

CORAL CAY CONSERVATION SUB-AQUA CLUB

ISLES OF SCILLY EXPEDITION 1992



EXPEDITION REPORT

by

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1. ABSTRACT

Between the 21-31 August 1992 a team of 17 volunteer divers from the Coral Cay Conservation branch of the British Sub-Aqua Club undertook two coastal marine survey projects on behalf of the Isles of Scilly Environmental Trust.

The first of these was a survey of foreshore erosion at Bar Point (St. Mary's). The mapping exercise undertaken indicates that there is no abundant offshore source of sediments suitable for replenishing those materials removed from Bar Point for aggregate extraction purposes.

Data generated by the survey together with existing studies provide evidence that Bar Point is naturally migrating eastwards, but that the rate of erosion of the western foreshore has recently accelerated, and that the configuration of the high-water mark at the tip of the Point has changed considerably. It is postulated that the latter can be attributed directly to aggregate removal, and has enhanced sediment transport eastwards around the Point by longshore drift, thus explaining the beach layering and increased cliff vulnerability and erosion along the western shore of the Point.

More studies of a similar nature are recommended to clarify further the mechanisms of change that are active at Bar Point.

The second project examined the status of seagrass beds in the shallow area between the main islands. Seagrass habitats are recognised as being of significant ecological importance to marine ecosystems, supporting a diverse, productive and relatively stable habitat. Seagrass populations in the north east Atlantic have undergone episodes of decline particularly in the 1930's, due to infection with a slime mould which causes a wasting disease. Divers from English nature noticed that this condition had reappeared in 1991 and infection was reasonably widespread.

The survey undertaken by Coral Cay Conservation divers examined and quantified rates of infection in three locations within the islands. It was found that infection rates were very high with almost all plants having some indications of disease. It is thought that climate may be responsible for the epidemic although further data is required before the true cause can be identified.

If the seagrass populations in Scilly decline significantly there may be serious consequences for the ecology of the marine in this region. It is therefore recommended that status of seagrass beds in Scilly should continue to be monitored and an attempt made to isolate causative factors.

In addition to these surveys a preliminary environmental impact assessment of the effects of effluent discharge from a desalination plant on St. Mary's on the adjacent littoral zone was undertaken by the Expedition's Science Officer.

The results of these projects demonstrate that amateur divers can be used successfully to generate simple data in relation to (a) foreshore physical processes and (b) general seabed mapping.

2. INTRODUCTION

Lying some 40km south-west of Lands End, the Isles of Scilly are the most westerly land mass of Great Britain (Fig. 1), comprising an archipelago of approximately 200 granite islands and rocks separated by a shallow sea. The five main islands - St. Mary's, St. Martin's, Bryher, Treco and St. Agnes - are inhabited, and support farming, fishing and tourist industries.

Swept over thousands of miles of sea by Atlantic depressions, the Scillonian atmosphere is extremely pure, and it is this, combined with the very small variations between winter and summer temperatures, and high humidity, that dictates the very individual composition of the natural history of the Islands. Rare indigenous plants, as well as exotics characteristic of sub-tropical climates thrive on the Islands. The almost complete absence of traffic and plentiful wind-break hedges and pines, provide ideal conditions in which one of Britain's most important bird populations flourish.

The shallow, sheltered marine environment surrounding the Islands is home to a variety of marine life that make up some of the most unique marine communities to be found in Britain. Gardens of jewel-anemones thrive amongst rare sponges and corals in the warm, clear and unpolluted waters of Scilly, and vast tracts of kelp forests and seagrasses support a wide range of animals including seals and porpoises.

So unique are the rocky shores of the western Islands that the scientific classification of shore-types had to be extended to include a special category for Scilly - the 'super-exposed'. Although battered by the full force of the Atlantic, delicate sea fans and various species of coral thrive in this harsh environment, at threat only from human interference. In contrast, on the more protected eastern seaboard, sheltered, deep-water habitats are home to flourishing colonies of various sponge species.

At the opposite end of the scale of exposure to the battered western shores, the protected seabed inside the archipelago is classified as 'very sheltered'. Here, granitic material ground away from the mother-rock and carried by tides and waves into the sheltered lagoon, form an infinite gradation of sediment types, from boulder-bars and beaches, through pebbles and gravel to fine sands and silts. These lagoon habitats hold some of the richest communities to be found around Scilly, many of which contain species rare enough to be rated of 'national importance'.

Granitic sediments are relatively heavy and settle rapidly, leaving the water clean and clear. This encourages the growth of plants and algae which require clear waters through which adequate sunlight can pass for photosynthesis. These clear waters encourage the growth of extensive beds of Eel-grass (*Zostera marina*) and the fast-growing kelp forests, and are home to some extremely rare algal species.

The Isles of Scilly

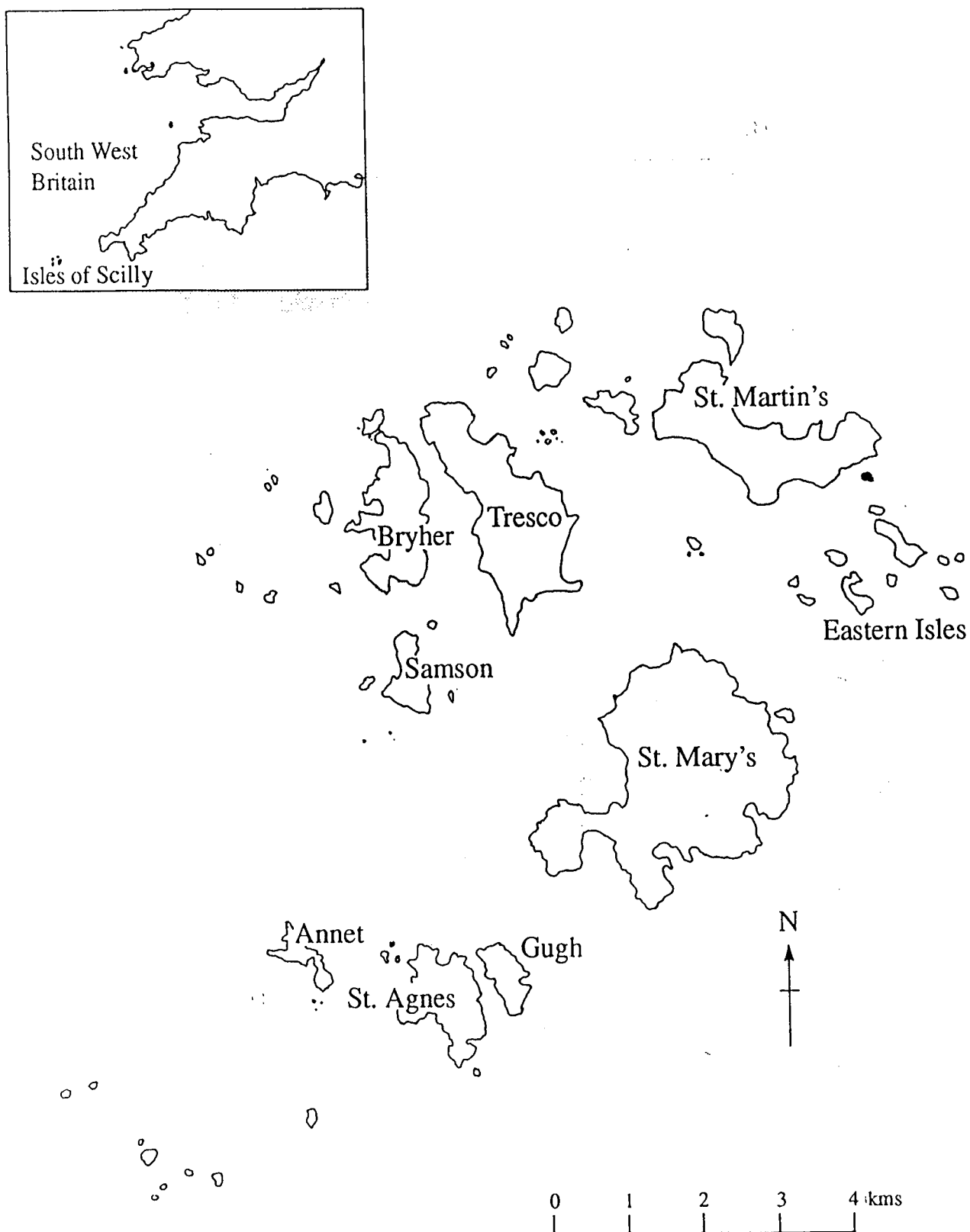


FIG. 1

Although deprived of many sources of nutrients that are common to the inshore waters of mainland Britain, the waters around Scilly support a wealth of marine life, including numerous commercial species and an important colony of the Grey Seal (*Halichoerus grypus*).

