



# **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 2006 – September 2007**

Living Landscapes Program- Belize/Glover's Reef  
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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 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 achieved most of the activities planned for this reporting period. The conservation strategy has been drafted, and will be refined and continually adapted as we learn from implementing our activities and from monitoring our progress. For each of our Seascape Species, we developed Conservation Seascapes that are integral to the conservation strategy document. We also made good progress on environmental monitoring, training and management planning.

#### **Training and capacity-building**

In FY07, we held a workshop for the Glover's Reef Advisory Committee (GRAC) in group dynamics, which complemented the previous training offered in leadership and conflict resolution. The Committee continued to meet on a quarterly basis and to supply recommendations, on topics such as enforcement and limiting access to fishing, that are being incorporated in wide-ranging policy decisions by the Fisheries Department. Working along with the GRAC and the reserve staff, we also completed a new management plan for the Glover's Reef Marine Reserve and the first draft of a set of best practices for the cayes of the Atoll. These best practices for the cayes of the Atoll are the cornerstones of the conservation strategy for the Glover's Reef Living Seascape, which takes a holistic approach and integrates the marine and terrestrial environment.

In partnership with the Fisheries Department, The Nature Conservancy (TNC) and Friends of Nature, we led a training workshop at the Glover's Reef Research Station in the spawning aggregation monitoring protocol for reserve biologists. We also arranged a Divers Alert Network (DAN) oxygen provider training course for members of the spawning aggregation monitoring teams.

In May 2007 we arranged for WCS turtle expert Dr. Cathi Campbell to provide training to interested caye owners, marine reserve staff, and WCS and Research Station personnel in the monitoring of nesting sea turtles. Dr. Campbell also trained WCS and reserve staff to conduct in-water turtle surveys and to tag turtles.

From March to June we carried out training for several fishermen in Sarteneja and Hopkins in the use of marine radios and GPS units, conducting training on a one-on-one basis in these villages and at sea. Educational activities completed included: revision and airing of the TV 'spot' on spawning aggregations on both television and national radio; development and printing of a Nassau grouper poster highlighting the catastrophic decline in the number of spawning adult fish; preparation of a Spawning Aggregation newsletter targeted mainly towards fishermen; and preparing and mounting a display at the University of Belize's Earth Day celebration. Two fishermen from Hopkins who traditionally fish at Glover's were hired to assist in the monitoring of the Northeast Point Nassau grouper spawning site in January and February 2007 and at the Long Caye mutton snapper spawning site in July 2007.

### **Monitoring**

We continued the fisheries catch data collection program with over 80 fishermen from Sarteneja and Hopkins participating. This program is revealing important information regarding the status of conch, lobster and finfish fisheries.

We collected four sets of data under our Long-term Atoll Monitoring Program (LAMP); we now have a total of 12 datasets since we initiated the program in 2005. The results of our analysis of the data for 2005 and 2006 were presented at the University of Belize's first Natural Resources Conference held in May 2007.

We are pleased to report that in May 2007 we initiated our sea turtle monitoring program with the assistance of Dr. Campbell, WCS turtle expert. We are focusing primarily on the endangered hawksbill turtle, which is one of our Seascape Species. Training in monitoring of turtle nesting activity was provided to reserve staff and two resort owners, who are presently collecting and recording data using the data sheets supplied by WCS. To date, three turtle nests have been recorded at Long Caye, and one nest has hatched successfully. The first in-water survey, conducted in partnership with marine reserve staff, was also carried out in May 2007. The results show that the Atoll is undoubtedly an important foraging area for juvenile hawksbills, as we observed 29 juveniles of this species during 11.5 hours of survey time. We also tagged eight hawksbills.

In addition, we started systematic monitoring for another seascape and keystone coral reef species, the long-spined black sea urchin, *Diadema*. We partnered with a sea urchin expert from the University of Belize, Dr. Leandra Cho-Ricketts, and two of her students to conduct surveys of this important herbivore on the reef. Transect surveys were completed in March and May 2007, and preliminary results show that urchin densities remain low on the Atoll, although there are signs of recovery in some locations.

### **Management and Planning**

Three important planning documents for marine reserve management were developed during this project period: a comprehensive revision of the reserve's Management Plan, a draft of Best Practices for the Cayes of Glover's Reef, and the draft of a basic Business Plan for the marine reserve.

The new Management Plan, the first for a marine reserve that conforms to the guidelines of the National Protected Area Policy and System Plan, has been formally presented to the Fisheries Administrator for approval. The plan should greatly assist the reserve in prioritization of their management activities and in keeping the fulfillment of the objectives of the marine reserve on track. The Best Practices for the Cayes provide a valuable set of guidelines for the caye and resort owners to follow and help to ensure that their development plans are compatible with conserving the fragile environment of the coral atoll. The Business Plan sets out some simple recommendations to help the marine reserve to move towards greater financial sustainability.

### **Core strategy**

We made considerable progress this year in finalizing the Conservation Seascapes for all seven of our Seascape Species: hawksbill turtle, Nassau grouper, Caribbean reef shark, star coral, queen conch, *Diadema*, and osprey. With the assistance of Dr. Samantha Strindberg of the WCS Living Landscape Program, we refined our habitat suitability index models and created new models for current abundance, target abundance, conservation impact and benefit-cost (using both threats and a cost index) for all species. The Conservation Strategy document has been drafted and will be finalized in conjunction with the Glover's Reef Advisory Committee (GRAC) in the next reporting period.

## **b. Highlights**

- **Initiated new monitoring programs for two seascape species**

During FY07, we launched monitoring programs for two of our seascape species: hawksbill turtles and *Diadema*. Although not many hawksbills have been recorded nesting at Glover's Reef, we suspected that the atoll was an important foraging area for juveniles. The results of our first in-water survey confirm that the atoll provides important foraging habitat for this highly endangered species. As every nest is important to the conservation of this species, we are pleased that we have been able to recruit two resort owners on the atoll to assist in the monitoring of nesting activity on their islands.

We are also very pleased to have forged a potential long-term partnership with a professor from the University of Belize in the launch of our monitoring of the long-spined black sea urchin, *Diadema*, at Glover's Reef. This species is an extremely important herbivore, which experienced a die-off throughout the Caribbean in the late 1980s due to disease. We are monitoring the comeback of this urchin at Glover's Reef, hoping that it will soon reach its earlier normal densities, and that its recovery will in turn lead to higher coral cover on the atoll.

- **Improved management planning framework for the Glover's Reef Marine Reserve**

Improved management of the Glover's Reef Marine Reserve is one of the major goals of our work. Stronger management depends to a large extent on having good, sound plans and we assisted this effort by supporting the revision of the management plan. The plan includes six management programs, which cover natural resource management, research and monitoring, community participation, public use, infrastructure, and administration. The plan lays out clear actions and recommendations for each program. We also supported the development of a Business Plan, which outlines straightforward actions that can help to make the marine reserve more financially sustainable, a challenge for most marine protected areas. In addition, we are working with a team of consultants to prepare Best Practices for the Cayes of the atoll, working closely with the landowners and the GRAC. These Best Practices will complement the overall management plan, and address concerns such as vegetation clearance, impact of activities on nesting sea turtles, waste disposal, and energy use. All three planning documents address threats identified by our conceptual models, including weak management, insufficient planning guidelines, and lack of sustainable financing. They also constitute part of the recommendations for priority actions included in our Conservation Strategy.

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

We continued to provide support to the Glover's Reef Advisory Committee (GRAC), which met on a regular quarterly basis during this period. The Committee's recommendations have served as the catalyst for the Fisheries Department to develop an enforcement policy that is almost completed, and to discuss the controversial matter of limiting access to fishing at certain sites. The Committee has been trying to determine the most efficient way to introduce limited fishing access to the Glover's Reef Marine Reserve and has made a recent recommendation to the Fisheries Administrator that is presently under consideration. On the recommendation of the Committee, a fisherman from Sarteneja has been appointed to the Committee and he has been a very active member. In fact, at the last meeting he reported that the Sarteneja fishermen would be willing to stop fishing for Nassau grouper if they could be granted special licenses to fish the atoll. The GRAC is proving its effectiveness as a mechanism for genuine stakeholder participation in the management of their resources.

