to be located in the right places. The northeast area, however, may need to be expanded in order to conserve areas of coral reef that are more resilient to bleaching events which we suspected due to the large channel in the reef located there - helping to lower water temperatures due to the increased water flow through the channel into the Atoll’s lagoon. In addition, the eastern stretch of reef may need further investigation, which if conserved would offer an area of connectivity between the Conservation Zone and the SPAG Zone. The conservation seascape maps can be seen in Appendix 1.

¹ MARXAN finds efficient solutions to the problem of selecting a system of spatially cohesive sites that meet a set of biodiversity targets (in our case these targets are population levels set for each of the seascape species). Desired population target levels were set at a relatively high level of 75% of carrying capacity for each species.

Activity 1.3 Identify high priority interventions

As mentioned in our first annual report, high priority interventions have been identified, as shown in our master conceptual model and also the models prepared for our suite of seascape species (see Appendix 2). As noted above, the conservation seascapes prepared so far have demonstrated that we may need to adjust some of these zoning boundaries and interventions, but only slightly, to target additional areas within the atoll that need further attention. These will be finalized over the next year when the seascapes have been completed for all species.

In April 2005, the human and biological seascape maps completed, along with all conservation seascape maps, were presented and discussed with the Glover's Reef Advisory Committee and local experts. Nine GRAC members and four local experts attended the meeting. GRLS staff gave participants an overview of the Species Selection Approach and a review of the human and biological seascapes (see Appendix 1), which were based on the maps drafted by the participants during the species selection and threats assessment workshops the previous year. Participants provided specific comments on the biological seascapes for *Diadema* and the Caribbean reef shark and adjustments have subsequently been made to these maps. Participants also recommended changes to the sewage threats map, which has also since been amended accordingly. A presentation was then given on MARXAN, which explained the basic concepts of the software, and how it analyzes spatial data and identifies the best and most efficient formulation of conservation zones that can conserve selected biodiversity targets, while incorporating 'costs' or threats. Following the final presentation on the preliminary conservation seascapes for conch, star coral and *Diadema*, participants stated that the process seemed logical and on target, and felt that it was progressing satisfactorily. They also mentioned that they would be interested in seeing the final product and would be keen to compare the present results with the situation 5 to 10 years from now. The final conservation seascapes will be presented at a similar meeting in FY06, along with the Conservation Strategy (a draft of which we expect will be completed by early next calendar year).

An easily accessible GIS database of Glover's Reef is being developed to maximize the impact of research on the Atoll, facilitate collaboration among researchers, and help communicate research results to managers. Work has begun on compiling all the relevant research data for Glover's Reef to be included in this web-based database. A Ph.D. student of Dr. Peter Mumby of Exeter University in the United Kingdom is spearheading this work. A questionnaire of metadata has been developed and distributed to all researchers who have conducted work on the atoll. The responses are being compiled and included in the GIS database. The database currently consists of a habitat map, a map of the different use zones, and some baseline data, including fish, coral, and coral recruitment monitoring sites.

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.

Although the Seascape Conservation Strategy has been under development this year, several interim actions have been initiated to help ensure our success in achieving the conservation targets. In order to increase the effectiveness of current regulations, a brochure for the marine reserve was prepared and reviewed by the GRAC and the Fisheries Department. A thousand copies have been printed and are presently being distributed by reserve staff to fishermen and visitors to the reserve. We hope that by supplying information to fishermen on the zoning scheme and its related regulations, the threat of illegal fishing in the Conservation Zone will be decreased. The brochure explains the reserve's different zones and regulations. A copy is included in Appendix 4. A Spawning Aggregation newsletter was produced in collaboration with the National Spawning Aggregation Working Group and over 300 copies were printed and distributed to fishermen and NGOs. It is

expected the newsletters will illustrate the positive effect the protection of the sites is having and thus garner support from fishermen to respect the protected areas and to not fish them illegally. We also updated the TV spot informing fishermen of the 11 spawning sites closed to fishing and the Nassau grouper closed season. The spot was broadcast about 3 times each week, on national television in December, January and February, and the costs were shared with WWF and TNC. We also arranged to have it aired on local TV cable networks in Dangriga, Hopkins and Sarteneja, and provided copies on CD to local NGO partners who arranged airings in the coastal communities of San Pedro and Punta Gorda.

