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Discussion Document

Project Title:

Lighthouse Reef Marine Survey Programme

Prepared by:

Coral Cay Conservation Ltd

Submitted to:

Department of Fisheries
Belize Audubon Society
Belize Coastal Zone Management Authority
Department of Forestry
Belize Ports Authority

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1. Executive Summary

- Lighthouse Reef Atoll is one of the largest and most pristine coral atolls in the Caribbean and provides an important source of revenue for Belize from fisheries and tourism. To date, the Half-Moon Cay Natural Monument and the Blue Hole Marine Natural Area are the only areas of Lighthouse Reef that receive full protection and government agencies and non-government organisations (NGOs) within Belize have identified the need to extend protected areas within the atoll.
- Since 1986, Coral Cay Conservation (CCC) has provided technical assistance to government agencies and NGOs in Belize with the acquisition, assimilation and synthesis of data for coastal zone management. CCC has also provided assistance with conservation education and training, and with capacity strengthening initiatives. Having recently completed a programme of surveys at Turneffe Atoll, CCC is scheduled to close operations and exit Belize by December 1998.
- In discussion with the principle agencies and NGOs involved with initiatives for the sustainable use and protection of natural resources at Lighthouse Reef, the two activities which were identified as requiring additional support which CCC is in a position to offer were (a) data collection for natural resource management, and (b) training. Following these discussions, in July 1998 CCC submitted a draft project concept note for extension of CCC operations in Belize beyond 1998 in order assist in these key activities.
- The primary aim of this discussion document is to expand upon the issues raised within the original draft concept note and in particular: (a) to provide further background information regarding the processes used by CCC for data collection, management and interpretation and their relevance in terms of management of natural resources at Lighthouse Reef; (b) to offer a more detailed logical framework for CCC's proposed inputs into the project; (c) and to detail CCC's inputs for project implementation, logistics and management.
- This document proposes a programme of surveys and training conducted by CCC at Lighthouse Reef, commencing in January 1999 for a period of four years. This will require the prior construction of a field base for use by CCC personnel and project counterparts and it is proposed that this be constructed in the north of the atoll at Sandbore Cay.
- The principle output of the programme will be a GIS database for Lighthouse Reef (including resource maps) from which informed management recommendations can be made. Other outputs will include training opportunities for counterparts in scuba diving and resource assessment skills, and the establishment of a field base on Lighthouse Reef. Funding for the majority of these activities will be met by CCC.

2. Introduction

Belize possesses the longest barrier reef system in the Western Hemisphere, stretching for 220 km along the country's coastline. Associated with this barrier reef complex lie Lighthouse Reef, Turneffe and Glovers Reef atolls which are classic examples of offshore atolls in the Caribbean.

Belize has a fairly extensive network of existing and proposed marine protected areas (MPAs), many of which have been listed jointly as a World Heritage Site under UNESCO's World Heritage Convention:

Site	MPA Status
Sapodilla Cays	World Heritage Site
Laughing Bird Cay	World Heritage Site
South Water Cay	World Heritage Site
Glovers Reef	World Heritage Site
Bacalar Chico	World Heritage Site
Half Moon Cay	World Heritage Site
Blue Hole	World Heritage Site
Hol Chan	designated MPA
Caye Caulker	recently designated MPA
Turneffe Atoll	to be designated a MPA
Port Honduras	proposed MPA

Whilst responsibility for managing existing MPAs is largely vested with the Department of Fisheries (within the Ministry of Agriculture and Fisheries), a number of other national agencies and NGOs are involved to some degree in MPA management. To enhance coordination of the different sectors active in the coastal zone, the Coastal Zone Management Act 1998 mandates the creation of a special body, the Coastal Zone Management Authority and a supporting Technical Institute.

Lighthouse Reef is one of the largest and most pristine of the Caribbean's atolls and provides an important source of revenue from fisheries and tourism. However, the Half-Moon Cay Natural Monument and the Blue Hole Marine Natural Area are the only areas of the atoll that receive full protection, under the management of the Belize Audubon Society (a national NGO) through cooperative arrangements with the Department of Fisheries, the Department of Forestry and other agencies.