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

In partnership with WCS Station staff and marine reserve staff we monitored the Nassau grouper spawning aggregation at Northeast Point, Glover's Reef. WCS also hired two fishermen from the village of Hopkins, who formerly fished this bank, to assist with the monitoring to ensure their involvement. Sadly, as at counts made at the other spawning aggregation sites around the country, the counts of Nassau grouper were alarmingly low at Northeast Point – only 500 were recorded during the January spawning season and 800 in the February season. In response to the declining numbers

of spawning groupers, the National Spawning Aggregation Working Group (led by WCS in its role as secretariat) has drafted several recommendations for additional measures to be instituted, including the introduction of a moratorium on the fishing of Nassau grouper and a ban on spear fishing within marine reserves. Importantly, the two fishermen representatives in the Working Group are supportive of the measures being proposed.

- **GCP Collaboration**

During FY07 we have collaborated on several activities with our international partners. We have worked closely with The Nature Conservancy (TNC) in our work with Spawning Aggregation Working Group, particularly in relation to the development of the database, the Nassau grouper posters, and the broadcasting of the TV spot. We printed the poster in English, and TNC printed a Spanish version. We shared the costs of broadcasting the TV spot, with WCS, TNC and WWF each assuming responsibility for the broadcast for one month, thus covering the major spawning period of three months.

We also collaborated with WWF in the reef monitoring of Glover's Reef. WWF led a nation-wide monitoring program to assess current reef health, using the AGRRA (Atlantic and Gulf Rapid Reef Assessment) methodology. WCS contributed to the effort by monitoring the 15 sites on Glover's Reef.

### c. Table of Activity Status

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<b>Objective 1</b>	<b>Develop and adopt a participatory strategy to reduce threats to marine life in the Glover's Reef seascape</b>		5
1.1	Complete threats and stakeholder analyses	Completed	5
1.2	Complete a Seascape Species Analysis	On track	5
1.3	Identify high priority interventions	On track	7
<b>Objective 2</b>	<b>Develop and implement sustainable and adaptive mechanisms to strategically address threats across the seascape</b>		8
2.1	Implement Seascape Conservation Strategy	On track	8
2.2	Provide technical support and training	On track	10
2.3	Strengthen and expand stakeholder support for the Seascape Conservation Strategy	On track; with exception of training for fishers in Reef Check which is now scheduled for 2008	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 is scheduled for late 2007	13
<b>Objective 3</b>	<b>Learn and teach best practices in the Glover's Reef Seascape and beyond</b>		15
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<b>Objective 4</b>	<b>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</b>		16
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4.4	Application of Living Landscapes Program tools beyond core sites	On track	21
4.5	Ensure coordination and communication services for the program	On track	22

## **II. Detailed Description of Progress**

### **a. Key short and long-term program objectives for the reporting period (October 2006 – September 2007)**

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 have continued to refine the conservation seascapes of our seven seascape species, using the best data available and incorporating the results of our monitoring programs. With the completion of these seascapes, we drafted the final conservation strategy document, which will be finalized in the coming year. Activities over the past year have included: collecting data through our various monitoring programs and sharing the results with our partners, training in monitoring techniques, providing support to the GRAC and to the Spawning Aggregation Working Group, and providing support to the marine reserve particularly in management planning.

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; conduct training for reserve rangers in an effort to strengthen enforcement capabilities; conduct training sessions for fishermen in monitoring and for our partners in data analysis and interpretation; implement an alternative livelihood activity for Hopkins fishermen; 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 FY07 we have made great progress in refining the methods used to create the Conservation Seascapes and in considering costs and benefits in order to strategically intervene to have the greatest conservation impact. We did not use the MARXAN software to create the models of the Conservation Seascapes, as was previously done for three of the target species. Instead, for each of our seven Seascape Species, the process was refined to incorporate the following steps and to create:

- A habitat suitability index model that describes the relative suitability of each habitat type for a particular species and hence reflects the potential distribution (potential Biological Seascape) for that species in the absence of threats.
- A cumulative threats model (Human Seascape) that is an aggregate representation of all the human activities that change the distribution or abundance of the target species. This is used as a proxy for cost with high threat representing high cost.

- A current abundance map, which is derived by transforming the potential biological seascapes into units of abundance based on the best available empirical data from monitoring activities.
- A target abundance map, which is derived by transforming the potential biological seascapes into units of abundance based on our own monitoring data or published information on densities expected in a healthy or viable population.
- A conservation impact or seascape model, derived from the target abundance map minus the current abundance map.
- A cost map according to threats (species-specific) and a cost map according to conservation costs (mainly costs of enforcement which are not species-specific).
- A benefit-cost map for each type of cost map obtained by dividing the potential conservation impact by the cost.

The maps corresponding to these models for each species are shown in Appendix A1.

One of the key refinements in the application of the Landscape/Seascape Species Approach was the process of setting Population Target Levels (PTLs) in order to evaluate whether our conservation actions are effective and we are moving towards those targets. In the instance of the Glover's Reef Living Seascape, for those species which are fished, the target levels reflect the resource use requirements of the local communities that rely on fishing for their livelihoods. Hence, for fished species such as Nassau grouper and queen conch the current and target abundance levels reflect the realities of a seascape comprising both general use and conservation zones (where the latter can act as a source to help replenish the remainder of the seascape). In fact, the current abundance of some species may be so precipitously low that the current conservation zone may not be adequate to reach the desired target levels (e.g., Nassau grouper numbers are estimated to be 800 spawning adults from the maximum count obtained during the February 2007 spawning aggregation survey, and a target abundance of at least 10,000 spawning adults is desired). For these species, a change in zoning or in the fishing regulations themselves may be required to save them (and their ecological function). The umbrella role of these species also ensures that the threats posed to other species (for example, to parrotfish by fishing) are also appropriately addressed.

Another innovation was to model the potential conservation impact that contrasts the difference between current and target abundance. This highlights the areas that must be targeted in order for us to have the greatest impact and is key to strategic conservation planning. The next step was to consider costs, of time and money, to reduce threats through our interventions. We considered two options for representing costs, namely: (a) the level of threat (assuming highly threatened areas may be the most expensive to conserve); and, more realistically, (b) an independently derived cost index map that reflects the cost of conservation. We subsequently derived benefit-cost models by dividing the potential conservation impact by each of the cost models. These models define, for each species and in a spatially explicit manner, where the highest potential conservation impact can be obtained at the least cost.

Taking the queen conch as an example, by transforming the potential biological seascape using current densities estimated from our monitoring data, the total population of adult conch on the atoll is calculated as approximately 551,245. The target abundance, based on the density of a healthy adult population as provided by the Healthy Reef Initiative, is 5,378,304 conch. We can see, therefore, that the target population is about 10 times more than the present population of conch on the atoll. Thus, by setting explicit targets and contrasting the current abundance to that target abundance we can more clearly see the huge amount of conservation work required to improve conch numbers.

Looking at the conservation impact map, and the related cost maps, we note that the northeast corner of the atoll and the eastern portion of the Conservation Zone are particularly important for conch. Based on the cost of conservation, however, it would be more cost-effective for management efforts to be concentrated on preserving the conch in the Conservation Zone.

The Conservation Seascape describes where the priorities for conservation work are within the seascape, in the context of the potential conservation impact maps, the PTLs, and the costs of doing conservation. The series of seascape models shown in Appendix A1 inform the Conservation Seascape and are integral to the Conservation Strategy document that will be finalized in conjunction with the GRAC. The Living Seascape planning approach we have applied to Glover's Reef will be focused on the selected seven seascape species; by protecting populations of these species we hope to

conserve all species and habitats in order to preserve the atoll's diversity and productivity. Furthermore, by focusing conservation actions on key threats, we will be allocating scarce conservation resources more efficiently.

### **Activity 1.3 Identify high priority interventions**

As mentioned in previous annual reports, our high priority interventions have been identified, as shown in our master conceptual model and also the models prepared for our suite of seascape species. Over the past few years, we have been making progress in implementing many of these interventions, which we report on under objective two.

