

CORAL CAY CONSERVATION BELIZE 1990-1995

UPDATE AND PROPOSED FIELDWORK FOR 1992

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1. CORAL CAY CONSERVATION: PROPOSED FIELD WORK FOR 1992

The scientific research work Coral Cay Conservation (CCC) proposes to undertake in Belize during 1992 can be divided into two parts:

Part 1: Continuation of marine surveys in the area of the proposed South Water Cay Marine Reserve;

Part 2: The Sapodilla Cays project.

The following is a brief outline of the research work CCC proposes to undertake in 1992, with some background on past and current CCC projects.

2. PART 1: SOUTH WATER CAY MARINE RESERVE

2.1 CCC: 1986 to 1989

Survey work has been carried out on the reefs and lagoons in the vicinity of South Water Cay by CCC since 1986. The 1986, 1987 & 1989 CCC initiatives adopted Reefwatch survey methods (Tropical Marine Research Unit, York University) which required the establishment of transect lines (100m in length) along different reef zones and in the lagoon, orientated in a North-South direction. As an example, during the 1989 project seven transects were established along the major reef zones (lagoon, backreef, reefcrest, inner forereef, outer forereef, and inner & outer dropoff) with the objective of providing baseline information on each habitat as a prelude to the establishment of permanent monitoring sites at these locations.

2.2 CCC: 1990 Onwards

Since 1990, CCC has been undertaking comprehensive surveys of the marine resources surrounding South Water Cay, an area which has been identified as a critical habitat (Belize Centre for Environmental Studies, 1990) and a potential site for the country's second marine reserve. This work is carried out under the jurisdiction of the Coastal Zone Management Unit within the Ministry of Agriculture and Fisheries (Belize), and using methods based on those recommended by South Pacific Commission (SPC)/United Nations Environment Programme (UNEP), (1984) and the Marine Nature Conservation Review of the Joint Nature Conservancy Council (Hiscock 1990).

The proposed reserve, an area of approximately 180km², encompasses a wide range of marine habitats including sand and mangrove Cays, seagrass beds, patchreefs and expansive sections of continuous Barrier Reef (Fig.1). The Smithsonian Institution has operated a small research facility on Carrie Bow Cay for the past 18 years, and has published a number of reports on specific marine projects undertaken in the area.

To date, CCC has compiled detailed data sets on the bathymetry and biodiversity of marine habitats, which in total account for 55% of the proposed reserve area (Fig.2). Barrier reef surveys have been conducted along transects orientated in an east-west direction and spaced at 50m intervals along the reef. In conjunction with the barrier reef surveys, surveys have been

carried out in areas of the lagoon South of Carrie Bow Cay in order to locate and map precisely individual patchreefs distributed throughout this area. Global Position System (GPS) technology is used to accurately record the positions of each survey area.

In September 1991, CCC was granted permission to write a management plan for the proposed South Water Cay Marine Reserve, which is to be submitted by September 1992. In order to facilitate the completion of surveys within this time frame, CCC has adopted modified survey protocols which include sub-sampling of lagoon habitats and changes in the spatial distribution of Barrier Reef transects. By adopting these modifications, it is hoped that work on the establishment of permanent monitoring sites can begin in May 1992.

2.3 University of Edinburgh

The following is an introduction and preliminary plan of the proposed University of Edinburgh/ Coral Cay Conservation project. The project proposal has been compiled by Dr Neil Stuart, lecturer in Geographical Information Systems and supervisor of the collaborative project.

Remote sensing studies to support a pilot GIS (Geographical Information Systems) for marine conservation around South Water Cay.

2.31 Remote sensing studies have been successfully applied to the inventory and management of coastal marine resources (Jupp et al,1986). Some of the main advantages of remote sensing are the provision of rapid, current and comprehensive assessments of habitat distributions within a reef system. Remote sensing also offers a non-intrusive method of monitoring changes within and between habitats that may be subject to disturbance.