More exotic visitors include the Great Basking Shark (*Cetorhinus maximus*), Pilot Whales (*Globicephala melaena*) and even the Killer Whale (*Orcinus orca*). The Common Dolphin (*Delphinus delphis*) and Common Porpoise (*Phocaena phocaena*) are both frequent visitors to the Islands. Records of passing Mediterranean-Atlantic 'vagrants' are not uncommon, and include the Sea Horse (*Hippocampus europaeus*), Trigger-Fish (*Ballistes capriscus*), Blue Marlin (*Makaira nigricans*) and various species of turtle. Not all such vagrants are welcome: the Japanese weed (*Sargassum muticum*) has now taken a firm hold in Scilly and may out-compete indigenous species for available space and sunlight for photosynthesis.

2.1 THE ISLES OF SCILLY ENVIRONMENTAL TRUST

The Isles of Scilly Environmental Trust was established in the mid-1980's for the sole purpose of *"protecting the beautiful Isles of Scilly, and preserving them undamaged, and as far as may be possible unchanged, for the enjoyment and appreciation of this and future generations."*

All the untenanted land of the Islands (including the uninhabited islands) and most of the Heritage Coast of Scilly have been leased to the Trust by The Duchy of Cornwall, and the Trust is mandated to manage and conserve these areas.

The archipelago of Scilly has been described as that group of islands and rocks contained within the fifty metre depth contour. This entire area has been declared a Marine Park and has been placed under the management of the Isles of Scilly Marine Park Committee, consisting of representatives of the Trust, the Duchy of Cornwall, the Sea Fisheries Committee and English Nature. Its aims are *"to conserve and protect the ecological, archaeological, historical and environmental heritage contained within the parks boundaries, and ensure its harmonious coexistence with traditional local activities, to the mutual benefit of the marine environment, the local community and visitors to the islands."*

The Park also has an educational and scientific aim, *"to control and co-ordinate opportunities and facilities for marine biological study and research, for the guidance, education and enjoyment of all those interested in the marine environment."*

Although Scilly has thus far escaped many anthropogenic disasters, such as major oil spills or chemical pollution, an essential component of the Trust's work is ensuring that the unique coastal resources of the Islands are protected from these potential dangers and the destruction that accompanies insensitive tourism and uncontrolled exploitation. The Trust has published a comprehensive Code of Conduct governing the management of the Marine Park and ensures that this is distributed to all users of the island's marine resources, including visiting tourists.

(Source: *"The Islands of Scilly: A Precious Heritage"* - an Isles of Scilly Environmental Trust publication).

2.2 ENVIRONMENTAL CHALLENGES IN SCILLY

Two recent disturbances within the boundaries of the Isles of Scilly Marine Park have been of particular concern to the Isles of Scilly Environmental Trust:

A) Shoreline erosion at Bar Point (St. Mary's):

Bar Point, situated on the northern end of St. Mary's, is a beach of mainly fine, clean, white sand backed by a small dune system and low cliffs. From observations made in recent years and from local knowledge it is suggested that Bar Point is receding as a result of sand and gravel depletion.

This has implications for two local issues:

- The potential use of Bar Point as a tip. If erosion is persistent this will have important consequences for tip management.
- The extraction of aggregate from Bar Point for local building purposes. Concern has been expressed that this industry may be responsible for the coastline recession.

It is well known scientifically that coastal areas formed of sedimentary material are subject to cyclic changes involving local redistributions of sediment. It is possible that the present changes at Bar Point reflect such conditions, or they may be the result of persistent natural erosion, or erosion resulting from aggregate extraction.

The crux of the problem would appear to be as follow:

IF: (i) it can be demonstrated that there is a large offshore/alongshore reservoir of material suitable for feeding the beach at Bar Point, and (ii) wave and/or tide processes are competent to carry material from this reservoir to Bar Point in substantial quantities,

THEN: (iii) aggregate extraction from the beach can be viewed in a more favourable light, particularly if the reservoir is very large compared to total tonnages extracted, and the rate of transport exceeds the extraction rate, and (iv) there is a good chance for improving the stability of the shoreline at Bar Point in the future using economical protection methods, e.g. groynes.

HOWEVER: if either (i) or (ii) are shown to be absent then the beach extraction industry can only be having deleterious effects, and the chance of checking erosion at Bar Point using economical methods is very slim, and expensive protracted engineering works would have to be added to the cost of installing a tip in this area.

B) Infection of Eel-Grass beds (*Zostera marina*) by *Labryinthula macrocystis*, and invasion by Japweed (*Sargassum muticum*):

The Eel-grass beds in shallow sandy areas of Scilly are of significant conservation importance. Not only do these plants stabilise loose sediments through the binding effect of their root systems, they also support a diverse and important fauna, including the recent sighting of a previously unrecorded Mediterranean species of wrasse.

Recent surveys by English Nature have noted the presence of two organisms which potentially pose a threat to the Eel-grass beds. The most important of these is the micro-organism, *L. macrocystis*, recognised as a black lesion on the blades of Eel-grass and causing a wasting disease in the plant. The presence of this micro-organism is of particular interest as this may be indicative of major fluctuations in weather patterns.

The Japweed *Sargassum muticum* has also reached Scilly and has been observed growing on the Eel-grass beds. This algae may also pose a threat by shading out the underlying eel-grass growth.

2.3 CORAL CAY CONSERVATION

Coral Cay Conservation is a UK-based, non-profit organisation. Established in 1986, Coral Cay Conservation has been undertaking a series of surveys of the unique coastal marine resources associated with the Great Atlantic Barrier Reef of Belize, under a Memorandum of Understanding with the Government.

Belize, a small Central American country, posses the world's second largest barrier reef. Unfortunately, an exponential rise in visiting tourists to the Reef combined with uncontrolled fishing is having a negative impact its ecology.

In order to assist the Government of Belize with initiatives to protect its coastal resources, Coral Cay Conservation recruits teams of over 350 volunteer scientists and divers each year to participate in a systematic survey of the Reef. These volunteers originate principally from the UK and an increasing number of them have joined forces under the umbrella of the Coral Cay Conservation Sub-Aqua Club (a branch of the British Sub-Aqua Club) to continue to apply their underwater skills to conservation projects in Britain.

The Coral Cay Conservation Sub-Aqua Club has a membership of over 80 and routinely spends one weekend in every four undertaking SeaSearch surveys along the British coastline on behalf of the Marine Conservation Society.

In August 1992, 17 members of the Coral Cay Conservation Sub-Aqua Club visited Scilly at the invitation of the Isles of Scilly Environmental Trust to (a) conduct sediment surveys at Bar Point, and (b) to assess infestation levels of Eel-grass communities by *L. macrocystis*, and the extent of invasion by Japweed.

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First UK job for Coral Cay

Coral Cay, the high-profile Belizean reef conservation project group, is branching out with some project work closer to home.

A group of fifteen ex-Belize Coral Cay volunteers spent 10 days in the Scilly Isles at the end of August, studying bar sedimentation and seagrass proliferation for the Isles of Scilly Environmental Trust. It was the Coral Cay group's first project in the UK.

Members of the Coral Cay Conservation Sub Aqua Club, the divers were all versed in underwater survey techniques and marine identification skills. Self-funded, their Scillies trip was helped along with discounts on accommodation and travel.

Coral Cay have stated that they have volunteers happy to work in the Scillies again next year. They would even plan "to go for longer" than the 10 days of



Diving and science go hand-in-hand on a Coral Cay expedition.

rather poor weather experienced this time around.