The Conservation Strategy was drafted according to the outline prepared during the previous reporting period. The document will be adopted as a product of the Glover's Reef Advisory Committee (GRAC) and chronicles the results of the planning process we have followed. This process has included the threats assessment, development of the conceptual models that depicts the links between the priority interventions and the threats, the Seascape Species selection approach, and the Conservation Seascapes that represent the intersection between the Human and Biological Seascapes- all culminating in the final product: the Conservation Strategy that comprises our recommendations for strengthening management of the outstandingly biologically diverse seascape of Glover's Reef. The Strategy document also includes a section on the importance of monitoring and evaluation. It will be reviewed by the GRAC and other key partners and organizations such as the Belize Tourist Board, the Department of Environment, the Forest Department and the University of Belize in the coming reporting period. Amendments and additions resulting from the review process will be incorporated in the final version. The report will then be printed and distributed to the many stakeholders of the Atoll reserve. We hope that the Strategy will be adopted by the GRAC and the reserve management team as their guide for prioritizing the activities that need to be implemented to effectively conserve the Atoll's biodiversity and productivity into the future.

A notable achievement was the revision of the management plan for the Glover's Reef Marine Reserve (Appendix A2). The management plan, although originally completed in 1988 and revised in 2003, was out-of-date and a management effectiveness evaluation recommended that the plan be updated. The new plan was developed in consultation with the GRAC and many other stakeholders. It is the first plan for a marine reserve that conforms to the management planning guidelines set forth in the National Protected Areas Policy and System Plan. Importantly, the section on Conservation Planning incorporates a summary of the results of our Living Seascape planning process, including our conceptual models, threats assessment, seascape models, and prioritization for conservation action. The plan also includes the results of our management effectiveness evaluation and socioeconomic studies. The new plan describes six main management programs and outlines objectives and activities for each program. This management plan has been formally submitted to the Fisheries Administrator for approval.

We have almost finalized the Glover's Reef GIS database, which is now online as a 'working document'. The database was created in order to make available any spatially explicit data of past and current research activities carried out, thereby maximizing the impact of research by facilitating collaboration between researchers and communicating research to resource users and managers. The three main categories of data are: biological data, physical parameters (such as temperature, bathymetry, currents, habitat) and metadata, which includes information on the data such as the author, project name, date, etc. For example, the database currently contains some of the LAMP data, and in the future other monitoring data will be added. The database needs to be updated on a regular basis and gaps in the information need to be addressed. In addition, several improvements need to be made to the site. Nevertheless, it is a valuable tool that documents some of the research and monitoring projects that have taken place on the atoll. The GIS database can be viewed at <http://programs.wcs.org/gloversreef>.

**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**

We continued our partnership with SWEET (Sarteneja Wildlife, Environment and Ecotourism Team), the local NGO in Sarteneja, providing a small grant to help consolidate our earlier project with the group (training fishermen and other villagers to become tour guides). SWEET is a grassroots community-based organization composed of villagers such as teachers and fishermen. As part of the previous project, a series of workshops were held to plan for tourism development in the village. As a result of this process, participants identified the need for training in basic computer skills and for forming a Sarteneja Tour Guide Association. The Association has been formed and legally registered, and has a core membership of 29 villagers. Our follow-up project addresses the need for computer training, which should help the newly trained guides and their families by giving them the means to market their services and to receive bookings. This focused on equipping SWEET with four desktop computers, two printers, associated software, cables, a wireless router, etc. The project also provided training for 24 participants in computer literacy, focusing on the use of Word, the Internet, and e-mail. All participants, 22 fishermen and two women, had taken part in the tour guide training program. The SWEET center is open for the participants to use the computers, and many have made use of this access to advance their skills beyond the first computer course. Most participants have set up email addresses. Discussions have taken place on website content, and SWEET members and tour guides have assisted with the development of the structure of the SWEET website, the photographs to be used, and the text. The marketing site will be added as a sub-site on the SWEET website. A copy of the report on the project with SWEET is included in Appendix A3.

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. We hope that our projects are assisting in providing a viable alternative to fishing activities (ecotourism); thus making their livelihoods more secure while reducing the fishing effort at Glover's Reef. A video with target audience villagers and possible donors was developed recently as part of a parallel activity that shows the need for alternative livelihood skills training projects such as this one, and the impacts they have had in Sarteneja.

We again hired two fishermen from Hopkins to assist with the monitoring of the spawning site at Glover's Reef in January and February 2007. These fishermen used to fish the spawning bank, so offering them this job helps to offset some of their losses in foregoing fishing at the site. At the same time they are becoming very knowledgeable about the monitoring program and the decline in numbers of Nassau grouper at the site.

**Support to the Spawning Aggregation Working Group**

The National Spawning Aggregation Working Group continued to meet regularly over the project period, holding six meetings between July 2006 and August 2007. The Committee implemented most of its annual work plan: coordinating the monitoring teams, promoting dive safety, conducting training, finalizing the web-based database, and carrying out public awareness activities (described below). WCS provided the secretariat for the Group, organizing meetings, preparing the agenda, writing and distributing minutes, and supplying documents for meetings. During FY07 we successfully improved representation of fishers on the Working Group by the addition of Mr. Carlton Young Sr., a well-respected patriarch fisherman from the Placencia Fisherman Co-operative, as a member. Mr. Luke Nunez, the Chairman of the newly formed Hopkins Fisherman Association, has also joined the Group. Both fisher representatives should be instrumental in strengthening our outreach efforts targeting the fishing community. The web-based database initiative has been led by the Nature Conservancy over the past year. The final training for members of the Group was led by the TNC consultant on the 19<sup>th</sup> June, and the web-based database is now up and running. All of our data for the Glover's Reef sites have been entered in this database, and other members are currently inputting their data for the other spawning

sites. Once this process has been completed, we plan to generate reports from the database that will help to guide management of the sites.

### **Public Awareness and Education**

Several public awareness activities were carried out in collaboration with the Working Group during FY07. We revised the TV 'spot' to include a brief statement from patriarch fisherman and Fisheries Advisory Board member, Mr. Carlton 'Jack' Young, Sr. TNC and WWF also helped to cover the cost of the broadcasts, which occurred on local television during the three main months of the Nassau grouper spawning season. . We provided copies of the TV spot on DVD to several Group members, who arranged to have it shown on the local cable networks in their respective communities. We also aired the spot on radio during February and March 2007. It was broadcasted on two radio channels that are widely listened to by fishermen, in English and Spanish. A copy of the transcript for this radio spot can be seen in Appendix A4.

In response to the results of a survey conducted in 2006 to assess the effectiveness of the Nassau grouper and spawning aggregation outreach program, we developed a Nassau grouper color poster that focuses on two key messages, the decline in numbers of spawning fish and the need to respect the fully-protected spawning sites and the four-month closed season (Appendix A5). The poster has recently been printed and over the next month we will be distributing 1500 copies, mainly through the members of the Working Group. The Group has stressed the need for the posters to be distributed to schools. The poster is targeted towards fishermen and the general public, as well as schools. It was felt that it would be useful to educate children about the dire situation facing the Nassau grouper, as most are probably not aware of the situation facing a species that many Belizeans prize as one of the best food fish. The poster will also hopefully trigger discussion on the need to halt damaging fishing practices, the issue of over-fishing in general, and the need for urgent action if they are to have the pleasure of seeing or eating Nassau grouper in the future.

WCS spearheaded the preparation of a paper entitled "*Experiences of the Belize Spawning Aggregation Working Group*", which was presented at the 59<sup>th</sup> Gulf and Caribbean Fisheries Institute held in November 2006 in Belize City (Appendix A6). The paper was co-authored by five members of the Working Group.

In January 2007 we organized a presentation by Dr. Enric Sala of the Scripps Institution of Oceanography as part of our regular seminar series hosted jointly with the Coastal Zone Management Authority and Institute. Dr. Sala's presentation, *Present Situation of Grouper Populations at Glover's Reef*, highlighted the dire status of the Nassau grouper population at Glover's as a result of over-fishing and recommended that a national moratorium be instituted. Twenty-four persons from government agencies and NGOs attended the presentation, which was held in Belize City. Dr. Sala was also interviewed by Channel 5 Television, which gave very good national coverage of the urgency of the situation and resulted in the Coast Guard contacting the Fisheries Department and pledging their support in enforcing the fisheries regulations.

We have recently completed the preparation of the Group's annual newsletter, working in collaboration with members from TNC and Green Reef. At least 300 copies will be printed and distributed, mainly to fishermen through the fishing co-operatives and fishermen associations. The newsletter highlights the latest monitoring results, recent local research on the black grouper, and an update on the new web-based database.

WCS is also helping to develop a web site for the Working Group. The information for the site has been compiled, a draft site has been prepared as a 'working document' and this draft is being tested. We hope to have the site up and running shortly.