Other interventions, mentioned below, include the collection of fish catch and effort data, training, and monitoring activities. The involvement of reserve staff, fishermen, and GRAC members in these activities should also help in general raising of awareness through increased knowledge. Unfortunately, the local NGO in Sarteneja that we had planned to collaborate with on a project to train fishermen in small business management and fly fishing was unable to take on the project. UNDP's Small Grant Programme that is our partner in this activity, however, has identified another NGO in the community that is strong and active. We are investigating the feasibility of carrying out the activity through this NGO in FY06.

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

Strengthening the capacity of the Glover's Reef Advisory Committee (GRAC) continued this year with a half-day training session on co-management, which was led by Dr. Patrick McConney of the University of the West Indies on the 17th March 2005 in Belize City. As the GRAC represents the major stakeholders for Glover's Reef and is the officially appointed committee to assist with management of the reserve, we have been focusing our efforts on strengthening this group. Ten members attended the training, which covered the key concepts, such as the definition of co-management, why and when co-management is a good option, and the factors required for successful co-management, the various types and phases of co-management, the demand for co-management within the region, and its costs and benefits. This session followed up on the leadership and conflict resolution training workshops we held earlier in 2004, focusing discussions on co-management issues, which had been brought up by Committee members during the previous workshops. As part of the training, members completed an evaluation of the status of critical conditions of the Committee in relation to co-management. Most of the concerns identified were legal or institutional. We plan to have another training workshop, in Project Management, tentatively scheduled for October 2005.

The GRAC has continued to meet on a regular quarterly basis over the past year and quorums have been met for each meeting. The next meeting is scheduled for October 2005. Members are located in Glover's Reef, Dangriga, Hopkins, Placencia and Belize City, and meetings are held alternately in Belize City and Dangriga. In January 2005, a special two-day meeting of the Committee was held at the WCS research facility at Middle Caye, Glover's Reef. During the first day, the members were given a tour of the research facility, followed by a regular Committee meeting. On the second day, reserve staff led a tour of the marine reserve for members, and also introduced them to the stakeholders who reside on the atoll.

We serve as the secretariat to the Committee, supplying agendas and minutes of the meetings, arranging meeting logistics, covering travel costs for members, and also distributing related material for meetings such as copies of the reserve's quarterly progress reports and work plans. Over the past year the Committee has reviewed operational plans, progress reports and educational materials. It has also provided specific advice to the Fisheries Department and reserve staff in relation to enforcement issues and fishing regulations, and made recommendations for improving the membership of the Committee. The Fisheries Department has expressed its

approval of the progress the GRAC has made over the last year and plans to use it as an example for the nation's other marine reserve advisory committees.

We have assisted reserve staff in the preparation of a proposal that was submitted to a national funding agency. The proposal was approved and funds for new outboard engines, boat repairs and an observation tower should be granted within the next few months mainly to be used to strengthen patrols and surveillance.

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 handline 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).

To foster a sense of responsibility amongst fishermen for sustaining fisheries, and to ultimately demonstrate the benefits of the no-take or Conservation Zone of the Glover's Reef Marine Reserve in supporting their livelihood, we have adopted a significant system of participatory data collection.

Following completion of a frame survey of the fishing industry of the Glover's Reef Atoll and the subsequent design of a data collection system in mid 2004, the fisheries catch data collection program was launched in February 2005. A technical assistant to WCS who is a former fisherman, a fisherman from the village of Hopkins, and the WCS Assistant Conservation Scientist underwent training in the data collection methodology conducted by the fisheries consultant. Presently, catch data are being collected on site at the Atoll by the Sarteneja fishermen who operate sailboats and fish for conch, lobster and reef fish. Data are also being collected at the landing site on the beach at Hopkins by the fishermen who mainly fish for pelagic species. Morphometric data are also being collected from samples of the catch. The system is working well and eight months of data have been collected. In addition, we are also collecting data from the Fisheries Department, which they gather on a regular basis from the fishing co-operatives concerning their catches of lobster and conch. A custom Excel spreadsheet has recently been developed by our consultant to store and manage the catch data. Analysis will be conducted at a later date and the results then shared with the fishing communities to show how their individual catch data are used in assessing the total catch from the Atoll and to demonstrate the usefulness of catch data in managing their fisheries. The catch data information will also be used in our evaluation study of the management effectiveness of the Glover's Reef Marine Reserve to be conducted later this year.