□ Earlier in the summer, a 12-man team from RAF St Mawgan BS-AC also visited the Scillies, carrying out some survey work for Southampton University along with their own holiday diving and training. Based on St Agnes in June, they took samples from various sites and recorded details of seaweed masses and urchin populations.

"We made 23 dives at excellent sites to be found around the Scillies," says group diver Rob Glassborow. "and the inhabitants of St Agnes made our stay most enjoyable."

Sediment sampling and analysis was conducted under the guidance of Dr. Rob Nunny, an expert sedimentologist. Brian Cleator, an Environmental Consultant, facilitated surveys of Eel-grass communities, and in the course of his work Brian also carried out a rapid ecological assessment of the environmental impacts of waste water from a local desalination plant on St. Mary's.

Details of the expedition, together with the results of the marine surveys undertaken, are presented in the following report.

3 THE EXPEDITION

In 1991, Brian Cleator (a past Coral Cay Conservation Volunteer) contacted the Coral Cay Conservation Sub-Aqua Club to request their assistance with investigations into two pressing environmental problems within the boundaries of the Isles of Scilly Marine Park, namely shoreline erosion at Bar Point, and microbe infestation in local Eel-grass beds.

After due consultation with the Isles of Scilly Environmental Trust, the Isles of Scilly Marine Park Committee, and other relevant bodies, approval was granted by the Duchy of Cornwall for the Coral Cay Conservation Sub-Aqua Club to carry out a survey programme in Scilly during August 1992.

An expedition team was assembled from members of the Coral Cay Conservation Sub-Aqua Club, the majority of whom had previously accompanied Coral Cay expeditions to Belize where they received advanced training in underwater survey and marine life identification techniques.

The Expedition Team was as follows:

Peter Raines	-	Expedition Leader
Carolyn Tripp	-	Logistics Officer
Dr. Robert Nunny	-	Science Advisor
Brian Cleator	-	Science Officer
Richard Hall	-	Diving Officer
Susan Burton		
Gareth Collier		
Brian Crockett		
Cath Downie		
Elaine Garlinge		
David Gunnersen		
Gordon McKenzie		
Kenna Matherson		
Barbara Murray		
Geoff Shaxton		
Bill Williams		
Mark Evans		

The Expedition was completely self-financed with funds raised solely by fixed contributions from the participating volunteers. Office facilities and items of diving equipment, including a 5.35 m Ribtec boat, was supplied by Coral Cay Conservation Ltd. All aspects of expedition planning were coordinated by Carolyn Tripp.

Items of food/beverages were kindly donated by Kellogg's Company of Great Britain Ltd., and Premier Brands Limited. The Isles of Scilly Steamship Company generously supported the Expedition by arranging subsidised transportation for equipment and personnel, and accommodation in Scilly was provided by the Board of St. Mary's School. English Nature provided the expedition with a mooring, use of an additional boat and storage facilities on St. Mary's dock.

The expedition accomplished its survey objectives to schedule and within the allocated budget, and despite unfavourable weather conditions each member of the expedition carried out their tasks with enthusiasm and professionalism. With the exception of temperamental outboard motors, all items of expedition equipment functioned faultlessly and we would like to express our particular thanks to Magellan (UK) Ltd for the loan of GPS navigation equipment.

The success of the expedition was largely due to the help and support generously offered by the Duchy of Cornwall's office, Isles of Scilly Environmental Trust and English Nature, to whom we are extremely grateful. We are also indebted to the inhabitants of St. Mary's for their support, encouragement and patience, and for allowing us to share with them the natural beauty of their Isles.

It is hoped that the work presented in this report will form the basis of future collaboration between Coral Cay Conservation and the Isles of Scilly Environmental Trust.



MEMBERS OF THE CORAL CAY CONSERVATION EXPEDITION TO SCILLY

4.

SURVEY REPORTS



4.1 A SURVEY OF FORESHORE EROSION AT BAR POINT, St. MARY'S, ISLES OF SCILLY

Prepared for: The Isles of Scilly Marine Park Committee

By

Robert Nunny, Ph.D.
(on behalf of Coral Cay Conservation)



1. INTRODUCTION

1.1 BACKGROUND

Bar Point lies at the northern extremity of the island of St Mary's in the Isles of Scilly (Figure 1.). It is a triangular spit of land, lowlying (maximum height ~10m Ordnance Datum) and characterised by sand dunes and associated vegetation. The area once formed part of a sandpit complex.

The Point is considered an area of natural beauty, and has been in the public eye recently due to the local council's intention to site a waste tip in the old quarry. This plan has now been dropped. The Duchy of Cornwall licence aggregate extraction from the foreshore at the Point. This long-standing operation is a source of local concern, and it is popularly believed that this activity is responsible for the considerable erosion evident along the western shore of the Point.

The future stability of Bar Point is a problem faced by the Isles of Scilly Environmental Trust (who lease the ground from the Duchy of Cornwall), and the Trust's recent offshoot, the Isles of Scilly Marine Park. When the committee of the latter organisation was approached by Coral Cay Conservation in 1991 with a request for permission to undertake voluntary conservation work within the Islands, Bar Point was identified as an area where data generation would help in future Marine Park management.

1.2 PREVIOUS STUDIES

English Nature (Nature Conservancy Council for England and Wales) maintain a strong interest in the Islands and undertake fieldwork there. As well as commissioning vegetation studies of dune areas, this organization has also undertaken beach profile studies at Bar Point, keeping a watching brief on the erosion problem. Data from these surveys, made in 1978 and 1990, was kindly made available for this study (Pat Sargeant, [pers.comm](#)).

1.3 SURVEY AIMS

The principle aim of the Coral Cay exercise was to reunite a team of amateur divers who had previously undertaken volunteer conservation work along the Belizian Barrier Reef, enabling them to maintain their interest in this type of underwater study and at the same time contribute to the Scillonian marine conservation effort.

The presence of an enthusiastic, partially scientifically trained group of divers in Scilly was utilized to address the following aims relative to the Bar Point problem.

- 1) To map the distribution of sediments in the subtidal areas encompassing Bar Point with the view to identifying the existence of potential offshore reservoirs of beach feed materials.

2) To consider tidal and wave-driven flows in the vicinity of Bar Point as mechanisms potentially capable of natural replenishment of beach sediments from offshore.

3) To resurvey some of the English Nature beach profiles in order to identify recent erosional and depositional changes.

This report attempts to address the available data and provide a preliminary scientific view of the impact of aggregate extraction on the local coastal environment.

2. METHODS

2.1 MANPOWER AND TIMING

The Coral Cay Conservation team consisted of twelve divers under the leadership of Mr Peter Raines. Sedimentological expertise and equipment (current meters, level, sieves etc.) were provided by Dr Rob Nunny of Sea Sediments Ltd. Coral Cay and English Nature provided dive boats and several local organizations provided facilities used by the team.

The study was undertaken between the 20th August and 1st September 1992.

2.2 UNDERWATER OBSERVATIONS

Five transects were swum within the subtidal areas encompassing the Point (Figure 1.). Each transect was 400-500m long and ran from just below the low water mark into deeper water. Transects were located using compass heading and a 100m tape extended along the seabed. Each 100m section was surveyed by a dive pair swimming from inshore to offshore; a marker buoy was used to fix the extending end of the transect as pairs changed over. Satellite Navigator fixes were taken at these points, but were often up to 200m in error.

Divers made written notes on the nature of the seabed at 10m intervals along the transect; a key to the type of information recorded is given in Figure 2. The main features of the sediment that the divers had been coached to look for were as follows:

- 1) Whether bedrock outcrop, boulders or potentially mobile sediment formed the bed.
- 2) The particle-size of sediments (Table 1.).
- 3) Clues as to the mobility of the sediments viz. compaction of sands, presence of bedforms such as ripple marks or drag marks, whether infauna burrow or feeding marks were preserved, degree of encrustation/weed growth of gravels.

Two sediment samples were collected per 100m, chosen to be representative of the sediments observed.