National and international agencies and NGOs have highlighted the urgent need for expansion of existing MPAs and creation of additional ones within Lighthouse Reef. However, there is general consensus that effective implementation will require technical support additional to that forthcoming from scarce governmental and NGO resources.

Under a Memorandum of Understanding with the Department of Fisheries (App. A), Coral Cay Conservation (CCC), a non-profit company registered in Belize, has over the past 11 years provided technical resources for marine surveys throughout the geographical range of the Belize Barrier Reef (e.g. Bacalar Chico, South Water Cay, Laughing Bird Cay, Sapodilla Cays and the Snake Cays). These data have been used to assist with the designation of four of these sites under the Belize Marine Protected Area Programme, and in conjunction with the GEF/UNDP Belize Coastal Zone Management

Project, have also been used to establish the first national marine habitat classification map of Belize. The techniques developed and used by CCC for resource assessment and training have been assessed and published in peer-reviewed primary journals and independently reviewed and accredited by a consultant on behalf of the GEF/UNDP Belize Coastal Zone Management Project and by the Department of the Environment of the British Government (App. B).

Having recently completed a five-year programme of surveys of Turneffe Atoll and produced the first marine and terrestrial habitat classification map of the area (App. C), CCC is currently scheduled to close operations and exit Belize by December 1998. However, it has been suggested that CCC's resources and technical capability could usefully be adapted and applied to a new programme of surveys of Lighthouse Reef.

In July, CCC prepared and submitted to the relevant agencies and NGOs a brief project concept note for surveys at Lighthouse Reef (commencing January 1999) which highlighted the following principle outputs:

- creation of an environmental database of the major benthic habitats of Lighthouse Reef;
- production of a series of detailed marine resource maps based upon remotely sensed imagery, including a geo-rectified baseline habitat map of Lighthouse Reef;
- further data for inclusion in the national marine habitat classification map of Belize;
- detailed descriptions of the major habitat types at Lighthouse Reef, including species inventories;
- provision of management recommendations for the establishment of marine protected areas;
- establishment of environmental monitoring programmes;
- training for counterpart project personnel.

This discussion document aims to expand upon the activities proposed by CCC in the original project concept note and to provide specific details relating to project implementation, CCC survey techniques and data management, personnel, project management, finances and outputs.

Lighthouse Reef Marine Survey Programme - Logical Framework

Lighthouse Reef Marine Survey Programme - Logical Framework

4. Survey Methods

The following table details the methods which will be used to complete the research objectives outlined in the logical framework. The table also highlights how data precision and consistency will be maintained. Further details of each survey technique are available in the Appendices.

Objective	Methodology	Output	Quality Control
1 Baseline resource assessment	Standard CCC transects ¹	GIS compatible database	Validated by Mumby <i>et al.</i> (1995) and continual assessment. Reviewed by Turner (1995).
2 Quantitative surveys of commercially important fish species	CCC fish census transects ²	GIS compatible database	Continual assessment and supervision by Project Scientist.
3 Quantitative benthic surveys	Point intercept transects ³	GIS compatible database	Validation to be undertaken during 1998. Continual assessment and supervision by Project Scientist.
4 Reef health assessment	AGRA-RAP ⁴	GIS compatible database	Validation to be undertaken during 1998. Continual assessment and supervision by Project Scientist.
5 Compilation of species lists	Continual observation	Coral, fish and invertebrate species lists	Species recorded by project science staff and collaborative researchers.
6 Data analysis of 1, 2, 3, and 4	Univariate and multivariate statistics ⁵	Delineation and description of habitat types, and assessment of fish populations and reef health	Analysis of multivariate analysis in Mumby <i>et al.</i> (1996).
7 Establishment of monitoring programme at appropriate sites identified from 1	Currently unknown - needs to be consistent with national monitoring programme	Establishment of monitoring sites and provision of baseline data set	Validation will be undertaken. Continual assessment and supervision by Project Scientist.
8 Production of GIS resource maps ⁶	Classification of remotely sensed imagery ⁷	GIS maps of marine habitats, fish populations, reef health and survey transects based on the national classification scheme and compatible with the national marine habitat map	Accuracy assessment using independent data set.
9 GIS analysis of 1, 2, 3 and 4	Spatial analysis within ArcView	Integrated GIS and description of spatial patterns of biodiversity, marine habitats and reef health	Collaboration with GIS researchers.
10 Provision of management recommendations	Data and map interrogation	Series of recommendations for areas to be considered for protection based on biodiversity, ecological and economic importance, uniqueness and perceived threats	Collaboration with in-country agencies, project partners and local stakeholders and fisherfolk.