2.32 For example in the context of the South Water Cay project, satellite images of this area could show the boundaries between living and non-living coral communities; seagrass beds; patch reefs and cays. The ability to reliably map the location of different habitat types around South Water Cay would provide several benefits to marine conservation in this area.

Immediate benefits would be a framework for better control and management of the Survey Dive Programme; areas that had been omitted or which show particularly interesting characteristics could be targeted for priority survey. Strategic, longer term benefits would include the ability to provide comprehensive mapping of the marine habitats, including the designation of protected areas and recreational areas according to sound and repeatable criteria.

2.33 To facilitate these practical benefits, at least three kinds of processing need to be applied to the remote sensing data. Firstly, the imagery must be registered to known ground coordinates so that the image can be read like a map to determine locations, directions and areas of features. The resulting image

when transformed into a map projection, is said to be geometrically corrected.

To correct the image into map co-ordinates, a number of ground control points (GCPs) are required. GCPs are permanent features of the area whose planimetric co-ordinates and elevation are known to high accuracy. These features must also be visible on the satellite image. Collecting good GCPs will be a crucial prerequisite to the success of this exercise. The most promising approach to collecting accurate co-ordinates for GCPs in this offshore situation is expected to be through triangulation of stereo aerial photographs.

Secondly, groups of pixels in the image that represent discrete entities of the marine environment (such as patch reefs) need to be identified and classified together as similar objects. A number of different classification methods will need to be explored to determine the most appropriate method for this area.

Thirdly , one must confirm that the image has been classified with acceptable accuracy. The classes of habitat on the computer generated map must reflect real variations in the marine environment. Verification is normally achieved by comparing predicted classes with results of ground surveys at a number of selected test locations. This process is commonly referred to as "ground truthing". We are fortunate in having a large quantity of "ground truth" data around South Water Cay, from the extensive Survey Dive programme. Therefore, validation of the classified

imagery should be possible.

2.34 The department of Geography at the University of Edinburgh is recognised as a centre of excellence for Remote Sensing/GIS applications in tropical environments and particularly in Belize. Through a programme of expeditions to Belize since 1960 the Department has developed an appreciation of many of the problems that need to be addressed in conservation and development planning (Furley et al,1987). Through working with the Belizean Government and conservation groups we have an extensive Geographical Information System(GIS). Most recently, members of the Department have developed a methodology for integrating remotely sensed classifications of vegetation with the cartographic base mapping of Belize. This has been used to successfully map the distribution of mangrove for the complete extent of the Belizean coast (Corves,Gray,Place and Zisman,1990).

2.35 The Department proposes to assist CCC with the handling, analysis and presentation of marine environmental information. Due to the need to report results for the inclusion in the South Water Cay management Plan in September 1992, we propose to concentrate on the marine environment surrounding South Water Cay. This test area will be used to develop methods for selecting GCPs and for estimating planimetry and elevation. Subject to availability of imagery, image processing will be undertaken to enhance, correct and classify imagery for the area surrounding South Water Cay. Classification will be validated against the Survey Dive data from CCC.

2.36 The Department proposes that the work above will largely be undertaken as the summer dissertation work of one or more students from the Department's MSc programme in GIS. Students would undertake the work between April and August 1992, with writing up of results in September 1992. The research will be supervised primarily by Drs Furley, Stuart and Chris Place from the Department of Geography and by Denise McCorry and other appropriate staff of CCC.

2.37 With the approval of CCC, the opportunity to volunteer to work on these projects will be advertised to students in January 1992. The students who agree to work on these projects and are subsequently offered travel to Belize by CCC will then be obliged to complete their project work by October 1992 and to the satisfaction of their supervisors.