In June 2005, we held data collection training workshops in the villages of Sarteneja and Hopkins, facilitated by the fisheries consultant and the WCS Assistant Conservation Scientist. For the meeting in Sarteneja, we partnered with the National Fishermen's Co-operative and the Belize Audubon Society, as they were also interested in offering similar training to the fishermen from the nearby communities of Chunox and Copperbank who fish the Lighthouse Reef Atoll. We were therefore able to share our data collection methodology that has been endorsed by the Fisheries Department with our partners and over 50 fishermen. Twelve fishermen and three tour guides participated in the workshop held in Hopkins. The workshops also provided a forum for fishermen to voice their many concerns about the fishing industry and fisheries management. Several key recommendations such as the need to have a special fisherman forum to discuss concerns regarding regulations, the high level of illegal fishing, the need to reduce the number of fishermen, the lack of alternative livelihoods for fishermen, the need for improved demarcation of the Conservation Zone boundaries, conflicts between tour guides and fishermen, etc., were made which we intend to follow up on over the coming months. A report of the fishermen training workshops is attached as Appendix 6.

In order to encourage support from the larger public as well, other educational material produced included pamphlets on the life history of the queen conch and spiny lobster. These were prepared by WCS Researcher

Dr. Charles Acosta and 300 copies of each have been printed. The pamphlets will be distributed to Standard 6 (Grade 8) students in Dangriga, Hopkins and Sarteneja when schools reopen in September. We also designed and painted a mural of the Glover's seascape in the reserve's visitor centre. The mural features the seven seascape species.

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

The formal co-management agreement for the management of the Glover's Reef Marine Reserve amongst the Belize Audubon Society, WCS and the Fisheries Department remains on hold. The moratorium is still in place on all new co-management arrangements for protected areas, as the National Protected Area Policy and System Plan will not be completed and approved by the government until a few months from now.

Although it is currently acting in an advisory capacity to the Fisheries Department in relation to the management of the Marine Reserve, the Glover's Reef Advisory Committee is in theory acting at the basic level of consultative co-management for this marine protected area. The Fisheries Department, however, has indicated its interest in the GRAC assuming more responsibility, increasing its involvement towards more active collaborative management. We are therefore endeavoring to strengthen the capacity of the Committee to assume this increased management role in lieu of the co-management agreement formerly proposed with the Belize Audubon Society.

In relation to informal assistance from the private sector, the landowner of Long Caye is willing to monitor nesting turtles on that island. We have not been able to provide the necessary training yet, however, and expect to make the arrangements for this activity in FY06. Several landowners contributed funds and material to refurbish and equip the reserve's visitor centre. The landowner of Southwest I Caye has contributed mooring buoys, and some of the proceeds from a sport fishing tournament were donated to purchase rope for the moorings. The owner of Northeast Caye has assisted by installing a marker at one of the strategic points of the reserve's boundary and replacing a couple of moorings. A resort on the mainland has also offered to donate picnic tables to the reserve headquarters. This willingness by stakeholders to assist the reserve demonstrates the improved working relationships between users and managers of the protected area.

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.

GRLS staff worked closely with the reserve staff in monitoring fishery-independent size information on the commercially fished species of spiny lobster, queen conch and five selected species of finfish, namely Nassau grouper, black grouper, hogfish, mutton snapper and queen triggerfish, collecting three rounds of LAMP (Long-term Atoll Monitoring Program) data in October 2004, and March and May 2005. Information has therefore now been collected over a period of a year. Conductivity, salinity, temperature, and depth are also measured. The data, which are collected in both the Conservation and General Use Zones, have been entered in the database provided by Dr. Acosta and shared with the Fisheries Department and CZMAI. Analyses will be done over the next couple of months and presented to Fisheries. The LAMP also contributes to the monitoring of two of our seascape species, the queen conch and the Nassau grouper.