¹ Described in Appendix D-1

² Described in Appendix D-2

³ Described in Appendix D-3

⁴ Described in Appendix D-4

⁵ Described in Appendix D-5

⁶ Options for completing data analysis and GIS map production described overleaf

⁷ Described in Appendix D-6

Options for Completing Data Management / Analysis and GIS Map Production

Responsibility for completing the data management / analysis and GIS work within the proposed Lighthouse Reef Project requires clarification. The following table outlines four options for discussion and includes details of staff and equipment requirements and any training that will be necessary.

	Option 1		Option 2		Option 3		Option 4	
Data management and analysis	CCC		CCC		Belizean agencies		Belizean agencies	
GIS analysis and mapping	CCC		Belizean agencies		CCC		Belizean agencies	
Responsibilities	- Data input by CCC field and UK staff - Data analysis by CCC field and UK staff - Pre-processing of remotely sensed imagery by CCC UK staff - Overlay of data sets by CCC UK staff - Classification of imagery by CCC UK staff		- Data input by CCC field and UK staff - Data analysis by CCC field and UK staff - Pre-processing of remotely sensed imagery by Belizean personnel in collaboration with CCC UK staff - Overlay of data sets by Belizean personnel in collaboration with CCC UK staff - Classification of imagery by Belizean personnel in collaboration with CCC UK staff		- Data input by Belizean personnel in collaboration with CCC field and UK staff - Data analysis by Belizean personnel in collaboration with CCC field and UK staff - Pre-processing of remotely sensed imagery by CCC UK staff - Overlay of data sets by CCC UK staff - Classification of imagery by CCC UK staff		- Data input by Belizean personnel in collaboration with CCC field and UK staff - Data analysis by Belizean personnel in collaboration with CCC field and UK staff - Pre-processing of remotely sensed imagery by Belizean personnel in collaboration with CCC UK staff - Overlay of data sets by Belizean personnel in collaboration with CCC UK staff - Classification of imagery by Belizean personnel in collaboration with CCC UK staff	
Requirements	Time allocation by CCC UK staff		- Time allocation of Belizean personnel with suitable GIS expertise - Time allocation by CCC UK staff		- Appointment of dedicated Belizean personnel - Time allocation by CCC UK staff		- Appointment of dedicated Belizean personnel - Time allocation of Belizean personnel with suitable GIS expertise - Time allocation by CCC UK staff	
Training	Training opportunities for project counter-parts by CCC field staff		- Discussions of CCC data collection, management and analysis with Belizean GIS personnel - Possible GIS training for Belizean personnel - Training opportunities for project counter-parts by CCC field staff		Training of Belizean personnel in CCC data collection, data input, data management and analysis		- Training of Belizean personnel in CCC data collection, data input, data management and analysis - Discussions of CCC data collection, management and analysis with Belizean GIS personnel - Possible GIS training for Belizean personnel	
Data sharing	- Dissemination of digital database by CCC - Dissemination of digital and printed GIS maps and meta-data by CCC - Workshops describing data analysis methods and results		- Dissemination of digital database by CCC - Dissemination of digital and printed GIS maps and meta-data to CCC - Workshops describing data analysis methods and results		- Dissemination of digital database by CCC - Dissemination of digital and printed GIS maps and meta-data by CCC - Workshops describing data analysis methods and results		- Dissemination of digital database to CCC - Dissemination of digital and printed GIS maps and meta-data to CCC - Workshops describing data analysis methods and results	

5. CCC Training Programmes

Working in collaboration with the Department of Fisheries, the Belize Audubon Society (BAS) and the University College of Belize (UCB), CCC has provided a range of conservation education and training programmes for Belizean nationals, including SCUBA diving (with over 100 Belizeans certified to date), marine ecology and survey techniques, various outreach schools projects and the production of interactive educational materials (App. E). CCC also recently co-funded and constructed the UCB Marine Research Centre at Calabash Cay (App. F).