2.4 Water Quality Monitoring Programme

Water quality monitoring is used to investigate the physical, chemical and biological components of an aquatic ecosystem. The marine waters of Belize contain a food chain which is of the highest complexity of any marine environment. This is due to the Barrier Reef ecosystem composed of so many interacting and varied habitats (mangroves, coral reefs and seagrass beds). Water quality monitoring is needed in Belize to obtain base-line data which will act as control data (used as an indication of the present state of the water quality) from areas with little anthropogenic activity. Insight into the natural components occurring in Belizean waters will be obtained. Data collected from developed areas where changes are occurring in the water quality can then be compared to the control sites. The main areas of concern with regard to the water quality in Belize at present are:

(A) The effects of agricultural development, such as soil erosion and increased sediment load, increasing levels of inorganic nutrients from artificial fertilisers and pesticide levels.

(B) Effects of domestic sewage disposal and the increased by-products of industrial developments , these include: heavy metals: hydrocarbon levels; increased sedimentation from coastal dredging and land reclamation. The water quality monitoring will be under the following parameters as proposed in the Coastal Zone

Management Plan (1989):

(A) Basic hydrographic parameters :

Temperature, salinity, Oxygen, pH.

(B) Suspended solids

(C) Inorganic nutrients:

Nitrates, Phosphates

(D) Faecal Coliform Bacteria

(E) Pesticides

(G) Hydrocarbon level

Coral Cay Conservation are working closely with Environmental consultants based in the UK. A Water Quality Monitoring Programme (WQMP) will be drafted and presented to the Coastal Zone Management Team. It is anticipated that with the aid of outside funding the proposed WQMP can be established during 1992.

3. PART 2: SAPODILLA CAYS PROJECT

3.1 BACKGROUND TO THE SAPODILLA PROJECT

The Sapodilla Cays area is considered a priority area for study by the Fisheries Department of Belize, who recognise the importance of maintaining the biodiversity of this unique natural resource. Guatemala, and to a lesser extent Honduras, claim right of access to these islands and the islands are coming under increasing pressure from tourism and fishing from all three countries (Belize, Guatemala and Honduras). Little information exists on the waters around these cays, therefore the primary aim of the Coral Cay Conservation project at Sapodilla is to gather the necessary base-line data essential to the Fisheries Department in Belize. With the ultimate goal being to include the cays in a Tri-National "Biosphere" reserve reaching into the interior of the Belizean mainland. The immediate task however is to establish guidelines for the use of the area by fishermen and tourists.

In July 1991 a small expedition consisting of Coral Cay Conservation volunteers, the British Forces, Programme for Belize and the Fisheries Department of Belize went to the Sapodilla Cays region and carried out preliminary survey work, (Fig. 3). The findings of this expedition are found in the fieldwork report no. IV, a survey of the coastal resources around Sapodilla Cays

Belize (O'Toole, Eckardt, McCorry, Raines and Ridley, 1991). This report also includes the preliminary recommendations for the protection of the natural resources around Sapodilla Cays, intended solely as a guide to limit further damage in this region. The more detailed studies CCC plan to complete in 1992 will aid the Coastal Zone Management Team in the development of a resource management plan for the region.

3.2 THE SAPODILLA CAYS 1992 PROJECT

The projected work for 1992 will involve the use of Coral Cay Conservation survey techniques already in use (see part 1 and used during the 1991 Sapodilla expedition) and the introduction of rapid assessment techniques, (Price, 1990). These techniques will be used to identify critical habitats in the Sapodilla Cays region and assist in the ground truthing of the satellite image (Landsat) of this region. The image was purchased by Coral Cay Conservation in 1991 and will be processed and analysed by two Msc students, one from Bangor University and the other from Silsoe College, Bedford during 1992.

Initially in 1992 Coral Cay Conservation anticipate work to commence on a part-time basis with seven to ten day expeditions every month beginning in January. Allowing for logistical feasibility, Coral Cay Conservation aim to stay full time from June/July 1992 onwards. This is dependent on the construction of accommodation and the available resources. It is planned that full time work at Sapodilla Cays will commence with the arrival

of the Bangor expedition in the summer 1992.

3.2 (A) The University of North Wales, Bangor.

The teaching of Marine Science at Bangor was first introduced in 1954, since then the School has grown to be one of the largest university teaching centres in Western Europe. In addition, the research activities of the School are recognised world-wide, and the range of expertise available in the School is presently unrivalled in Britain.