Dr. Tim McClanahan also continued monitoring the health of the coral reef communities of Glover's Reef this past year, comparing various indices between the General Use Zone and the Conservation Zone, including number of species of hard coral, algae, and fish, herbivory, percentage of algal and coral cover, and fish density.

The results of data collected over the past 6 to 8 years appear for the most part inconclusive, with the exception of fish density where numbers for most species are higher in the Conservation Zone. Further analysis, however, is required. Examples of the graphs can be seen in Appendix 3.

GRLS staff, along with the Glover's reserve biologist, the marine biologist from the Belize Audubon Society (BAS), and two fishermen from Hopkins, monitored the spawning site at Northeast Point on Glover's during the full moon in January 2005. They observed approximately 2,200 Nassau groupers, an increase of 500 over the previous year's count of approximately 1,700. They also investigated the spawning sites east of Long Caye and Middle Caye.

During this time, GRLS staff were able to join Enric Sala's team of researchers in monitoring the Northeast Pt. site and the Tiger grouper spawning site off Southwest Caye. The data collected have been entered in the national spawning aggregation (SPAG) database, developed by the SPAG Working Group and managed by the CZMAI.

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.

Several lessons have been learned in applying the approach to a marine site. In contrast to terrestrial species, many marine species, such as the Nassau grouper, have a wide range of habitat requirements due to the varied stages of their life history. This presents a challenge when building conservation seascapes for marine species. In addition, determining potential carrying capacity of the Atoll for different life stages - such as for grouper juveniles - is very difficult, as not much is known about how many juvenile groupers are required to result in a viable breeding population. Another challenge has been dealing with species, such as the Caribbean reef shark, that live mainly on the boundaries of the reserve. These lessons are informing the Landscape (Seascape) Species Approach as it is being applied in other marine systems around the world.

Generally, one of the most important lessons learned has been the importance of collecting spatially explicit data. Mapping data that are linked to specific locations helps improve site management and also ensures that monitoring of conservation targets is accurate and meaningful. There is a dearth of such information in Belize, both for terrestrial and marine habitats. We are now very conscious of this shortcoming, and with the use of GPS technology we are striving to ensure that the majority of the data we collect are geo-referenced.

Janet Gibson, the GRLS director, attended the LLP annual meeting held in May 2005. This provided the opportunity to share experiences gained in applying the approach at twelve different sites around the globe, and to learn more about designing conservation landscapes/seascapes and setting population targets. Gibson was also able to share her experience in developing a monitoring framework for the Glover's seascape, which has been used as the prime example in a technical manual of the WCS' Living Landscape Program entitled *Measuring our effectiveness: a framework for monitoring*. The framework is linked to the conceptual model and provides details on the activities, indicators and targets for each of the interventions, threats and conservation objectives in the model. It has been very useful to monitor progress of the program and to develop annual work plans more explicitly linked to our overall project goal.

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

LLP and GRLS staff were able to share the threats assessment process, as described in the Human Activities Assessment Technical Manual, and lead joint workshops with the Belize Audubon Society and the World Wildlife Fund for Lighthouse Reef and the Belize Barrier Reef, respectively. The resulting threats maps, along

with the ones developed for Glover's Reef and the Turneffe Islands the previous year, were shared with the National Protected Area Policy and System Plan project. They were also shared with the World Resources Institute (WRI), which has developed a Coastal Data CD for Belize, along with a Coastal Data Atlas. WRI has recently completed a 'Reefs at Risk' project for the Caribbean and is currently working on one specifically for Belize. This organization uses scientific data and modeling to develop its threats or risk maps. In contrast, our threats maps had the input of a cross-section of stakeholders, including local users who are often ignored. As mentioned earlier, we also trained members of the Belize Audubon Society and National Fishermen Cooperative in the fish catch data collection.