2.3 CURRENT METERS

Two 'Sensordata' recording current meters were deployed on 'U' rigs at sites west and east of the Point shown in Figure 1. The meters were mounted 1m above the seabed. Current velocity, direction and water temperature were automatically recorded every 8 minutes.

Ideally the meters would have been deployed in deeper, weed-free sites, but these lay in the local steamer route. After three of four days therefore the meters became fouled with floating weed, and ceased to yield useful results.

2.4 BEACH PROFILES

The positions of the English Nature profiles were fixed from local landmarks and a provided map using triangulation methods (see Appendix). A level and staff were used to survey selected profiles down to the waters edge. A closed transect was surveyed linking temporary bench marks set up on each profile to the height of a concrete plinth in the central area of the spit. The height of the latter had been fixed by English Nature as +7.88mOD. Results are plotted relative to previous surveys in the Appendix.

The nature of the beach sediments along each profile were described, and samples of beach sand collected.

2.5 LABORATORY ANALYSIS

The particle-size of sediments sampled was determined using dry sieving techniques. Approximately 400g of sediment was sampled. Samples were oven dried at 105°C and gently disaggregated. A nest of sieves from 1000-63 microns at 0.5 phi intervals was used in conjunction with a 2.8mm sieve to isolate 'gravel'.

Sediment was shaken and brushed through the sieves and the weight retained on each sieve weighed to the nearest 5g using a small spring balance. The nature of any gravel material present was described.

Particle-size raw data are given in Table 2.

3. RESULTS

3.1 DESCRIPTION OF THE SEA BED AND BEACHES

The divers' descriptions of the seabed along the five surveyed transects are given in Figures 3-7 (key in Figure 2). The following general seabed types were identified:

- 1) Bedrock outcrop or boulder fields. Usually dense weed cover.
- 2) Cobbles, commonly with sand and or gravel between, and dense weed cover.

3) Gravelly sand, commoner west of Bar Point (Figure 14). The degree of encrustation/weed growth suggests that these deposits are essentially stable

4) Coarse and medium sand deposits, often with a significant shell fragment content. Over the shallows of Crow Bar the sands were very loosely consolidated and showed ripple marks aligned to the direction of tidal flow, both indicative of tidal current transport of sands as bedload.

5) Fine sand deposits, confined to an area extending eastward from Bar Point, and showing surface markings produced by the burrowing activity of the infauna, indicative of stable conditions at the time of survey.

The nature of the intertidal areas is shown in the Plates. West of Bar Point the cliffs are comprised of old blown-sand deposits overlying head ('ram'), Plates 4, 5 & 6. The head crops out along the cliff foot. There is an upper beach storm deposit of large cobbles (Plates 1-5). Below this is a thin sand deposit of the order of 10 m width (Plates 1-5). Below this level is a platform of boulders, cobbles and interstitial sandy gravels, all weed covered (Plates 1-3). At the tip of Bar Point (Plate 8) there are more extensive thin patches of sand, more particularly on the lower beach. The weed cover on the cobbles and boulders is interestingly absent. To the east of the Point the sand cover becomes near continuous (Plate 7) with limited gravel/cobble areas along the low water mark. The upper beach grades gently into Marram-covered wind-blown dune deposits.

3.2 PARTICLE-SIZE OF SAND DEPOSITS

Processes of sand transport create sand particle populations within the seabed deposits; the mean size and sorting characteristics of these populations can provide clues as to the origin of the sands. Two factors complicate this situation, making interpretation more difficult.

1) a sand deposit may be formed by more than one process, making it necessary to isolate the component populations.

2) a sand deposit may be composed of material of different hydrodynamic characteristics eg quartz grains and shell fragments. This will confuse the characteristics of a population defined simply in terms of particle-size.

The particle-size distributions of sands sampled along the five transects and on the beach are shown in Figures 8-13.

A basic subdivision in sand types can be made between those with population mean size in the range 800-400 microns, and those in the range 200-100 microns. The latter, fine sand deposits occur in a tongue which extends from an area immediately north of Bar Point to the east, into the deepest areas surveyed (Figure 18).

This zone encompasses the most northerly tip of Bar Point, where fine sands form the lower beach. Elsewhere sands of 800-400 micron mean size (medium and coarse sand) dominate; in particular the mobile sands of Crow Bar are composed of this material.

Sand particles of 200-100 micron diameter are those most easily set in motion by flowing water. Once the threshold of motion has been exceeded however the tendency is for these fine particles to move in suspension, thus being capable of rapid transport within the body of the water flow. As a result seabed deposits of this material tend to accumulate in lower energy areas adjacent to areas where high energy tidal or wave-induced flows frequently cause sand transport.

In contrast, although medium and coarse sands only require slightly stronger flows to initiate motion, once the threshold for transport is exceeded these particles tend to move as bedload, with grains rolling and bouncing along the seabed. Considerably stronger flows are required to enable this size of material to move in the more rapid suspension transport mode. In consequence the presence of well-defined medium or coarse sand deposits at a locality suggests that tidal or wave energies frequently cause sand transport there.

3.3 TIDAL CURRENTS

The tidal stream data available for this study are less than adequate. Admiralty float-release data shown on the local chart provide only the most general indications of flow in this area; on the rising tide currents generally set to the east, and south-going ebb currents appear to bifurcate in the vicinity of Bar Point to pass either side of St Mary's. Our own short-term observations relate only to neap tides, and do not tally closely with the generalised Admiralty predictions. It is understood that recording current meter data are available for the Crow Bar area (obtained during electricity cable laying) but these data have not been available for this study.

Records obtained during the August 1992 study do however highlight the following characteristics of flow close under the Point.

a) Flows are stronger at the site west of Bar Point. On neap tides (Figures 15 & 16) peak flows in this area attain ~25 cm/s, just sufficient to initiate motion in fine sands. In contrast flows east of Bar Point did not exceed 13 cm/s, incompetent to transport sand. It might be expected that spring tides see a doubling of the flow velocity, when sand transport should be very active at the western site but only just possible at the eastern site.

b) There is a marked asymmetry in flow strength between flood and ebb at the western site (Figures 16 & 17). Strongest flows are most prolonged when the tidal current is running to ~60°, thus the residual movement of sand at the western site would be expected to be to this direction.

3.4 BEACH EROSION AND DEPOSITION

In the following description Mean High Water Springs (MHWS) has been taken as +2.8m OD. Relevant map and sections are located in the Appendix.

Examination of historical map data by English Nature has shown that between 1900 and 1978 Bar Point moved considerably to the east. The average rate of recession (erosion) of the western coast of the spit over this period was about 0.35 m/yr.

PROFILE A. The most southerly transect west of the Point. There was severe erosion of both the cliff and the upper beach levels between 1978 and 1990 (MHWS recession rate 1.4 m/yr); between 1990 and 1992 little change took place.

PROFILE B. Not surveyed in 1992. Erosion similar to Profile A between 1978 and 1990 (MHWS recession rate 1.0 m/yr).

PROFILE C. Over the years 1978-1990 there was considerable erosion of the upper beach and steepening/slight retreat of the cliff (MHWM recession rate 1.3 m/yr). Between 1990 and 1992 slight cliff-foot erosion continued, and there was a minor build up of sand on the upper beach.

PROFILE D. Only the cliff top was surveyed in 1978; comparison with the 1990 cliff position shows that considerable cliff face retreat occurred during this period. Erosion of the upper beach levels and cliff retreat continued through the period 1990-1992 (MHWS recession rate 0.7 m/yr).

PROFILE E. The most northerly transect on the west coast of the spit. Considerable cliff retreat accompanied by a massive fall in the level of the upper beach (~2m) occurred between 1978 and 1990. Although the 1978 survey did not extend quite to the high water level, by extrapolation the minimum rate of MHWS recession up to 1990 was 2.5 m/yr. Between 1990 and 1992 the upper beach levels generally altered little, but the cliff foot continued to retreat (MHWS recession rate 1.5 m/yr).