### **Development of Business Plan**

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. The team visited Belize from 19 May to 8 June 2007. WCS provided background information on the Glover's Reef Marine Reserve, arranged meetings with the Fisheries Department, and a visit to the marine reserve where the students met with reserve staff and residents and resort owners on the atoll. The Fisheries Department, as the authority managing the reserve, provided the financial information required to develop the plan. However, as the Department did not supply all the detailed information requested, the plan does not include as in-depth an analysis as initially anticipated. Nevertheless, the plan should be a useful tool for the reserve managers. The plan recommends three main strategies to increase the financial sustainability of the marine reserve: (1) developing a fund or

structure that would allow donations and grant funds to be accepted for the reserve; (2) introducing a modest increase in the entrance fee and improving fee collection; and (3) increasing visitation. These three strategies are presented and discussed in the plan along with some suggestions for more cost-effective management. A copy of the draft plan is included in Appendix A7.

## **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 continued to meet on a regular quarterly basis during this period, in October 2006, and in January, April and June 2007. Two of these meetings were held in Dangriga and two in Belize City. Quorum was maintained at a reasonably high level, eighty-one, eighty-eight, sixty-nine and fifty-six percent, respectively. 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, arranging training sessions, and generally keeping members updated on the progress and results of various projects related to the marine reserve.

A major role of the GRAC is to provide advice and recommendations to the reserve management staff and the Fisheries Department. It has been concerned mainly with enforcement and the need to reduce fishing effort on the Atoll. In response to the recommendations of the Committee, the Department has almost completed drafting a formal enforcement policy, which should be instrumental in strengthening enforcement activities. Furthermore, as a result of the discussions held at Committee meetings, the resort owners at Glover's have responded to the need to recruit a second ranger at the marine reserve and have funded the salary of this ranger for the past four months. It was expected that the Government would take over the responsibility of the ranger's salary by July 2007. As of September 2007, the Ministry of Fisheries has taken responsibility for the ranger's salary, and approval of the position is pending. In addition, as a result of Committee discussions on the need for stronger patrolling at the Northeast Point spawning site during the Nassau grouper spawning season, arrangements were made with a resort owner to help provide a large boat to use as a base, which allowed the rangers to stay overnight at the site.

GRAC members have also been discussing possible mechanisms to reduce fishing effort by limiting access to fishing at the marine reserve. The Committee formally submitted a paper on the matter to the Fisheries Administrator, recommending a limit be placed on the number of boats permitted to fish the Atoll. Senior management personnel at the Department have discussed the recommendation and have reported back to the Committee that the limit can only be placed on individual fisherman licenses. At the last Committee meeting, a follow-up recommendation was made to the Fisheries Department that special licenses for Glover's be issued to traditional fishermen only, and a general process for introducing this measure was outlined. We have been asked by the Fisheries Department to assist with developing a detailed mechanism for introducing special licenses at Glover's Reef Marine Reserve, and the GRAC addressed this matter at its meeting in September 2007.

At the request of the GRAC, a representative from the Sarteneja fishing community was appointed a member in mid-2006 and has attended every meeting over the past year. Importantly, this representative has agreed that if such special licenses are granted only to traditional fishermen, the fishermen of Sarteneja will voluntarily agree not to fish for Nassau grouper at Glover's Reef.

Training continued to be offered to GRAC members. In October, a half-day training session was offered in group dynamics. The workshop was held in Dangriga and 11 members attended. The objectives of the training were to attempt to build a more cohesive group and to encourage participation and enthusiasm. The members were exposed to team-building concepts and ideas, and they participated in some interactive 'teaming' exercises to foster communication and problem-solving.

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 drafted Terms of Reference for the preparation of development guidelines for the cayes of the Glover's Reef atoll and advertised the consultancy position in late 2006. The purpose of the consultancy was to draft, in consultation with the main stakeholders, a comprehensive set of development guidelines specifically tailored for the cayes of the atoll that are compatible with their location within a marine reserve, to provide a mechanism for the guidelines to be publicized and to encourage their adoption and use. We received three applications and chose a team of two consultants who had the required qualifications and experience in planning and coastal management. Work started on the guidelines in February 2007. In early May, the consultants first met with the various regulatory agencies, visited the site and met with most of the landowners, met with the Glover's Reef Advisory Committee, reviewed the relevant legislation and policies, and then prepared and distributed the first draft of the guidelines. Several of the landowners, however, had concerns about the accuracy of the information related to the current development on their respective cayes and about some of the guidelines being proposed. Their main concern seemed to be that these guidelines may eventually become law and they do not wish to have any legal restrictions on land use. To allay their concerns, we agreed to have a special meeting with as many of the landowners as possible on the 15<sup>th</sup> June, and stressed that these were suggested voluntary guidelines or best practices. In fact, many of the resort owners have already introduced good practices in the running of their resorts, such as using compost toilets, using very low levels of energy, conserving water, and keeping as much of the natural vegetation as possible in their landscaping. A revised version of the document has been distributed to the landowners and we plan to meet with them in October 2007. The best practices proposed relate to land tenure, conservation (e.g. protection of vegetation and turtle nesting beaches), tourism use, infrastructure, energy, water, and waste disposal. We hope to finalize the best practices document in late 2007 and present it to the relevant agencies and the GRAC. We will also prepare and disseminate a colorful pamphlet that summarizes the best practices, which can also be used as a guide for managers of other marine protected areas.

**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**

Our fisheries catch data collection program at Glover's continued this year, with two years of data collected at the end of January 2007. The program has been very successful, with two former fishermen who are technical assistants to WCS collecting the data on lobster, conch, and finfish catches from fishermen on-site at Glover's Reef and at the landing beach in the village of Hopkins. Each fisherman who supplies data to the data collectors is given a fuel coupon, which is redeemable for two gallons of fuel. More than 80 fishermen from Sarteneja and Hopkins have participated in the program. The catch data sheets, which were revised in 2006, are sent to the WCS office in Belize City where, with the help of a student from the University of Belize (UB), the data are entered in an Access database.

The analysis of the first year of data (Feb. 2005 – Jan 2006) was presented in a booklet that was completed in August 2006. Copies have been widely distributed to the fishermen participating in the program and others, and the results have been quoted in several national meetings and reports. The second year of data will be analyzed with the assistance of WCS statistical expert, Dr. Samantha Strindberg, in October 2007. We will then report back to the fishermen and the Fisheries Department on the results, and compare them to the results of the first year of the program. Dr. Charles Acosta, WCS research associate, has also conducted a preliminary stock analysis of the biomass data to attempt to develop a sustainable model for the conch and lobster fisheries.

The extensive dataset is providing valuable insights into a fishery that is considered as 'low tech' and artisanal, but yet appears to be highly efficient for capturing select reef species. With the exception of regulations for the Nassau grouper fishery, the finfish fishery in Belize is not regulated. In 1994, the finfish fishery was described as 'lightly exploited'; however, the preliminary results for Glover's indicate a fishery (for all finfish species) that is approaching the estimated sustainable level. Furthermore, the fishery was described in 1994 as consisting mainly of piscivores (snappers, groupers, barracudas, etc.). In contrast, the Glover's Reef dataset shows that these species comprise only 35% of the catch, and that herbivorous species such as parrotfish accounted for almost 33% of the current catch. The data are providing evidence on the small numbers and sizes of Nassau grouper in the catch, which supports our position that the fishery for this species should be closed.

At least another year or two of data are required to verify trends and to conduct more appropriate analyses that require longer time series. We plan to continue this project for at least another year.

### **Training for fishermen**

As the National Fishermen Co-operative cancelled their participation in the proposed training workshop due to problems with member fishermen from the communities of Chunox and Copperbank who have been taking undersized conch and lobster and selling them to other buyers, we decided to move ahead with the project by training fishermen from Sarteneja and Hopkins on a one-on-one basis in the use of radio and GPS units for biodiversity protection. This method has proved more effective than carrying out the training in a group, as the fishermen have received more individual attention. It has also provided the opportunity for more in-depth discussions with fishermen, important to developing trust between both parties. We have handed over four sets of radio and GPS equipment to Sarteneja fishermen and two sets to Hopkins fishermen over the past year. The six recipients of the equipment were chosen on the basis of the same criteria agreed to in the previous project period: they were upstanding members of their respective co-operative, they had participated in our data collection program at Glover's Reef, and they had a clean record with the Fisheries Department (i.e. no record of warnings or arrests for illegal fishing). Each fisherman had to sign a special participation agreement, which was also signed by the Fisheries Department, the respective fishing co-operative, and WCS. We are continuing our follow-up program with these selected fishermen, checking them at sea and also noting their use of their logbooks for recording reports on infractions. As part of this project, we plan to prepare and print a simplified version of the fisheries regulations as a small waterproof pamphlet that these captains can have on hand to refer to in the field. We expect the provision of this training and equipment will result in fishermen taking a more active and responsible role in the management of their fisheries and the marine reserve.