It is proposed that CCC continues to provide support for training of Belizean project counterparts in SCUBA diving (PADI courses available from Advanced Open Water Diver to Dive Master) and marine ecology and survey techniques.

5.1 SCUBA Training

For SCUBA training, counterpart agencies and NGOs will be required to fund only the supply of dedicated course materials (e.g. personal training manuals and PADI registration documentation) and insurance for trainees (cover can be arranged locally through the CCC Insurance Scheme). The costs of all other training components (including supply of PADI Instructors, course instruction materials, transfers from Belize City, accommodation and food for trainees at the Lighthouse Reef Field Base (LRFB; Section 6)) will be met by CCC. The seven-day PADI training course to Advanced Open Water Diver level will be scheduled on a monthly basis. Further advanced PADI courses (up to Dive Master) will be tailored to the needs and availability of the individual trainees and availability of Instructors. Allocation of course places will be limited to the total permitted space allocation at the LRFB and dependent upon the available space unoccupied by on-site project personnel (Section 6). Courses must be booked at least three months in advance through the CCC office in Belize City.

5.2 Marine Ecology and Survey Techniques

Training courses in marine ecology and survey techniques (App. G) will be scheduled on a monthly basis and will require a minimum stay at the LRFB of 14-days. Course participants will be required to be certified to a minimum level of PADI Advanced Open Water Diver grade (see above) and have insurance cover (insurance cover can be arranged locally through the CCC Insurance Scheme). The costs of all other training components (including supply of Instructors, training materials, transfers from Belize City, accommodation and food for trainees at the LRFB) will be met by CCC. Allocation of course places will be limited to the total permitted space allocation at the LRFB and will be dependent upon the available space unoccupied by on-site project personnel (Section 6). Courses must be booked at least three months in advance through the CCC office in Belize City.

5.3 Field Survey Project Management

Throughout the project there will be opportunities for project counterparts to work alongside CCC field science staff (Section 6.2.4) as an Assistant Science Officer. Training will be offered in using remotely sensed imagery for directing survey work, co-ordinating field survey teams and collating data recording forms. Minimum stay at the LRFB will be four weeks and will incorporate data management and database training

(Section 5.4). Prior to training, course participants will be required to undertake the course in marine ecology and survey techniques (Section 5.2). Allocation of course places will be limited to two participants each month. Further details of field survey work are given in Section 4 and Appendix D.

5.4 Data Management and Database Training

Throughout the project there will be opportunities for project counterparts to work receive data management training from CCC UK and field science staff as an Assistant Science Officer. Training will be offered in inputting data into the CCC database, quality control of entered data and basic data analysis. Minimum stay at the LRFB will be four weeks and will incorporate field survey project management training (Section 5.3). Prior to training, course participants will be required to undertake the course in marine ecology and survey techniques (Section 5.2). Allocation of course places will be limited to two participants each month. Further details of data management and analysis are given in Section 4 and Appendix D.

Due to liability restrictions placed upon CCC, the assistance offered by CCC will be limited only to Belizean nationals. CCC cannot offer training or support to nationals from North American and certain other countries.

6. Project Facilities, Management and Funding

6.1 Project Facilities

In order to effectively carry out the objectives of the Lighthouse Reef Survey Project (LRSP), a base of operations (the *Lighthouse Reef Field Base* (LRFB)) will need to be constructed at a suitable location on the atoll. Sandbore Cay offers the most suitable and a readily available location for the LRFB. Sandbore Cay is government-owned and offers readily available area on the western side suitable for construction. It also offers a protected deep water harbour for boat access and anchorage and has a lighthouse which will provide suitable elevation for the establishment of radio-telecommunication contact throughout the atoll and to mainland Belize (App. H). Sandbore Cay is managed by the Belize Ports Authority who have, in principle, agreed to offer a short lease for construction of the LRFB, subject to further review. One kilometre south lies Lighthouse Reef Resort which operates a private airfield. It is anticipated that an agreement can be reached with the owners of the Resort for use of this airfield for transfers of project personnel by chartered aircraft between Belize City and the atoll, and in the event that emergency air medical evacuation is required.