PROFILE F. The northernmost profile east of the point. Over the years 1978-1990, as on Profile E, there was considerable cliff retreat and at least a 1m fall in the upper beach level (minimum MHWS recession rate 2.1 m/yr). Between 1990 and 1992 there was tremendous erosion of the beach levels across much of the width of the intertidal area; the MHWS recession rate was about 3.5 m/yr. This is the fastest erosion rate recorded from all the surveys of the Point.

PROFILE G. This profile runs into dunes rather than a cliff. The 1978 survey did not extend down to the high water mark, and the profile was not surveyed in 1992. From the limited amount of data available it would seem that between 1978 and 1990 there was some erosion of the upper beach, but the dunes increased in level.

PROFILE H. This profile also runs into dunes at its inner end. Between 1978 and 1990 the upper beach levels stayed similar but the dune levels increased. In the two years following 1990 the dune levels stayed similar but the upper beach accreted considerably, the MHWS advancing seawards at an average rate of 7.0 m/yr.

In general the transects levelled in 1992 confirm the continuing trend of change in the coastal configuration as identified in previous surveys.

The rate of recession on some profiles on the western shore of the spit has, since 1978, been at least three times higher than the average rate of recession since 1900. The rate of recession is at its greatest towards the northern tip of the spit.

Although on most profiles the data are inadequate to follow changes to the middle and lower beach, the indications are that greatest change is occurring around and above the level of MHWS. This is the area of the 'storm beach', formed by wave and wind action. Inspection of the Appendix map shows that the plan-form of this area is changing. Between 1978 and 1992 the storm beach area along the length of the western shore has narrowed in a consistent fashion; at the Point the decrease in the area of the storm beach has been much greater; east of the Point the width of the storm beach is increasing. Thus the 1900 'sharply pointed' plan of the spit is being transformed into a much blunter feature.

DISCUSSION

4.1 SUBAERIAL AND INTERTIDAL SEDIMENT MOVEMENT

Bar Point is a spit subject to eastward translocation through recent historic time. The spit is not just composed of recent marine sediments but has a core of Pleistocene periglacial deposits ('ram'). This material is being constantly exposed along the eroding western shore of the spit; its winnowed remains (gravels, cobbles, boulders) form the wide gently-shelving intertidal platform along this shore. The eastern (accreting) shore of the spit comprises beach sands grading inland into windblown dune deposits. These pass into older dune deposits, presumably formed when the spit lay further west than at present, which are seen overlying the ram in the cliff exposures of the western shore.

Waves and wind must be the principle agents causing changes to the spit. Prevailing ground seas and storm waves moving in through St Mary's Roads from the south-west impinge at an angle on the western shore of the beach, causing both erosion and longshore drift to the east, the latter process carrying away the coarser materials produced by the erosion, which would otherwise accumulate to form an energy-absorbing and erosion-checking beach. Sands carried by this east-going longshore drift will pass around the Point and accumulate on the lee eastern shore.

This process will reverse during episodes of easterly wave activity, but net transport of beach material would appear to be to the east.

The superabundance of sand deposits on the east shore produces high-level dry sand surfaces, ideal conditions for wind transport of sand under onshore (easterly) winds. Thus a dune system is built westwards back onto the spit. In contrast the low-level frequently inundated beach conditions of the western shore, backed by a cliffline, are not conducive to the formation of wind-blown deposits.

Old wind-blown sand strata form the upper part of the eroding cliffs of the western shore of the beach. The release of this material onto the beach through cliff erosion therefore completes a clockwise circulation of sand around the spit. This cycle requires eastward wave-driven drift, westward windblown transport and the eastward translocation of the spit itself for its completion. The material undergoing this cycle is principally medium sand (mean size ~400 microns).

4.2 SUBTIDAL SEDIMENT MOVEMENT

West of Bar Point the seabed contains a high proportion of cobbles and gravels; east of the Point sands dominate.

In the northern part of the area surveyed, in the vicinity of Crow Bar, medium/coarse shelly sands are found exhibiting characteristics indicative of frequent transport by tidal currents.

In a zone extending eastwards from and incorporating the tip of Bar Point fine sand populations are found. These sands showed stable characteristics at the time of survey, indicating that tidal currents in this area are normally incompetent in transporting sand.

These observations in combination with the limited tidal current data generated during the study allow the following deductions to be made concerning tidally-driven circulation of sediment within the area.

Nowhere are tidal velocities strong enough to move gravel.

In the west and north of the surveyed area tidal currents are frequently capable of transporting sands, and the residual direction of transport appears to be to between the east and northeast. Other than in the Crow Bar area sand deposits are not abundant and sometimes absent, indicating that medium/coarse sand is in short supply; ie. there does not appear to be a major source of sand to supply currents flowing from St Mary's Sound to the zone immediately north of Bar Point. There is no evidence relating to the source of sands in the Crow Bar area.

The zone of fine sand deposits extending eastwards from the Point may owe its existence to the fallout of suspended particles from the decelerating east-going stream as it rounds the spit.

Wave action will also play an important role in sediment transport in this area. No recorded data are available on waves at Bar Point, but from local knowledge the oscillatory flows under winter ground seas in particular must be effective agents of bed disturbance. Wave action will have two effects in this respect. Firstly tidal movement of sediment will be enhanced. Secondly the residual flows under shoaling waves will cause an onshore movement of material moving as bedload (cobbles, gravels, medium and coarse sands) and an offshore displacement of particles moving in suspension (fine sands). The latter mechanism will play a critical role in any exchange of sediments between Bar Point and the offshore areas: whereas tidal or wave-reinforced tidal flows will cause movement of sediment parallel to the shore, flows under waves undergoing refraction and breaking onto the shore can carry material onto and off the beach.

Source areas for material moving onshore will be the immediate subtidal zone off the Point. West of the Point this zone comprises principally gravels and cobbles and is therefore unlikely to be an important source of sand. Onshore movement of gravels and cobbles is probably a very slow process, occurring only during infrequent periods of very high wave energy. The rafting effect due to large fronds of weed attached to pebbles etc. is known to enhance transport rates. East of the point the major component of the seabed is fine sand. The hydrodynamic properties of this material prohibits its long-term accumulation landwards of the breaker zone, and there is consequently little potential for the supply of beach-forming sediments.

4.3 IMPACT OF AGGREGATE EXTRACTION

In previous sections evidence has been reviewed which indicates that

- 1) Bar Point comprises a core of old (Pleistocene) terrestrial deposits overlain by various more modern marine and aeolian sediments
- 2) the Point is being moved eastwards along the coast by natural processes of erosion and deposition, due principally to the wave action causing longshore drift
- 3) the process of translocation may involve a long-term natural clockwise cycle of beach-forming sediments around the 'spit' and
- 4) the potential for natural replenishment of the beach sands of the spit from offshore sources is small.

Examination of the beach/cliff profile changes undertaken in Section 3.4 has revealed that

5) in recent years the rate of eastward recession of the west coast of the spit has been up to four times the average for this century and

6) a significant change has taken place in the plan shape of the spit since 1978, with the storm beach area at the tip of the Point becoming much reduced in area. This has occurred as a result of the lowering of the beach by around 2m in some areas. The position of the access road to the beach here, the presence of vehicle tracks on the beach, and the remarkable absence of weed growth on the gravels and cobbles of the zone all indicate that this is the principle area of extraction, from which it follows that at least some of the lowering of the beach is attributable to aggregate winning.

The first point that is clear is that Bar Point is naturally undergoing change. If aggregate extraction is having an effect it is one of accelerating rather than initiating erosion.

Erosion of the western shore occurs because beach deposits are not substantive enough to absorb storm wave energy. Low beach levels are in turn due both to the poor rate of beach material supply (shore erosion itself seems to be the only major sediment source) and to the persistence of an east-going littoral drift which carries away the beach.

Natural climatic cycles occur; it is possible that recent accelerated rates of erosion at Bar Point are a result of increased storminess or an increased frequency of waves from a westerly direction. Only detailed examination of meteorological records can prove or disprove this point.

It is also feasible that increased rates of eastward translocation of the Point are attributable to changing characteristics of the Pleistocene deposits that are being exhumed.