With the uncertainty of the date for the training originally planned in partnership with the National Fishermen Co-operative, we were unable to schedule the training for fishermen in ReefCheck that was also planned to take place during the four-month lobster closed season. Furthermore, the one-on-one training and the installation of the radio equipment were also more time-consuming than the previously planned one-day workshop. We aim to implement the ReefCheck training for fishermen at Glover's Reef, in collaboration with Green Reef, during the 2008 lobster closed season.

We are in discussion with the Hopkins Fishermen Association (HFA) to jointly determine a suitable alternative livelihood activity to implement. Our original plan was to carry out a pilot project using Fish Aggregation Devices (FADs) at Glover's Reef. However, as we were concerned about the possible harmful effects FADs could have on pelagic species, we decided against introducing this fishing method. Over the past several months the HFA has been concentrating on implementing a project supported by UNDP/GEF on the use of lobster shades as a less harmful fishing method within the South Water Caye Marine Reserve. A lobster shade is a type of aggregating device that has recently been introduced to Belize after having been used very successfully for many years in the Sian Kaan Biosphere Reserve in Mexico. It provides a 'shade' when placed on sea grass flats that is attractive to lobsters, which are free to come and go. Fishermen dive down, check under the 'shades', which are made of concrete, and scoop up the legal-sized lobster with a hand net. Unlike spearing or hooking lobsters, the 'shades' allow fishermen to return any berried or undersized lobster unharmed to the sea. Divers often damage the reef as they look for lobsters, but with this fishing method, the pressure on the reef is avoided as the 'shades' are only placed in the sea grass areas. Thus the idea behind the project is to encourage fishermen to stop diving for lobsters and use lobster shades, which is a more sustainable method of fishing. We have supplied training for fishers in the use of GPS units to assist them in the placing and mapping of the shades as part of the UNDP/GEF project. As this project is drawing to a close, we hope to move ahead with our alternative livelihood activity with this group in the coming year.

### **Training for reserve staff**

Working in collaboration with the Fisheries Department, the Nature Conservancy and Friends of Nature, WCS organized a three-day refresher course on the Reef Fish Spawning Aggregation Monitoring Protocol in November 2006. Six reserve staff participated, representing five marine protected areas. In addition to training in the application of the monitoring protocol, the course addressed dive safety, fish identification and size estimation, navigation, and data collection. The course was held at the WCS Glover's Reef Research Station. These refresher courses are very useful to ensure that the quality of data collected is maintained at a high level.

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

The moratorium on new co-management arrangements for protected areas remains in place, although the approved policy encourages the use of co-management agreements as the preferred arrangement for protected area management. Moreover, the Fisheries Department indicated recently that they wish to streamline and standardize the management of all marine reserves and they are not interested in creating new co-management agreements. The Department currently has agreements with five NGOs. Two NGOs in southern Belize are considering merging, which would result in three marine reserves coming under the management of one organization. It would be prudent to see how this merger develops, and if it is successful, then it might provide a viable option as a co-manager of the Glover's Reef Marine Reserve in the future.

In the meantime, as mentioned in previous annual reports, we are assisting in the strengthening of the Glover's Reef Advisory Committee, which is the primary mechanism available for stakeholder participation in reserve management. As mentioned under Activity 2.2, we have continued to assist with the strengthening of the GRAC through supporting its meetings, offering training to its members, and involving members in the strategy planning process.

This past year we initiated the turtle nest monitoring program in partnership with caye residents and the marine reserve staff. Two caye residents, from Long Caye and Northeast Caye, expressed interest and took part in the training in April 2007 offered by WCS turtle expert, Dr. Cathi Campbell. A staff member of the WCS research station on Middle Caye also participated in the training. The participants have agreed, on an informal basis, to monitor turtle nesting activity on their respective cayes and supply the data to WCS and the reserve staff. They have been supplied with data sheets, and to date we are aware that at least three turtles have nested on Long Caye, and one nest has hatched.

**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)**

With reserve staff, we collected an additional four sets of LAMP data at Glover's Reef over the past year, in July and September 2006 and February and May 2007. The data for 2004 - 2006 were analyzed and the results were presented at the University of Belize's Natural Resources Management conference held in May 2007 (Appendix A8). The results of our analysis showed that the Conservation Zone, or no-take area, is supplying some protection to several commercial species. Conch density and average size are larger in the Conservation Zone (CZ) than the fished General Use Zone (GUZ). However, over 20% of legal size conch were not mature, as they did not have a flared lip. In other words, although they are immature and have not yet had the opportunity to reproduce they can be legally harvested under the current law. We have been advocating for changes to conch size limits, and the Fisheries Department admits that a change is required, but the challenge is to change the law to something practical and workable. The problematic issue is that the presence of a flared lip is the best indication of maturity; however, fishermen constrained by limited space on their boats usually shell the conch at sea and put the meat on ice in their iceboxes, and will not want to have to bring in the shells as well.

The results also show that the overall average density of legal size conch (12.1 conch/ha) was much lower than that recorded in the 2004 Fisheries Department's conch country report (53.98conch/ha). Furthermore, the average density of lobster in the CZ recorded in this study (4.2 lobster/ha) was much lower than that documented in a similar study conducted between 1996 and 2001 (35.4 lobster/ha). However, the density of lobster was still twice as high in the CZ as in the GUZ, and the average size of lobsters in the CZ was also greater than in the GUZ. Similarly, although the general density of fish was low, it was higher in the CZ than in the GUZ. For Nassau grouper specifically, the results show that while densities of Nassau grouper are very low, they are higher in the Conservation or 'no take' Zone (almost 2 fish/ha) than the General Use or fished Zone (less than 1.5 fish/ha). The number of Nassau grouper observed has also declined and the average size of fish indicated that most were juveniles. We also added parrotfish to our list of finfish species to monitor. The rainbow parrotfish, the largest herbivorous fish in the Atlantic, was not observed, and numbers of other

parrotfish were low. Among the recommendations that form part of our conservation strategy, we are calling for: the protection of parrotfish; a revision of the conch minimum size limit; a ban on spear fishing, as this fishing method is resulting in very low densities of many reef fish; and the continuation of this important monitoring program. A copy of our datasets and our analysis report (Appendix A9) has been provided to the Fisheries Department. We continue to meet with the fisheries authorities to discuss these recommendations and advocate for the necessary policy and legislative changes.

### **Turtle monitoring**

This year, we started our monitoring program on the nesting activity and in-water surveys of hawksbill turtles, a very endangered species. WCS sea turtle expert Dr. Cathi Campbell visited Glover's in May 2007 to launch the program. She provided training in nest monitoring to WCS and marine reserve staff and interested caye owners. Caye owners are presently collecting data on nesting activity, using the data sheets WCS has provided. Dr. Campbell also spent four days training WCS and marine reserve staff in the technique of carrying out systematic in-water surveys and in tagging turtles. During the survey 38 turtles were sighted, 29 of which were hawksbills. Ten of the turtles were captured and tagged; eight of these were hawksbills. A copy of the survey report can be seen in Appendix A10. WCS local staff are in the process of drafting an in-water survey protocol that we will share with the staff of the other reserves interested in introducing in-water turtle surveys. As we suspected, the Glover's Reef Atoll seems to be an important foraging site for hawksbill turtles, and we plan to conduct quarterly surveys in the future, working along with reserve staff. Our tagging program should allow us to see whether some of the turtles that nest on the cayes and at Gales Point, one of the largest nesting sites for hawksbills in the region, also forage at Glover's Reef. Dr. Campbell plans to return to assist with a second survey and to provide additional training in September 2007. Conservation of the hawksbill turtle, which has been experiencing significant declines in nesting activity, is even more important in the face of climate change. Increasing temperatures will affect nests and sex ratios, rising sea level will threaten to inundate nests and erode nesting beaches, and changes in currents as a result of climate change could also alter migration routes.