CCC will fund the construction, maintenance and management of the LRFB for a period of four years, after which it is assumed that ownership would revert to the Belize Ports Authority. CCC will also loan its stock of survey equipment and other items for the duration of the project.

The timing of construction will be crucial in determining CCC's future presence in Belize and to the successful completion of the project within the suggested time-scales. It is recommended that construction commences prior to the end of 1998.

The LRFB will include the following facilities:

- Sleeping and canteen accommodations for up to 35 staff and project personnel;
- One lecture area with library, office and medical facilities;
- One shower and toilet block;
- One air compressor and SCUBA equipment storage block;
- One mechanical workshop and parts storage unit;
- One electricity generation plant building;
- One fuel storage area (located adjacent to the existing pier);
- One pier (via renovation of the existing pier).

6.1.1 Water Supplies*

Potable water will be supplied from bio-filtered ground water via an elevated water storage system and from rain-water roof run-off.

6.1.2 Waste Management*

Toilet waste will be treated via installation of composting toilets (App. I). Shower and kitchen liquid waste will be treated via a grey water processing plant (App. I). Organic kitchen waste will be treated via a composting unit whilst non-organic wastes will be returned weekly to the mainland for disposal via municipal land-fill. This equipment will be donated to the project upon completion.

6.1.3 Electricity*

110/220 volt electricity will be supplied by installation of an electricity generator, operated at fixed hours daily to conserve fuel. 24 hour 12v supply for operation of waste management systems (Section 6.1.2) will be provided via a system of battery banks linked to the generator plant and, where necessary, photovoltaic charging systems.

6.1.4 Radio-telecommunications

Radio-telecommunications within Lighthouse Reef and with the mainland will be established via a combination of VHF/FM and satellite systems, with transceivers mounted on the lighthouse at Sandbore Cay.

6.1.5 SCUBA Equipment

Three Bauer Mariner (7 cfm) air compressors currently owned by CCC will be installed at the LRRS. CCC also owns 70 compressed air SCUBA cylinders, 30 plus sets of SCUBA equipment and a range of spares including repair workshop equipment.

6.1.6 Boats

CCC owns and operates four 25ft GRP skiffs (each fitted with twin Yamaha 40hp outboard motors, navigation and safety equipment). CCC also owns and operates a 32ft aluminium-hull re-supply vessel, the *West End Witch*. This equipment will be transferred for use at the LRFB. It is proposed that the existing pier at Sandbore Cay be

renovated for boat mooring and dockage and that a small fuel storage area be constructed adjacent to this pier.

6.1.7 Research Equipment

CCC owns an extensive supply of research equipment, a library of field guides and training manuals, audio-visual training materials and other equipment which will be re-located to the LRFB.

6.1.8 Medical Facilities

CCC operates under strict guidelines to ensure the safety and well-being of all project personnel whilst working in the field. This includes the installation of a field medical facility staffed 24 hours by qualified medics (Section 6.2) to provide full medical support for minor injuries and for more serious incidents requiring stabilisation prior to medi-evacuation to mainland hospital facilities. A fully-equipped medical facility will be established at the LRFB.

(* denotes items that will be donated by CCC upon completion of the project)

6.2 Project Management

6.2.1 CCC Belize City Co-ordinating Office

CCC's in-country project logistics will be managed from a CCC office in Belize City, staffed full-time by the Project Manager and Administration Assistant (Section 6.2.4). This office will be the main point of contact with the LRFB and with personnel from counterpart agencies and NGOs. The CCC Belize office will be responsible for co-ordination of project logistics and other supportive activities and will be equipped with radio-telecommunications equipment.

6.2.2 Transfers of Personnel

Project personnel will normally be transferred between mainland Belize and the LRFB via boat. However, in the event that weather does not permit safe transfer by sea or where a large group of personnel are to be exchanged, CCC may arrange transfers via chartered light aircraft, dependent upon prior agreement with the owners of the air field at Lighthouse Reef Resort.

6.2.3 Re-supplies

Weekly re-supply of food, fuel and other items for use at the LRFB will normally be by sea, via the CCC re-supply vessel, *West End Witch*. Re-supplies will be co-ordinated via the CCC Belize City office.