Further afield, the Species Selection software developed by the LLP and the Glover's Reef example were distributed to a researcher from Biotropica (Centro de Investigacion y Conservacion de la Biodiversidad Tropical), an organization working on cetaceans in Margarita Island, Venezuela. Biotropica, along with marine experts from the marine biological station at Margarita (EDIMAR), has applied the Approach successfully in designing a marine sanctuary, with cetaceans as the flagship species. Furthermore, the researcher plans to use the Approach as part of his Masters thesis on the marine ecosystem of the Golfo Dulce in Costa Rica. We are pleased to have piloted the use of this approach, and to see it used as a tool by others.

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 program 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 that encompass a diverse array of ecological characteristics, land-uses, resource-use issues, and jurisdictional arrangements. To develop new approaches, facilitate and harmonize testing and implementation among these core sites, and capture the synergistic benefits of diverse experiences, a central coordination unit is charged with designing and managing the program. This unit guides the development of landscape-scale conservation 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 FY 2005, the Coordination Unit accomplished most of its planned programmatic, technical, and administrative goals. The CU worked with field sites to design conservation landscapes for the Glover's Atoll, Maya Biosphere, and Madidi sites (design for the Eastern Steppe of Mongolia will be completed in FY06). CU staff refined and simplified the process for selecting landscape species, including development of software as a decision-support tool for analysis. The concept and rationale for using landscape species to focus conservation planning and monitoring at a landscape scale was disseminated to the conservation community through a peer-reviewed publication.

Activity 4.1 Provide technical assistance to site-based conservation

Members of the WCS/NY Coordination Unit worked closely with field sites to provide targeted technical input (help desk, and informal and formal training) throughout the year. In some cases this involved trips to sites as reported in the previous section of this report.

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

Activity 4.2.1 Living Landscapes Program Technical Manuals

The Living Landscapes Program produced two new brief how-to guides, called Technical Manuals, after field testing and fine-tuning the methods at several WCS/BCLS field sites: one concerning participatory spatial assessments of human activities, and another one focusing on how to build conceptual models for a project. The manuals were also translated into French and Spanish, distributed to field staff, and made available on our website for wider use. We responded to requests from program staff of TNC, WWF and AWF and distributed copies of the threats assessment and conceptual modeling manuals, each of whom now have projects that have applied these techniques in the field. We have also made available our bulletins (brief conceptual guides on strategic approaches and tools) and technical manuals for the USAID Mission and Washington staff during their Agriculture, Environment and NRM training held in August 2005. These were enthusiastically received. In addition, we have written three additional manuals that are currently in review and will be published within the next few months. The three draft manuals are: Developing a monitoring framework from conceptual models; Building biological and human landscapes; and conducting household surveys. Enthusiastic uptake of the LLP bulletins and manuals continues to demonstrate the utility of the lessons we are learning under BCLS and are sharing with the larger conservation community.

Activity 4.2.2 Landscape Species Approach progress

4.2.2.1 Landscape Species Selection Software

Revisions to the landscape species selection software were completed, and version 2.0 was released and distributed to BCLS sites, other WCS sites, and conservation practitioners at large. The new version includes refinements of criteria used to rank candidate species for selection (e.g., heterogeneity of habitat use), provides more user-control of selection criteria, and includes an overhaul of the process of selecting species to maximize their complementarity.

4.2.2.2 Conservation Landscapes

As one of the priorities for this year, LLP staff worked closely with sites to design conservation landscapes that map conservation priorities within larger, undefined landscapes. During the last Living Landscapes Program Annual meeting, presentations were given from 7 sites where staff have conducted a preliminary round of designing conservation landscapes (Ndoki-Likouala (Congo); Madidi (Bolivia); Northern Plains (Cambodia); Adirondack Mts (NY-USA); Glover's Reef (Belize); Madison R. Valley (MT-USA); and Maya (Guatemala). For each, identification of priority areas within the landscape was based on: (1) spatially-explicit needs of selected landscape species (biological landscapes), and (2) mapped threats (human landscapes). Analytical methods for determining a set of priority lands that are sufficient for long-term conservation, while efficiently addressing threats, were described using several different methods, including MARXAN and C-Plan software. We were therefore able to compare such methods, and will be applying these to further landscape designs. Decisions were also made on population target levels that should be incorporated into final analyses, aiming at a minimum for populations that are demographically sustainable. Plans for finalization of conservation landscapes have been outlined for each of the 7 sites over the following year.