### **Spawning aggregation monitoring**

We supported the monitoring of the Nassau grouper spawning aggregation at Northeast Point, Glover's Reef in January and February 2007, working in partnership with WCS Station staff and marine reserve staff. During spawning in January, our team worked with WCS research associate Dr. Enric Sala. To help ensure the involvement of fishermen, WCS also hired two fishermen from the village of Hopkins, who formerly fished this bank, to assist with the monitoring. Sadly, the counts of Nassau grouper were alarmingly low – only 500 were recorded during the January spawning season and 800 in the February season. Very low counts were made at the other spawning aggregation sites around the country. An analysis of the data collected for the Northeast Point, Glover's Reef spawning site is included in Appendix A11. All data for the site have been entered in the newly developed web-based database that is accessible to Working Group members. In response to the decline in numbers of spawning groupers, the National Spawning Aggregation Working Group has drafted several recommendations for additional measures to be instituted, including the introduction of a moratorium on the fishing of Nassau grouper and a ban on spear fishing within marine reserves. As secretariat of the Working Group, WCS has led the development of this submission. It is presently being finalized and is expected to be formally presented to the Fisheries Administrator within the next few weeks. Importantly, the two fishermen representatives in the Group are supportive of the measures being proposed.

### **Coral reef monitoring**

In 2006, WWF spearheaded a nation-wide coral reef assessment in Belize using the AGRRA (Atlantic and Gulf Rapid Reef Assessment) methodology. We contributed the data for Glover's Reef to the national study. The data were collected in May 2006 from 15 sites that were chosen randomly within the Glover's Reef Marine Reserve, from a variety of areas representing shallow fore-reef, reef flat and patch reefs. All sites were of less than 35 ft. depth. Preliminary results of the analysis, which was conducted in FY07, indicate the following:

- Coral cover was low, averaging of 8% (the national average was 11.3%).
- Macroalgal cover was quite high, at 15.6%. Ideally, a healthy reef should have low macroalgal cover, but the die-off of *Diadema* coupled with the high catch of parrotfish has reduced two of the most important coral reef herbivores, which has likely led to an imbalance in the ecosystem, resulting in the high level of macroalgae at Glover's.

- Coral disease level was low at 2.8%; this was mainly ‘dark spot’, followed by white band disease.
- There was a low level of bleaching, at 2.2%; no bleaching was observed on the patch reef sites, but some bleaching was evident on the fore-reef sites.

In general, the fore-reef sites were in a healthier state than the patch reef sites, possibly due to more flushing by oceanic waters and less fishing pressure. We plan to map these data, along with the results of two earlier studies, to determine whether there is any pattern of reef health across the atoll and how this compares with our maps of predicted reef resilience and resistance to bleaching. Any discernable pattern could be useful for future decisions on changes to the zoning scheme of the reserve.

### ***Diadema* monitoring**

This year we also started systematic monitoring of another of our Seascape Species, *Diadema*, working in partnership with the University of Belize (UB). WCS, along with UB lecturer and researcher Dr. Leandra Cho-Ricketts and two of her students, carried out two field trips to Glover’s in March and May 2007. The initial analysis of the transect survey results shows that although overall density was low ( $<2$  urchins/m<sup>2</sup>), eastern back reef sites had more abundant densities, with one site having as many as 1.8 urchins/m<sup>2</sup> (see Appendix A12). A healthy reef generally has a density of 2 urchins/m<sup>2</sup>. We plan to partner with UB again in the coming year to continue this important survey work.

### **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.**

The process for developing Conservation Seascapes for our selected species demonstrated the challenges posed by marine species. For instance, setting population targets for many species was often difficult, especially due to: the concern of shifting baselines; the fact that the importance of different habitats at various life history stages is more pronounced for marine species; the difficulty in representing the process of recruitment, which is 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 changes on a seasonal basis, which is also difficult to map. Mapping for future threats, the scale of severity of threat, and their interaction is also a challenge. Therefore, our models are based on estimates and use relative scales. Nevertheless, they have been extremely useful in ensuring that we have compiled and organized our spatial data well, presenting distribution of species and threats, and providing estimates of current and target abundances. The contrast between current and target abundances has been especially striking and has highlighted the urgency of conservation action. The process has also shown us where there are gaps in our knowledge, and the importance of continued monitoring to determine whether our actions are helping us to achieve our target abundances. For example, we need to learn more about the importance of the atoll as a foraging area for the endangered hawksbill turtle. In addition, it is through our regular monitoring of the Nassau grouper spawning site that we have recognized the need for additional protective measures to promote the recovery of the site. The planning approach has also enabled us to realize the tremendous impact of fishing on the queen conch and the extent of the decline in numbers, adding greater urgency to the need for revisions to the legislation governing this fishery.

We attended the WCS LLP Annual Meeting that was held in the Adirondacks, New York in May 2007. While there, we shared our application of the Living Landscape/Seascape Planning Approach to this tropical marine site with others using this approach at other sites around the globe. A more detailed version of our Conservation Strategy will be included as part of a series of case studies that will be published.

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

The development guidelines, or best practices, for the cayes of Glover's Reef will be finalized in late 2007 and we will be sharing these with all other marine protected areas as an example of a guide for environmentally-friendly development of the cayes of Belize in general, particularly those that fall within the boundaries of a protected area.

We are also developing a monitoring protocol for in-water turtle surveys that can serve as a guide for other marine protected areas that plan to implement turtle monitoring.

The management plan for Glover's Reef incorporated the Living Seascape Approach as the conservation planning mechanism for the marine reserve. This plan can serve as a model for future management plans elsewhere, as it is the first for a marine reserve that follows the recommended planning guidelines that have been formally adopted on a national basis.

We are pleased to report that Friends of Nature has adopted the LAMP methodology at the Gladden Spit Marine Reserve. We have also shared this method, as well as our fisheries catch data collection methodology, with The Nature Conservancy, who is assisting the local NGO TIDE (Toledo Institute for Development and Environment) in setting up a fisheries monitoring program in the Port Honduras Marine Reserve.

Finally, our coral bleaching threat map for Glover's Reef was used as an example in the recently published Healthy Reefs guide for the region, in the section that discusses setting benchmarks and targets for reef resiliency to bleaching.

**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 FY07, 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. These efforts culminated at the LLP Annual meeting which took place in the Adirondacks, NY over May 2-8, 2007. During this meeting, all WCS/GCP funded and WCS/LLP volunteer sites presented and discussed their use of LLP/GCP tools in the development of their conservation landscapes. During this year we continued to refine and simplify the process for selecting landscape species, including revision of the software decision-support tool. Though the software uses context sensitive help, and is designed to be usable without training, we decided to further facilitate field adoption of landscape species selection (i.e., conservation target selection) by finalizing and disseminating a 'how to' manual (Appendix B1) to accompany the selection software. In addition, we continued working with our field staff and NY program and accounting staff to explore how best to integrate project strategic planning elements, such as conceptual models and monitoring frameworks, into annual operations planning and reporting.

## 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.** LLP-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.

For example, the Eastern Steppe of Mongolia is the youngest LLP/GCP site. This year, Dr. Amanda Fine and her Mongolian team made huge strides in completing steps of WCS's conservation planning methodology, the Landscape Species Approach. LLP staff from New York provided substantial support and guidance to the Mongolia staff. Presentation and review of the results took place during a stakeholder workshop in Ulaanbaatar on October 3, 2006. During visits to Mongolia, Drs. Karl Didier and Eric Sanderson also participated in several meetings and discussions with The Nature Conservancy and the World Wide Fund for Nature (WWF-Mongolia and US) about collaborative conservation planning and implementation in the Eastern Steppe, now known as the Zuun Bus collaboration. Dr. Didier has also provided some spatial information and technical support to TNC as they proceeded through their conservation planning framework in Mongolia. Dr. Samantha Strindberg also assisted field staff in Mongolia to develop a sampling design and field protocol to collect information in order to obtain the first empirically based estimates of population size, distribution, and habitat use of the critically threatened Siberian marmot, a Landscape Species, across the Eastern Steppe.

Another highlight was that Janet Gibson and her team at the Glover's Reef Living Seascape (GRLS) made great progress this year with the seascape models for all seven of their Seascapes Species: hawksbill turtle, Nassau grouper, Caribbean reef shark, star coral, queen conch, *Diadema*, and osprey. Dr. Samantha Strindberg of LLP-NY traveled to Belize City in February 2007 to assist the Belize field team in refining their potential biological seascape and human threat seascape models and to create new models for current abundance, target abundance, conservation impact and benefit-cost for all species. This information is a key element of the Conservation Strategy document for GRLS.