It seems unreasonable however, for reasons given in 6) above, not to ascribe the substantial lowering of the intertidal area at the tip of the Point to aggregate winning, which appears to take place in precisely that locality. It would be instructive to compare the volume lost with the licensed abstractions over the appropriate period.

If however it is accepted that the lowering and changed plan-form of the tip of the point is consequent upon aggregate removal, the following secondary impact must also be considered. The natural shape of the tip of the spit, determined by the balance between the supply of sediment from the eroding western shore and the relative frequency of storms from the western and eastern sectors, produces a high-tide line immediately west of the tip which is aligned roughly north-south (see Appendix map), whereas presently this line is oriented much closer to NNE-SSW. Rates of longshore drift are controlled both by the level of energy within the breaking waves and the angle with which they impinge on the shore - the more acute the angle the greater the rate of

transport. Thus under present day alignment of the shore the potential rates at which sediments can pass eastwards around the Point are considerably increased compared to the pre-1978 situation. Previously slower rates of loss of beach sediment eastwards around the Point would have increased the residence time of beach materials on the western shore, increasing the volume of the beach and obviously reducing erosion.

Thus it is quite possible that there is a simple and direct link between the abstraction of aggregate on the tip of the Point and the increased rapidity of erosion on the western shore of the Point. Through the operation of the mechanism described it is feasible that the changed rate of cliff and beach destruction on the western shore of the spit is considerably in excess of the actual rate of aggregate removal. The balance would appear to accumulate principally along the eastern shore of the spit.

5. CONCLUSIONS AND RECOMMENDATIONS

A survey undertaken by volunteer divers has successfully generated useful information on the nature of seabed and intertidal sediment circulation at Bar Point, St Mary's, Isles of Scilly.

Previous studies have shown that Bar Point is subject to natural eastward translocation. A topographic survey undertaken as part of the present study has confirmed that present rates of erosion of the western shore of the Point are substantially higher than the mean value for this century.

The results of subtidal mapping and current meter measurements indicate that there is unlikely to be a significant feed of sediments to the beaches of the Point from offshore. This information in itself suggests that the present operation removing aggregate from the beach at the tip of the Point is not good practice.

It is postulated that there is a long-term clockwise cycle of beach sands around the Point, involving net east-going littoral drift, westward aeolian transport into the central area from the eastern shore, and the slow eastward translocation of the Point itself which re-releases the windblown material in the eroding cliffline of the western shore.

The tip of the Point has shown gross changes in level and plan over the last decade, and also shows superficial characteristics consistent with active aggregate removal. If it is accepted that the marked changes in this localised area are attributable to extraction, then it can be simply demonstrated that the recent increases in the rates of beach and cliff erosion witnessed along the western shore are also very likely to be a consequence of the aggregate winning. This is because the changed plan of the tide-line at the Point has increased the angle at which storm waves from the western sector break on the beach, thus increasing the rates of littoral drift and depleting beach levels west of the

Point in favour of levels east of the Point. Depleted beach levels equate to increased cliff and shore-platform erosion at times of high wave energy.

Further surveys directed to this problem should seek to repeat the transect mapping with the aims both of increasing the quality and detail of measurement, and identifying change. Current meter measurements are required to confirm the patterns of tidal flow tentatively identified in this report. Sample analysis should be extended to cover microscopic inspection of grains, and determination of shell content, with the aim of confirming sources and pathways of the sand-grain populations identified.

Diam. mm.	Grade term	Phi
>256.0	Boulder	
256.0		-8
	Cobble	
64.0		-6
	Pebble	
4.0		-2
2.83	Granule	-1.5
2.0		-1
	Very	
1.41	coarse	-0.5
	sand	
1.00		0
0.71	Coarse	0.5
	sand	
0.5		1
0.351	Medium	1.5
	sand	
0.25		2
0.177	Fine	2.5
	sand	
0.125		3
	Very	
0.088	fine	3.5
	sand	
0.0625		4
	Very coarse	
	silt	
0.0313		5
	Coarse silt	
— 0.0158		6
	Medium silt	
0.0079		7
	Fine silt	
0.0040		8
	Very fine	
	silt	
0.0020		9
<0.0020	Clay	

TABLE 1. PARTICLE-SIZE OF SEDIMENTS:
WENTWORTH'S GRADE SCALE

		PARTICLE DIAMETER in microns										
		>2000	1000	710	500	355	250	180	125	90	63	<63
		SIEVE SIZE IN PHI UNITS										
FIELD NO	REPORT NO	>1.5	0	0.5	1	1.5	2	2.5	3	3.5	4	<4
THA1	1.1	30.1	6.6	6.6	14.0	21.9	13.5	4.7	1.7	0.6	0.1	0.1
THA2	1.2	80.6	4.1	1.2	1.2	3.5	5.7	2.1	0.9	0.3	0.3	0.2
THB3	1.3	38.4	14.1	13.5	13.5	9.7	4.1	2.7	2.4	0.8	0.5	0.2
THB4	1.4	46.0	25.0	9.0	6.8	4.7	2.6	2.4	1.4	0.8	0.7	0.5
THC0	1.5	33.7	57.4	6.0	1.2	0.5	0.2	0.2	0.2	0.2	0.2	0.0
THC50	1.6	98.6	0.7	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THD0	1.7	47.0	30.5	10.8	8.2	2.1	0.5	0.2	0.2	0.2	0.2	0.2
THD50	1.8	64.7	10.8	8.0	10.2	3.9	1.1	0.6	0.3	0.1	0.1	0.1
T2A0	2.1	6.2	7.6	3.9	4.7	9.8	25.4	27.8	10.3	2.7	1.2	0.5
T2A50	2.2	8.9	18.0	7.3	5.2	8.0	22.9	21.2	6.1	1.6	0.7	0.0
T2B1	2.3	27.2	19.6	7.0	4.4	7.0	12.0	13.3	6.3	1.9	0.6	0.6
T2B2	2.4	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T2C0	2.5	17.1	22.4	6.9	19.9	29.0	4.4	0.2	0.2	0.0	0.0	0.0
T2C50	2.6	39.9	16.9	11.3	15.5	12.9	1.3	0.6	0.6	0.3	0.4	0.4
T2D0	2.7	23.4	33.1	9.3	14.2	17.3	2.8	0.0	0.0	0.0	0.0	0.0
T2D50	2.8	25.8	25.9	5.8	27.7	11.8	2.6	0.2	0.1	0.1	0.0	0.0
T2E50	2.9	29.0	31.2	5.4	12.2	19.1	3.2	0.0	0.0	0.0	0.0	0.0
T2E100	2.10	12.0	37.7	7.5	15.3	22.8	3.9	0.3	0.3	0.3	0.0	0.0
T3A0	3.1	24.1	20.8	3.3	2.6	7.7	14.2	21.2	5.1	0.7	0.4	0.0
T3A50	3.2	18.1	52.6	4.3	1.7	1.7	1.7	8.6	7.8	1.7	0.9	0.9
T3B50	3.3	10.3	6.5	5.3	13.0	50.2	10.5	3.0	0.7	0.2	0.1	0.1
T3E100	3.4	84.1	13.6	0.5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
T3C0	3.5	31.7	27.2	10.3	11.8	14.7	2.7	0.6	0.5	0.2	0.2	0.1
T3C50	3.6	7.1	25.8	11.6	32.6	19.1	3.3	0.1	0.1	0.1	0.1	0.1
T3C100	3.7	1.0	12.1	9.9	37.6	34.0	4.5	0.3	0.1	0.1	0.1	0.1
T3D50	3.8	0.7	5.3	16.9	54.7	12.6	4.6	2.7	1.3	0.6	0.4	0.3
T4A0	4.1	0.7	8.2	14.2	19.4	15.3	10.1	14.2	11.9	3.7	1.5	0.7
T4A50	4.2	1.4	3.3	9.0	21.7	34.0	11.8	5.7	7.1	3.3	1.9	0.9
T4B50	4.3	0.0	0.0	0.0	4.8	4.8	4.8	7.1	31.0	21.4	19.0	7.1
T4E100	4.4	0.7	5.5	13.8	38.9	29.5	2.9	2.5	3.6	1.5	0.7	0.4
T4C0	4.5	0.8	7.4	16.2	39.5	25.2	3.5	3.1	2.7	1.0	0.4	0.2
T4C50	4.6	0.7	9.2	12.7	37.2	27.4	6.1	3.9	2.0	0.4	0.2	0.2
T4D0	4.7	0.3	3.8	5.7	22.4	28.4	22.7	12.2	3.0	0.8	0.5	0.3
T4D50	4.8	0.3	2.9	9.5	49.2	22.9	8.9	4.1	1.3	0.3	0.3	0.3
T4D100	4.9	0.9	8.9	48.1	28.8	3.4	4.3	3.0	1.6	0.5	0.2	0.2
TEA10	5.1	5.8	6.8	4.3	18.8	36.8	11.1	5.5	4.5	2.6	1.9	1.9
TEA50	5.2	0.8	2.6	3.9	18.0	38.1	8.5	7.0	8.2	5.2	4.4	3.4
TEC0	5.3	1.0	3.9	3.9	7.8	3.9	2.9	21.6	32.4	13.7	6.9	2.0
TEC50	5.4	0.7	3.3	19.7	3.3	3.3	19.7	28.3	9.2	6.6	4.6	1.3
TED0	5.5	1.6	6.0	3.6	7.6	4.8	7.6	35.9	23.9	5.6	2.4	1.2
TED50	5.6	55.6	1.7	2.2	1.1	3.9	3.3	6.7	15.6	3.3	5.6	1.1
AMID	0.1	0.0	12.2	13.4	19.5	26.8	19.5	7.3	1.2	0.2	0.0	0.0
RMD	0.2	0.0	72.5	11.4	3.3	2.2	2.4	5.7	2.2	0.2	0.2	0.0
FLWM	0.3	0.0	23.7	7.6	3.3	7.6	15.1	32.7	6.8	2.0	1.0	0.3
HLNE	0.4	0.0	0.4	3.8	21.3	51.1	18.9	4.0	0.2	0.2	0.0	0.0
HMD	0.5	0.0	0.8	6.9	20.9	41.4	29.3	0.4	0.2	0.0	0.0	0.0