4.2.2.3 Testing the landscape species approach

Ad hoc assessments to-date have informed us that field projects use the Landscape Species Approach (LSA) tools with some variation, depending on the circumstances at different sites. Some have dedicated a great amount of time to landscape species selection and have done threats assessment with wide participation, while others have carried out both these exercises within a relatively short amount of time and with a handful of project staff. We would like to be able to draw some principles from these variations and be able to advise others on the utility of the approach, its individual steps, and the conditions under which it may or may not provide advantages to conservation.

With this in mind, LLP has engaged non-LLP WCS staff to work with us (both field-based and central) in reviewing the use of LSA at twelve sites that constitute the core LLP portfolio (including all BCLS/GCP sites – both past and present), and in assessing users’ and other WCS’ staff perception of its utility for site based conservation. The assessment will mainly be questionnaire based with some follow-up interviews with field staff. LLP intends to use the findings to better adapt our program and LSA tools for site-based planning. This assessment has begun, and will be completed in the first half of FY06.

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

Activity 4.3.1 Living Landscapes Program Annual Meeting

The Fourth Annual Meeting of the Wildlife Conservation Society’s Living Landscapes Program (LLP) took place from May 24- June 1, 2005 in Ruaha River Lodge, Ruaha National Park, Tanzania. A total of twenty-five WCS field and New York-based staff attended the meeting, including representatives of all but one of the BCLS/GCP-funded sites² and from other WCS regional programs (Marine and Africa). Participants spent five days in a formal meeting setting and one day on a project field trip. In addition to continued group work on LSA tools, the group spent significant time discussing field topics identified both prior to and during the meeting. Topics included those centering on local socio-economic contexts (community-based wildlife management, addressing socially diverse landscapes, economic incentives as conservation tools, measuring the impact of outreach efforts), power & governance issues (dealing with national political instability, analysis of stakeholder power relationships), zoning as a conservation tool, and economic valuation of natural resources/wildlife. In addition to sharing experiences, ideas and perspectives on each topic, we agreed to distribute contacts and/or relevant literature as a follow-up to many of the discussions. Particular interest was raised in conducting stakeholder power analyses and economic valuation of ecological goods and services, and possibly undertaking direct payments to communities for conservation compliance. Report of the meeting has been distributed to meeting participants, and is available upon request.

Activity 4.3.2 CMP: leadership, design, writing and audits

David Wilkie and Craig Groves continued to represent WCS within the Conservation Measures Partnership. Groves and Wilkie contributed directly to the analysis of lessons learned during the pilot audits conducted in FY04-05 and are currently helping to draft a protocol for conducting multi-partner peer-reviews of conservation projects. Wilkie worked closely with other CMP partners to assess the feasibility of developing software to guide field staff through the steps in the ‘Open Standards’ for conservation planning and adaptive management. This CMP activity resulted in development of a business plan for software development. Wilkie and Groves will continue to provide technical guidance as tool modules are developed for the Adaptive Management software. The eAdaptive Management software is an attempt to integrate best-practices of conservation planning into a simple to use software package. The software will guide practitioners through the steps in effective planning and project adaptive management and provide a system for tracking conservation progress over time. WCS staff worked with TNC to ensure that our institution process for cataloging our field projects is compatible with the TNC Project Inventory website. In the next 3 months, WCS will complete a review of WCS efforts to implement activity-based cost accounting within the Gabon and Bolivia programs. This review is eagerly anticipated by a number of donors, including the USAID Congo Basin Forest Partnership program.

Activity 4.3.3 Cross-organizational Learning Initiative

At the beginning of September, the Landscape Ecologist and socio-economic monitoring specialist participated in a multi-partner workshop organized by WWF on Landscape Planning. They presented the Landscape Species

² The following BCLS/GCP sites were represented: Ndoki-Likouala (Congo); Yasuni (Ecuador); Eastern Steppe (Mongolia); Glover’s Reef (Belize); Maya (Guatemala). Madidi (Bolivia) was not represented due to insecurity problems in Bolivia prior and during the meeting.

Approach and participated in the process of applying different landscape planning tools, used by the different NGO partners, to the Samburu Heartland in East Africa.