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

### Activity 4.2.1 Living Landscapes Program technical manuals

In FY07, we finalized and disseminated one technical manual, *Technical Manual 5: A quick reference guide to the Landscape Selection Software version 2.1* (Appendix B1), and had the LLP manuals and bulletins that were completed in FY06 translated into Spanish and French (Appendices B2-B9; Technical Manuals 3-6 in Spanish are currently being produced); these will be printed and will also be available online in PDF format. These publications are currently being disseminated to WCS projects, partners (government, NGO and local), and other conservation and development colleagues. The manuals are designed to provide clear and practical instructions to field practitioners on using a number of conservation tools. We also updated two of the older, English-language Technical Manuals (Appendices B10 and B11).

## Activity 4.2.2 Landscape Species Approach progress

### 4.2.2.1 Building Conservation Landscapes and Seascapes

In FY07, LLP staff in New York finalized methods for building conservation landscapes and seascapes, based on the experience of our pilot implementation at GCP and LLP field sites. We drafted a Technical Manual on combining biological and threats landscapes into conservation landscapes, that will provide field practitioners with guidance as to where and what actions would have the greatest positive impact on wildlife conservation and natural resources management. We then worked with the field sites to pilot the use of the draft manual as a decision-support tool. Feedback from these pilot sites is helping us refine and revise the manual before it is finalized for publication as a hard copy and as a PDF on our website.

Substantial progress has been made during the year in the finalization and implementation of tools that are part of the Landscape Species Approach, including:

- **Selecting Landscapes Species.** Drs. Strindberg and Didier, with assistance from other LLP-NY staff, produced written guidelines as an addendum to the already published software that guides users through the process of selecting Landscape Species. The guidelines were published as a Living Landscapes Technical Manual (Appendix B1), which is provided online on the program's website. Over the past year, this decision-support tool was used by the Eastern Steppe of Mongolia and Madidi projects.
- **Setting Population Target Levels.** Dr. Sanderson with assistance from other LLP-NY staff finalized guidelines for setting quantitative Population Levels for conservation targets (e.g., Landscape Species). Guidelines were published as a scientific paper in the November 2006 issue of *BioScience* (Appendix B12). Over the past year, this tool was used extensively by all four GCP sites (the Eastern Steppe of Mongolia, Madidi, Glover's Reef, and Maya Biosphere Reserve projects), as well as by at least 7 other WCS projects (e.g., Western Forest Complex, Thailand; Northern Plains, Cambodia).
- **Building Biological and Human Landscapes.** Dr. Didier, with assistance from other LLP-NY staff, finalized guidelines for creating Biological and Human Landscapes, which were published as a LLP Technical Manual in FY06. Dr. Didier also began production of a scientific paper to overview these tools, which will be completed and submitted for review during FY08. Over the past year, these tools were used extensively by the four GCP sites as well as by at least 7 other WCS projects (e.g., San Guillermo, Argentina; Adirondacks, USA; Ruaha, Tanzania).
- **Building Conservation Landscapes.** Drs. Didier and Sanderson, along with assistance from other LLP-NY staff, finalized guidelines for creating Conservation Landscapes (i.e., maps of the possible impact of conservation action). Dr. Didier began development of a LLP Technical Manual on the tool, which will be published in FY08. Over the past year, this tool was used extensively by all four GCP sites, as well as by at least 7 other WCS projects (e.g., Nouabalé-Ndoki, Congo; Coastal Patagonia, Argentina; Nam Kading, Lao P.D.R.).
- **Monitoring Frameworks.** The Glover's Reef Living Seascape (GRLS) team has been dynamically updating and using their monitoring framework to effectively track their conservation actions, the ongoing threats in their landscape and the status of their conservation targets. They view it as a living document that allows them to see changes in the status of their indicators over time. This provides them with an incredible sense of both the ongoing challenges that they face and the progress they have made in conserving the GRLS. Similarly, like other LLP sites, the team in Guatemala is evaluating the effectiveness of their conservation actions in part by monitoring the status of their Landscape Species. That said, monitoring highly elusive species scattered across vast geographic areas is a huge challenge and Dr. Samantha Strindberg of LLP-NY provided technical support for the design and analysis of this type of monitoring. The second two-week LLP/WCS workshop on "Statistical Design and Analysis of Biological Monitoring Programs for Conservation Management", designed and led by Dr. Samantha Strindberg, 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 Rony Garcia Anleu from Guatemala, along with Esteban Suárez (Yasuni-Napo Landscape, Ecuador) and Hugo Rainey (Ndoki-Likouala Landscape, Congo). Both the Ecuadorian and Congolese landscape sites were supported by the first round of USAID/GCP funding and are continuing to apply the tools and build upon the success of their previous conservation work.

### **Activity 4.2.3 Integrating strategic planning and project management**

LLP-NY staff have continued to work with our field sites and WCS NY operations (i.e., regional program and accounting staff) to devise ways to integrate strategic planning with operations planning and reporting. LLP program staff contributed substantially during our WCS organization-wide strategic planning process. Drs. Amy Vedder and David Wilkie were both extremely active members of the Strategic Planning and Review Coordination (SPARC) committee – a group charged with revising the operations processes and protocols within WCS’s international program. LLP staff was also key sources of technical input into our new organizational strategic plan, lead by Dr. Craig Groves. As a result of our efforts, LLP/GCP developed tools are now to be integrated into annual work planning, budgeting and reporting, starting in the FY09 budget cycle (i.e., December 2008). WCS will be the first international conservation NGO to integrate site-based strategic planning into annual operations planning. This fills a major gap in the adaptive management infrastructure that we need to truly measure our conservation effectiveness.

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

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

##### **Annual meeting of WCS/LLP staff**

LLP organized and hosted an annual meeting to bring together WCS/GCP and LLP field site staff to share and capture lessons learned in the implementation of threats-based approaches to biodiversity conservation at landscape scales. The meeting took place in the Adirondacks, NY from May 2-8, 2007. Twenty WCS staff attended from ten field sites, including seven staff from the current USAID-funded sites. In the past these meetings have proven enormously fruitful for our field staff, as they provide a forum for serious, practical discussions about the challenges they face in effecting conservation in large, complex landscapes. GCP support to LLP offers us one of the few opportunities to bring WCS field staff from each of our Regional Programs together to share lessons learned and best practices. This is of enormous value to our field sites as it allows innovative and effective conservation practices to quickly spread across our organization, and thus enhances our ability to effect conservation across the planet.

This meeting was judged by attendees as the best since LLP’s establishment and the first meeting in Madidi, Bolivia. Field staff were particularly excited because pilot development of the full suite of LLP strategic planning tools had been completed, allowing staff to see how the approach was implemented at different sites and to assess what strengths and weaknesses they found in the process. A series of Guidance Briefs is being developed based on the discussions at the meeting. These Briefs will be posted on the website to allow conservation practitioners to better understand what each tool is intended to achieve within a conservation project management cycle, what training resources are available, and what information, staff skills and time are required to use each tool.

Furthermore, LLP staff are working on a collection of case studies that will recount and capture our collective experience, over the last 9 years, in developing this unique and systematic approach to threats-based conservation at a landscape scale.

##### **Cross-site learning**

Former WCS GCP/LLP Program Director Dr. Amy Vedder traveled to Guatemala in the fall of 2006. She and Guatemala LLP project director Roan McNab undertook an overflight of the Maya biosphere reserve to view the broader landscape and visualize the many issues and conditions that influence forest resource conservation, and to discuss how WCS is using different strategies in distinct parts of the reserve to address these different challenges. Dr. Vedder also made a field visit to Paso Caballos and the macaw areas, and went to Tikal and Uaxactún village to meet with partners and see, first hand, how WCS is effecting conservation and livelihoods in the Maya Biosphere Reserve.

### **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). To follow up on an FY06 workshop attended by the GCP partners, Drs. Didier and Wilkie have been working closely with Madeleine Botrill (formerly with WWF) and other GCP partners to publish a scientific paper which reviews and compares the target selection procedures of the WCS, TNC, WWF, CI, and AWF. The paper was submitted to the journal *Conservation Biology* during FY07 (Appendix B13). Although the paper was not accepted for publication, the authors were invited to resubmit given some revisions. Dr. Didier and Ms. Botrill have begun revisions and plan to resubmit in FY08.