TABLE 2. SIEVE ANALYSIS DATA (% DRY WEIGHT RETAINED)

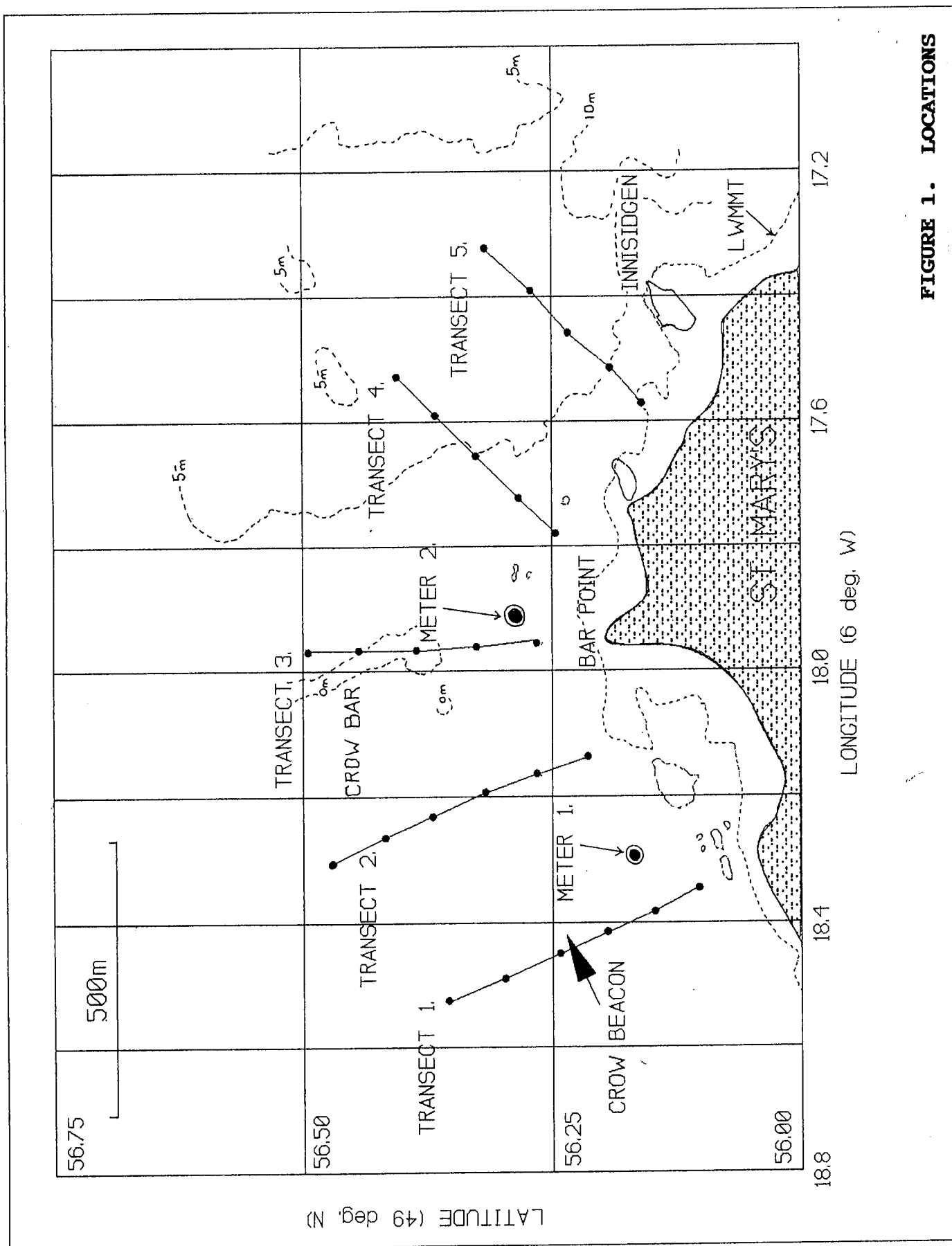


FIGURE 1. LOCATIONS

	Envelope containing fine sand populations
	Zone where sand population absent
	Sand transport active north of this line

This is a hand-drawn contour map. It features several sets of contour lines:

- Top-left set:** Solid lines sloping downwards from left to right, labeled 800, 600, 400, 200, and 100.
- Middle-left set:** Dashed lines sloping downwards from left to right, labeled 600(100), 400, 200, and 100.
- Bottom-left set:** A solid line sloping upwards from left to right, labeled 600, 400, 200, and 100.
- Right-side set:** A dashed line sloping upwards from left to right, labeled 600(200), 400, 200, and 100.

The map also includes a coastline on the far right, represented by a wavy line. At the bottom left, there is a hatched area with diagonal lines. An arrow points from this hatched area towards the center-right of the map. Various numerical labels are scattered throughout the map, some enclosed in parentheses or circles, indicating specific data points or elevations.