Under the supervision of Dr. John Turner, a group of undergraduates and one MSc student from the School of Ocean Sciences, along with an MSc student from Silsoe College will carry out essential research in the Sapodilla area. The project aim is to develop a coastal zone management plan for the conflict avoidance and sustainable use of living and non-living marine resources in the area.

The following are the main objectives and a rough timescale:

As compiled by Dr John Turner on the 29th January 1992:

- i) Initial assessment of coastal zone management requirements by mapping and overlaying all existing information, so as to ascertain the breadth of the project.
- ii) Preparation of species composition lists, based on literature

and CCC expeditions in the area. This will form the basis for preliminary assessment of the coastal zone.

The above two points are being investigated from February onwards by CCC, Kathy Thorpe (MSc Bangor) and Frank Eckardt (MSc Silsoe).

- iii) Semi quantitative rapid assessment (RSA) of the whole coastal zone of the Sapodilla Cays will be carried out to rank data on coastal resource distribution, multiple resources use including present and potential conflict, and current environmental impact. Spot truthing will provide opportunity to assess general accuracy and value of the satellite image classifications, although more detailed work will be carried out to obtain ground information data. The RSA will be carried out in June by the MSc students, CCC volunteers and Belizeans.
- iv) Using data from the RSA and the Landsat image, key sites of conflict and/or biological and physical interest will be identified.
- v) Permanent transect stations will be established at key sites. These should be extensive, and should be defined by landward and seaward extensions of linked ecosystem variables/impacts (ie. may involve terrestrial work). Stations at sites to be truthed and surveyed using audio-video recordings to produce image database, and line, belt and quadrat techniques to measure diversity abundance and structure. (Bangor Expedition, and Belizeans. July - August 1992).

vi) During part (v), ecological studies on ecosystem structure and function, and environmental impact of specific developments will be investigated by Bangor expedition members.

vii) Preparation of a draft coastal zone management plan encompassing areas surveyed in 1992. Truthed surveys and video/photo image database will facilitate reclassification of satellite image. The modified classification system will be used to produce synoptic maps of all identifiable habitat types in Sapodilla Cays (Bangor expedition and Belizeans).

viii) Repeat objectives (iv) and (vi) over necessary number of field seasons (as determined by (i) and (iii) above, updating draft coastal zone management plan each year. Belizeans should be increasingly involved, taking initiatives and co-leading later expedition phases). Purchase, classify, truth and reanalyse new image in 3 - 5 years depending on rate of change and development of Cays.

ix) Assisting the Coastal Zone management Unit in preparation and submission of coastal zone management plan, which will involve full public participation.

3.2 (B) Silsoe College:

Frank Eckardt will carry out his MSc. project required as part of the Applied Remote Sensing MSc course at Silsoe College (Cranfield polytechnic). Frank will be co-ordinating closely with the Bangor expedition and his work will involve the processing of the image of the Sapodilla Cays region. This work is being conducted between October 1991 and May 1992 using the Food and Agriculture Organisation of the United Nations pilot study report on the Maldives (Lahtieri, 1988) as a guide-line. The project will consist of the classification and geometric collection of the image. Frank will be participating in one of the Sapodilla expeditions during 1992.

3.2 (C) Sapodilla Expedition Reports

Research reports produced from the data generated at Sapodilla will take three forms in 1992:

(1) Coral Cay Conservation will publish preliminary reports detailing the exact research carried out and the raw data collected.

(2) Two MSc reports will be completed by October 1992 and will be submitted as course work by the MSc students.

(3) Undergraduate final year projects will also be produced from the data collected at Sapodilla.