6.2.4 CCC Project Staff

The Belize-based CCC project staff will include the following key personnel:

Project Manager (PM)

The Project Manager is based at the CCC offices in Belize City. The PM's duties include co-ordination of all project activities with the field staff and liaison with the counterpart agencies and NGOs. The PM's responsibilities also include budget control and management of CCC funds. The PM reports directly to the project counterpart agencies and NGOs and to their UK-based CCC Line Manager (a CCC Director). The PM is a full-time position and is currently held by Mr Henry Lanza, a Belizean with six years management experience with CCC.

Administration Assistant (AA)

The Administration Assistant is based at the CCC offices in Belize City. The AA's duties are to assist the PM. The AA reports directly to the PM. The AA is a full-time position and is currently held by Mr Curtis Zuniga, a Belizean with nine months experience with CCC.

Project Scientist (PS)

The Project Scientist is based periodically at the CCC offices in Belize City and the project field base. The PS's duties include co-ordination of all research and scientific training activities with the PM and field staff, and liaison with the counterpart agencies and NGOs. The PS's responsibilities also include quality control of research activities and management of data (App. J). The PS reports directly to the project counterpart agencies and NGOs and to their UK-based CCC Line Manager (the CCC Science Co-ordinator). The PS must possess at least a Master degree in marine sciences and is employed on a voluntary basis for a period of six months.

Science Officer (SO)

The Science Officer is based at the project field base. The SO's duties include day-to-day management of all research and scientific training activities under the supervision of the PS. The SO's responsibilities also include data management (App. J). The SO reports directly to the PS. The SO must possess at least a Bachelors degree in marine sciences and is employed on a voluntary basis for a period of three months.

Expedition Leader (EL)

The Expedition Leader is based at the project field base. The EL's duties include day-to-day management of all activities at the project field base, adherence by project personnel to CCC policies relating to operations and safety, and co-ordination of re-supplies. The EL reports directly to the PM. The EL must have proven managerial skills and is employed on a voluntary basis for a period of three months.

SCUBA Instructor (SI)

The SCUBA Instructor is based at the project field base. The SI's duties include day-to-day management of all SCUBA-related activities and instruction at the project field base, adherence by project personnel to CCC policies relating to safe diving practice, and maintenance of SCUBA equipment. The SI reports directly to the EL. The SI must be certified to at least PADI Open Water Instructor level and is employed on a voluntary basis for a period of three months.

Medical Officer (MO)

The Medical Officer is based at the project field base. The MO's duties include overseeing the health and safety of project personnel, adherence by project personnel to CCC policies relating to health, and maintenance of medical stocks. The MO reports directly to the EL. The MO must be a certified medic (usually a registered nurse or GP) and is employed on a voluntary basis for a period of three months.

Technical Supervisor (TS)

The Technical Supervisor is based periodically at the project field base and Belize City. The TS's duties include overseeing the maintenance of project equipment and stock control of spare parts. The TS reports directly to the EL and PM. The TS must be a certified mechanic or specialist technician. The TS is a part-time position which is currently held by Mr xxx Sanchez, a Belizean with extensive mechanical experience.

Catering Manager (CM)

The Catering Manager is based at the project field base. The CM's duties are to cater for project personnel based at the project field base and to co-ordinate catering re-supplies. The CM reports directly to the EL and PM. The CM must possess a Public Health Certificate. The CM is a full-time position.

6.3 Project Funding

The principle source of funding for CCC project activities is derived from recruitment of paying volunteer personnel (App. F). Income derived from CCC Volunteers for the Lighthouse Reef Survey Project will be used to fund the construction of the LRFB, equipment requirements, staff salaries, project logistics, counterpart personnel training and all other project components.

The minimum threshold of CCC volunteer recruitment numbers required to financially sustain the project is 20 per month and CCC will require a minimum space allocation of 25 places at the LRFB to ensure sufficient cash flow and correct personnel levels to achieve the project aims within the specified time-frame. Although volunteers can elect to spend a minimum of two weeks with the project, the average duration is four weeks with the maximum permissible stay set at 12 weeks.

Funds are allocated from CCC's head office in the UK to the CCC Belize office on a monthly basis, subject to submission of monthly budgets by the CCC Project Manager. CCC's accounts are audited and published annually.