Recently, LLP-NY has begun leading an effort to publish much of our progress and the progress of other NGOs on landscape-scale conservation planning. We plan to secure agreement from a journal to publish a special section on the spatial aspects of landscape conservation planning used by the GCP partners (WCS, TNC, WWF, CI, and AWF). The WCS contribution will likely include an overview of the Landscape Species Approach, and possibly several case study applications of the approach from our project portfolio, including case studies from the Eastern Steppe of Mongolia, Glovers Reef in Belize, Adirondack Park in the US, Nouabalé-Ndoki in Congo and Nam Kading in Laos. We hope to have all papers for the special section submitted by the end of FY08.

### **Activity 4.3.2 CMP: leadership, design, writing and audits**

CU staff continues to play a leadership role in the identification, design and implementation of Conservation Measures Partnership activities. We work closely with all CMP members to identify best-practice tools to use as models for development of eAdaptive-Management (now named Miradi) software modules. We provide CMP with ongoing lessons from our efforts to integrate project strategic planning and annual financial management, and offer recommendations as to how this experience can help guide future updates of Miradi.

LLP NY staff conducted, and ten WCS/LLP site field staff participated in, a 1/2 day practical test of the Miradi adaptive management software developed by the Conservation Measures Partnership. As the software is designed on the TurboTax model (i.e., can be used straight out of the box without any training), neither expatriate nor national project staff were provided any guidance on how to use the software, they were only told briefly the range of tasks that the software was designed to help field staff undertake. By the end of the 4 hour test run, all staff reported that the software was indeed easy to use and the help files were exceedingly useful - though often more difficult for non-English speakers. Primary feedback was a desire for short Video Tutorials for each step in the process showing how to use the software, as this would reduce the need to read the detailed help files.

LLP NY staff continued to contribute to activities being undertaken by the Conservation Measures Partnership. Specifically, we provided guidance to Elizabeth O'Neill as she prepared a review of CMP experience undertaking conservation audits.

### **Activity 4.3.3 Local engagement in conservation survey**

In FY07, we extended the reach of a synthesis of field-based practice, published as a WCS working paper: "Casting for Conservation Actors: People, Partnerships and Wildlife" (Appendix B14).

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

Dr. David Wilkie shared lessons-learned and best practices from the WCS-Boston College People and Parks project in Gabon during a 2-day workshop at the UNEP World Conservation Monitoring Centre (WCMC) focused on the integration of livelihood measures into protected area management effectiveness monitoring and assessment. In addition, he shared WCS experiences on the use of monitoring frameworks and livelihood assessment tools in a 2-day workshop on methods for assessing the livelihoods impact of conservation activities, organized by Fauna and Flora International and the African Wildlife Foundation. Christopher (Kit) Kernan of Conservation International has asked that we train a social science team in Equatorial Guinea on the methods developed during the People and Parks project, so that he can meet his CARPE obligations for enhancing the participation of local people in conservation programming and assessing the

positive and negative impacts of USAID conservation spending on local economies. In addition, information gleaned by Dr. Wilkie during the latter meeting encouraged us to revise our LLP Technical Manual 4 (Appendix B11) to incorporate a very clever and simple poverty assessment tool developed by Rick Davies – The Basic Necessities Survey (BNS). This tool continues to promote the use of a standard basket of assets to assess household wealth.

#### **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.

LLP NY staff designed and delivered a 2-day conceptual modeling and monitoring framework training for program staff in the WCS regional programs (about 40 people), plus 14 staff from WCS field sites. The training was held at WCS's headquarters in NY. The fourteen field participants who benefited from this workshop included staff from other LLP design and demonstration sites. Both the Ecuadorian and Congolese landscape sites were supported by the first round of USAID/GCP funding and are continuing to apply the tools and build upon the success of their previous conservation work.

Dr. Didier worked closely with several non-core WCS sites to implement the program tools, including most prominently the Adirondacks, USA and the San Guillermo Biosphere Reserve in Argentina. The LSA tools have also contributed greatly to Dr. Didier's work on landscape scale planning projects in Samburu-Laikipia, Kenya and Argentine, Patagonia.

Dr. Wilkie used strategic planning tools developed by LLP and financed by USAID/GCP to help the WCS Democratic Republic Congo program to select conservation targets around which to focus their conservation effort at a national level, to identify critical landscapes to conserve these targets within DRC, and to begin the development of conceptual models for each critical landscape. Dr. Wilkie leveraged GCP support to help develop a strategic plan for conservation of Asian and African elephants.

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

Dr. Strindberg and Gosia Bryja leveraged GCP support to LLP by helping our WCS Lao team to apply the Landscape Species Approach to conservation planning in the Nam Kading National Protected Area in the Bolikhamxay province of Lao. These LLP activities were part of a multi-stakeholder Integrated Ecosystem and Wildlife Management Project (IEWMP), and led to the generation of species conservation landscapes that illustrate the areas where human use of the landscapes and animal habitats intersect (i.e. areas where potential threats to animal populations exist). The results of the analysis have already been adopted by the Lao government to develop interventions for the new management plan for the Nam Kading National Protected Area.

Gosia Bryja of LLP-NY traveled to Argentina in October 2007 to provide support to the Sea & Sky project as they implement LLP/GCP tools in their marine conservation planning initiative. She worked with Valeria Falabella to build biological models for their previously selected seascape species: Magellanic penguins, Black-browed albatrosses, Squid, Common hake and Southern Right whale. Leveraging GCP support to pilot the use of our landscape-scale conservation planning tools within vast, complex, 3-dimensional seascapes is an important but challenging new direction for LLP.

##### **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. Set of Seascape Maps for each Seascape Species
- A2. Management Plan for the Glover's Reef Marine Reserve
- A3. Report from SWEET on computer literacy training
- A4. Transcript of radio spot on Nassau grouper spawning aggregation
- A5. Nassau Grouper Poster
- A6. Paper: *Experiences of the Belize Spawning Aggregation Working Group*
- A7. Draft Business Plan for the Glover's Reef Marine Reserve
- A8. PowerPoint presentation of LAMP survey results
- A9. Results of a Long-term, Fishery-Independent Monitoring Program at Glover's Reef Marine Reserve
- A10. Report on sea turtle monitoring
- A11. Analysis of spawning aggregation data collected for the Northeast Point, Glover's Reef site
- A12. Report: Status of *Diadema antillarum* at Glover's Reef Marine Reserve
- B1. LLP Technical Manual 5- *A quick reference guide to the Landscape Species Selection Software version 2.1*
- B2. LLP Manuel Technique 3- *Mesurer l'efficacité - cadre de suivi*
- B3. LLP Manuel Technique 4- *Les enquêtes sociales – un outil de conception, d'action et de suivi pour la conservation*
- B4. LLP Manuel Technique 5- *Guide de référence rapide au logiciel Landscape Species Selection version 2.1*
- B5. LLP Manuel Technique 6- *Bâtir le Paysage Biologique et celui des Menaces : une approche pas à pas*
- B6. LLP Bulletin 8- *Mettre en Place des Objectifs Démographiques pour la Conservation de la Faune : Combien d'Animaux Doit-on Conserver ?*
- B7. LLP Bulletin 9- *Se Partager des Paysages convoités : La Conservation à Travers les Yeux des Animaux*
- B8. LLP Boletín 8- *Estableciendo Tamaños Poblacionales Meta para la Conservación de la Vida Silvestre: ¿Cuántos Animales Debemos Salvar?*
- B9. LLP Boletín 9- *Compartiendo Paisajes Valiosos: Conservación a Través de los Ojos de la Vida Silverstre*
- B10. LLP Technical Manual 2- *Creating Conceptual Models - a tool for thinking strategically*
- B11. LLP Technical Manual 4- *Household Surveys – a tool for conservation design, action, and Monitoring*
- B12. Sanderson, E. (2006). How Many Animals Do We Want to Save? The Many Ways of Setting Population Target Levels for Conservation. *BioScience* 56(11): 911-922.
- B13. *Comparing Landscape-Scale Target Selection Procedures of Five International Conservation Organizations*
- B14. WCS Working Paper- *Casting for Conservation Actors: People, Partnerships and Wildlife*