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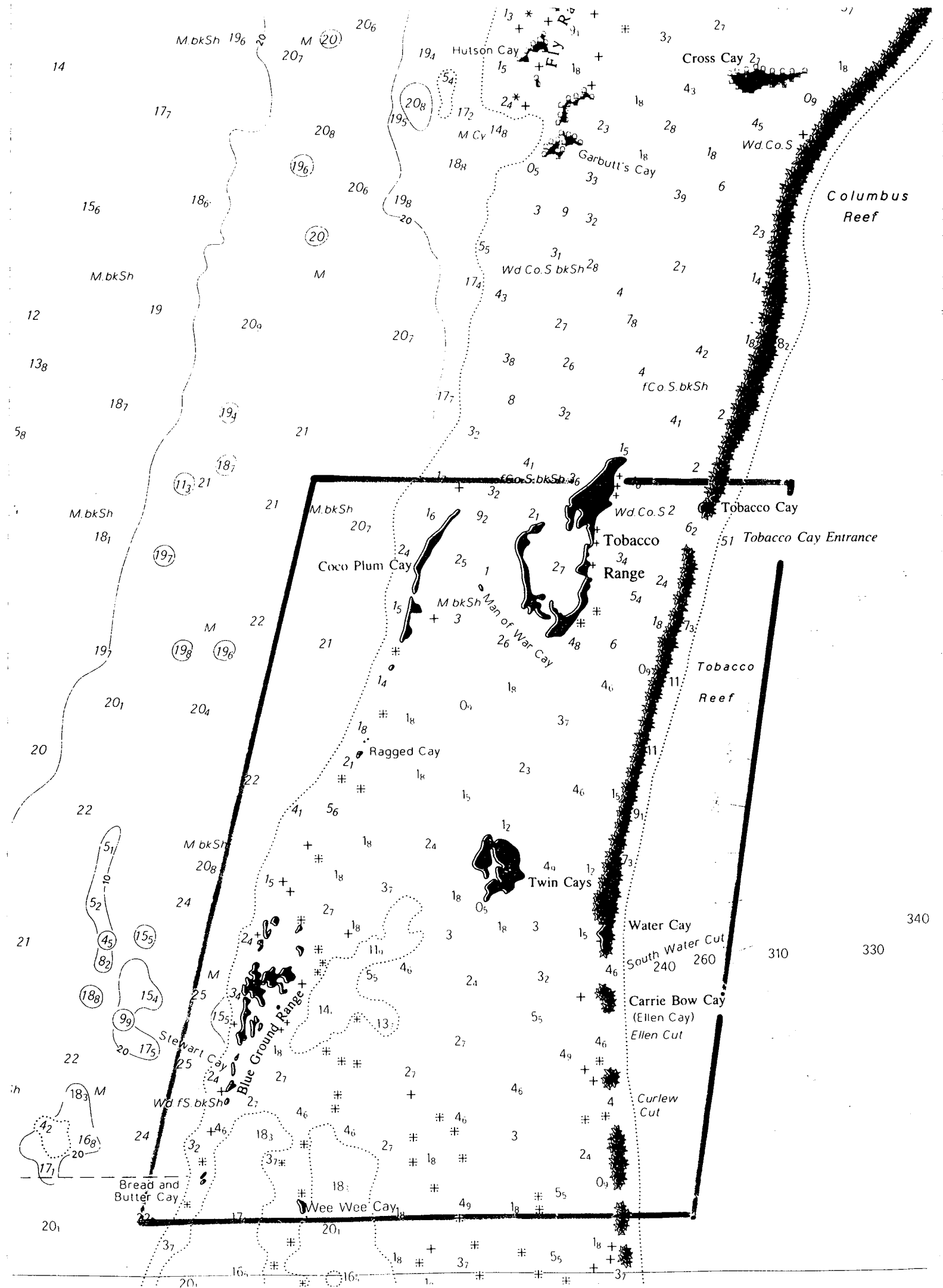
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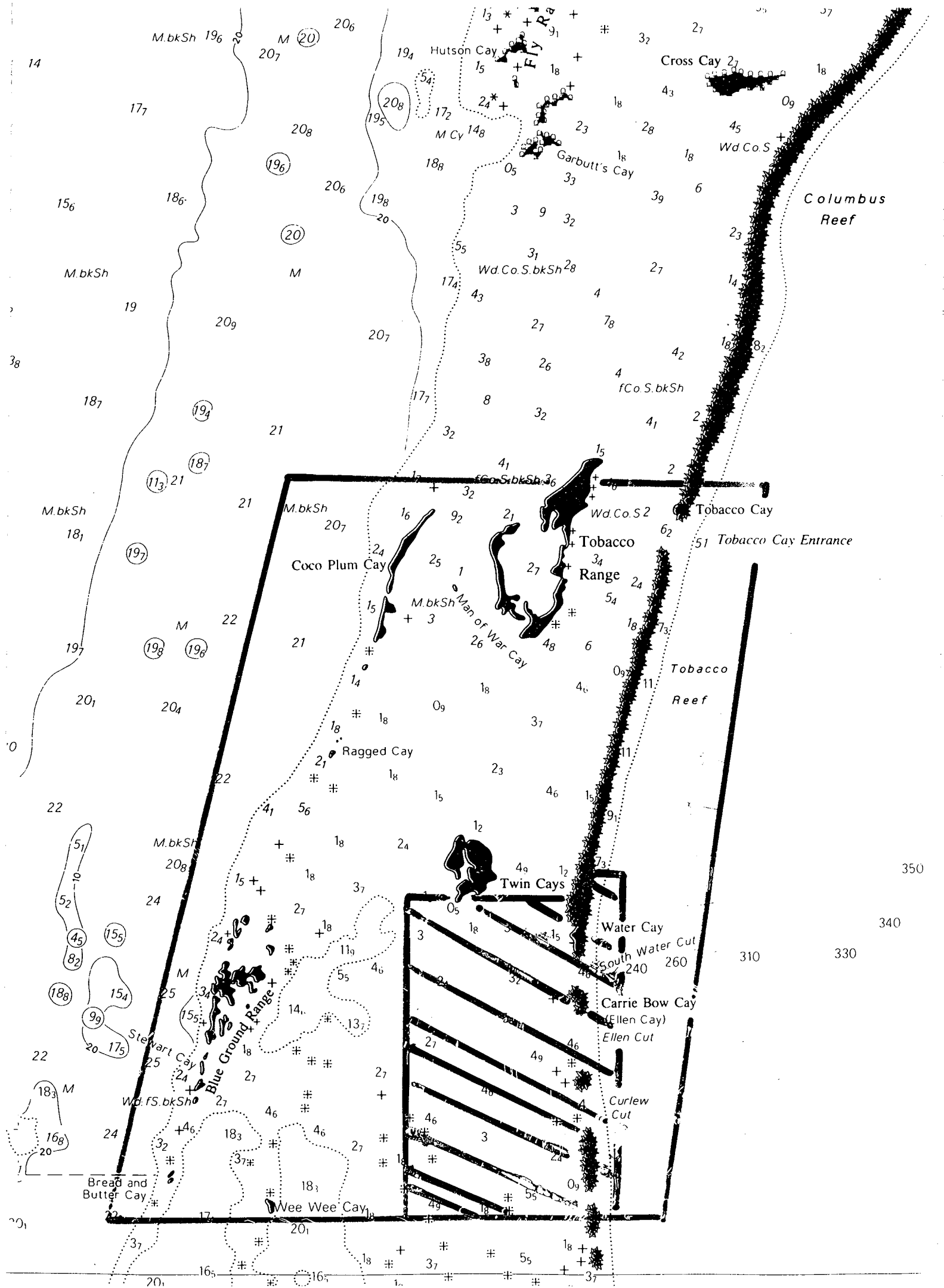
5 FIGURES

FIGURE 1 : SOUTH WATER CAY MARINE RESERVE



5 FIGURES

FIGURE 2: SURVEYED AREA WITHIN SOUTH WATER CAY MARINE
RESERVE



5 FIGURES

FIGURE 3 : SAPODILLA CAYS REGION