4.3.4 Synthesis of Lessons from site-based conservation

4.3.4.1 Local engagement in conservation survey

After testing the survey design for the study on engaging local people to promote effective conservation of wildlife and wildplaces, the survey instrument was refined and finalized. Completion of the survey has been postponed for late 2005, and will be completed during the first quarter of 2006. Analysis of the survey results will be compiled and written up for publication in a peer-reviewed journal and as an LLP bulletin that outlines a set of guiding principles for engaging local people in conservation.

4.3.4.2 Survey of “protection” as a conservation strategy at sites

The WCS Maya Biosphere Reserve Project conducted the survey of protection measures used by a number of WCS sites. However, response rates were limited, and due to other pressures at the project site, the finalization of the survey results analysis has been postponed until FY06.

4.3.4.3 Preliminary assessment of the human welfare impacts of establishing national parks (Parks and People project)

With funding provided by the John D. and Catherine T. MacArthur Foundation, LLP staff in collaboration with the WCS Gabon program and the Ministry of Forest Economy in Gabon conducted a baseline household welfare survey of 1,000 households living close to the borders of 4 national parks in Gabon, and an additional 1,000 control households living outside the influence of the parks. This survey is the first of three surveys planned over the next 5 years to assess the income, health, consumption, natural resource use, and family function impacts of establishing protected areas on local families. Results of the baseline survey will be analyzed within FY06 and will allow us to assess the role that market access plays in the welfare status of families proximal to and distant from the parks. Additional funds were secured from the National Science Foundation to support the Gabonese social science teams working on the Parks and People Project, and to assess the role that individual time preference (discount rates or patience) plays in investment in health care, education, savings, and sustainable use of natural resources. An article on the Parks and People project was accepted for publication in *Conservation Biology*.

Activity 4.4 Application of Living Landscapes Program tools beyond core sites

4.4.1 Training workshops in the use of LLP tools

Staff conducted a number of workshops to train field practitioners in the use of conservation planning tools throughout the year. In addition to holding in-service WCS training workshops on building conceptual models for conservation projects and using these as the foundation for monitoring conservation success, staff held such workshops for project partners in Madagascar (May 2005) and Gabon (March 2005).

In response to increasing demand for training in the conservation tools, the socio-economic monitoring specialist also ran a training of trainers workshop for WCS directors and program managers in August 2005. As demand for training opportunities exceeds the staff time available in LLP, we envision that participants from these workshops will in turn train and work with field staff and partners in different parts of the world. Such staff will be able to follow up with post-workshop support to interested partners, e.g., protected area staff in Madagascar and Gabon.

4.4.2 The World Conservation Congress

As part of the World Conservation Congress in Bangkok, Thailand in November 2004, the program director led a symposium titled “Applying Ecosystem Management for Biodiversity Conservation: A Wildlife-focused Approach”. The aim of the symposium was to draw out principles and, using case studies, outline the utility of wildlife-focused strategies and management that are integrated within complex environments of human influence. Emphasis was placed on current work from active conservation initiatives, and included a case-study presentation from the Madidi, Bolivia project – a USAID/EGAT funded project. The workshop was well-attended, and highlighted the value of wildlife targets for landscape-scale conservation planning and management.

Activity 4.5 Ensure coordination and communication services for the program

LLP Coordination Unit staff periodically met 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. The Outreach Coordinator and others continued to meet with collaborators, NGOs, governmental officers, and representatives of other stakeholder groups to promote use of BCLS-derived strategies and tools, to assess their utility, and to determine whether additional tools would be of use to field practitioners.

CU staff worked with field staff in the preparation and review of annual reports and implementation plans. The CU staff also organized the annual GCP meeting in May 2005 where we presented the Landscape Species Approach and project cycle used by WCS. We feel that this was a particularly focused and useful GCP meeting.

III Appendices

1. Biological, Human and Conservation Seascapes
2. General and Seascape Species Specific Conceptual Models for Glover’s Reef
3. Coral Reef Ecology Graphs – Dr. Tim McClanahan
4. Glover’s Reef Marine Reserve brochure
5. Reports of Fishermen Training Workshops