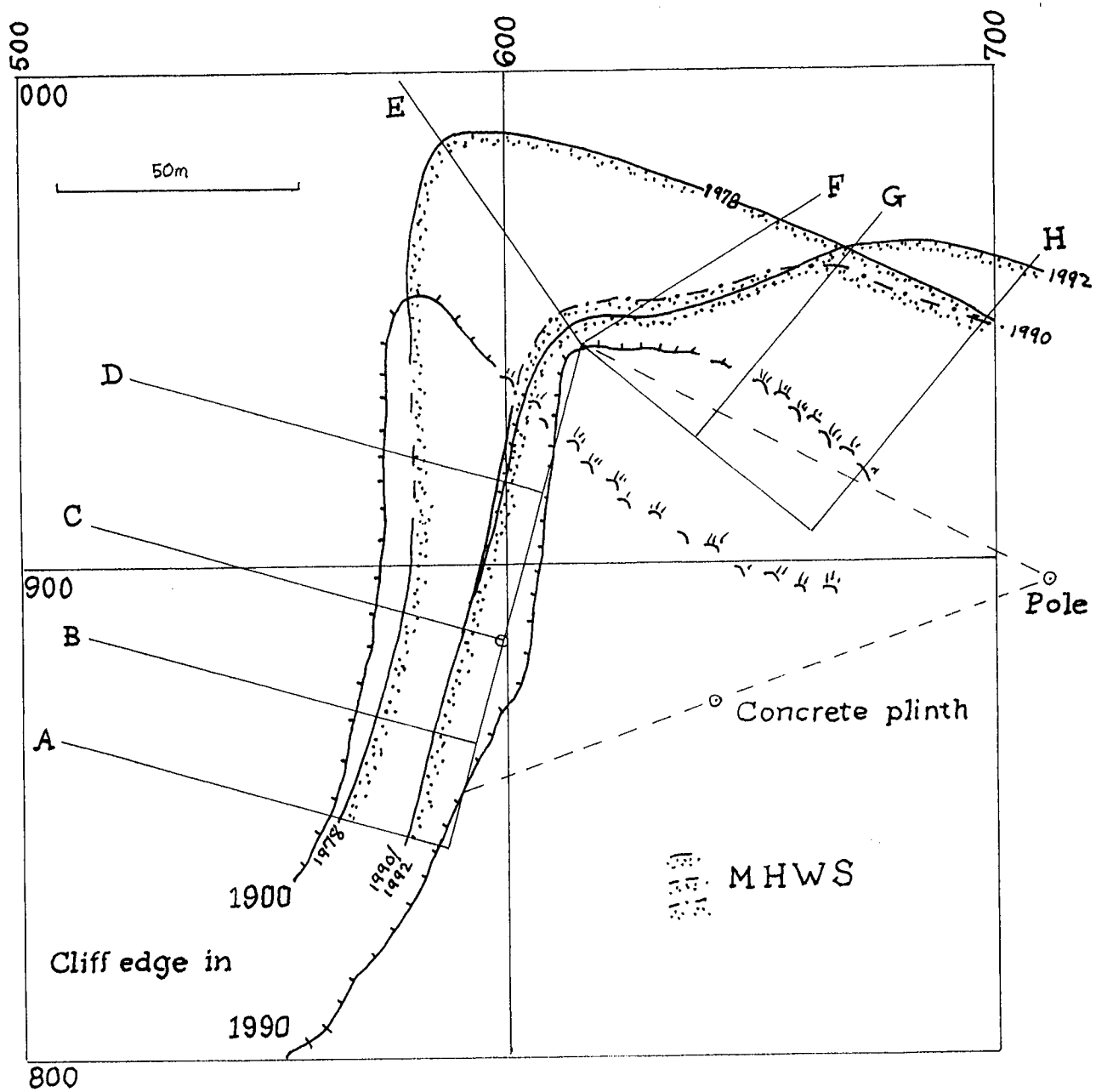
FIGURE 18. SAND DISTRIBUTIONS

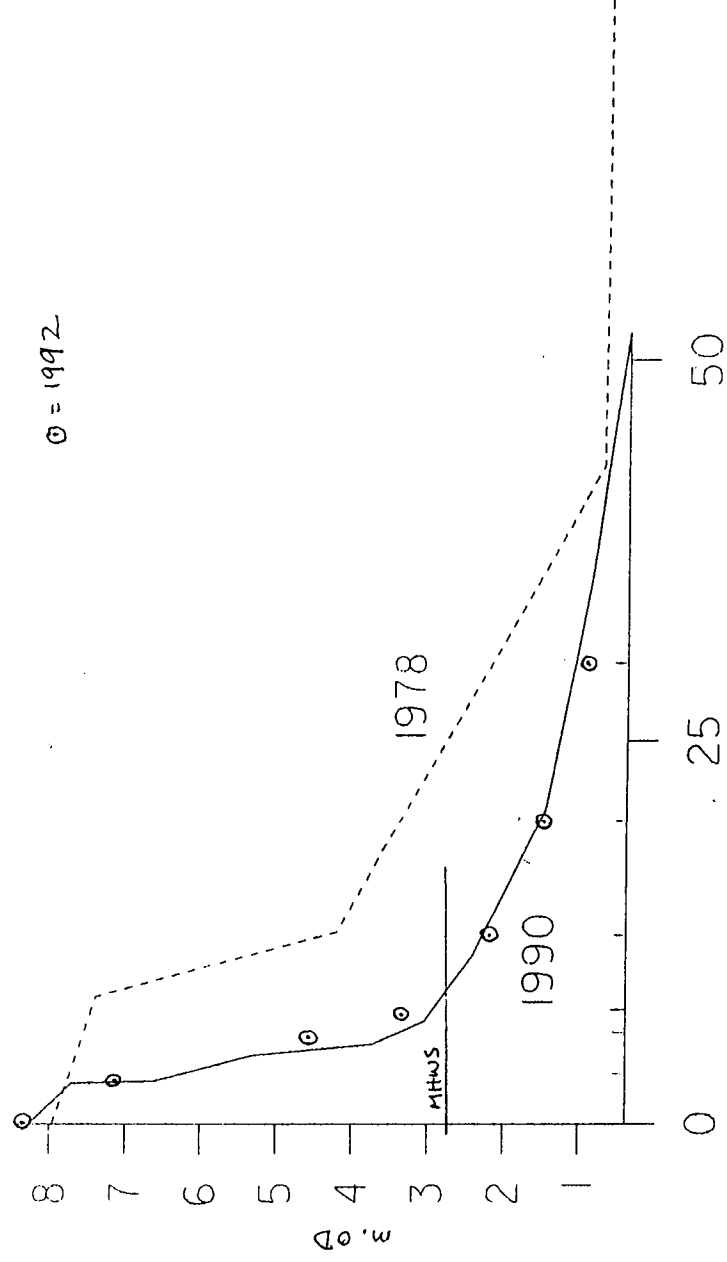
APPENDIX

EXTRACTS FROM NCC REPORTS ON TOPOGRAPHICAL CHANGES AT BAR POINT

1992 SURVEY DATA ARE SUPERIMPOSED

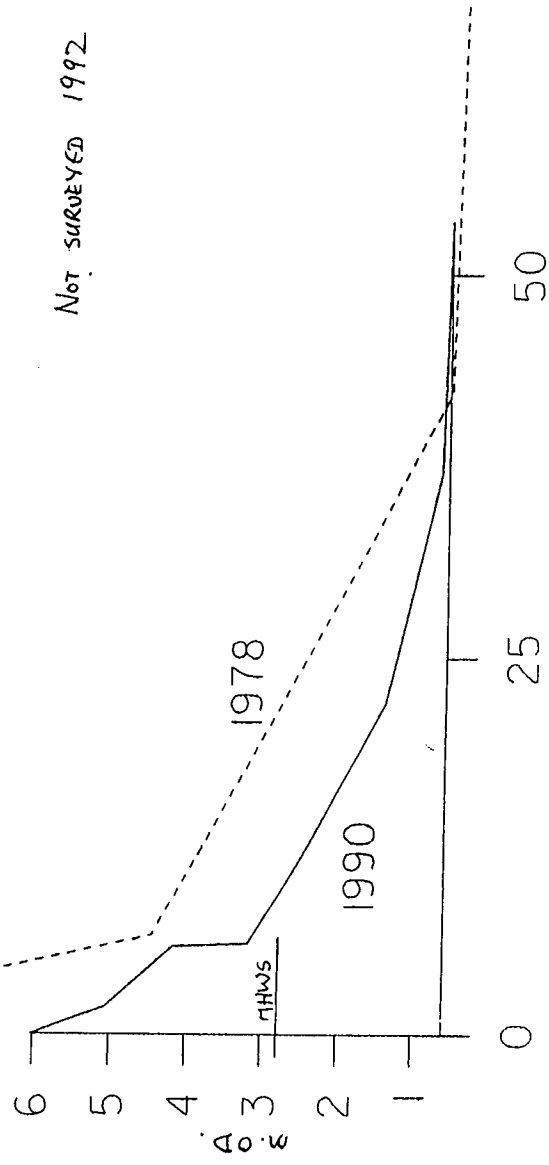
The map shows the National Grid, triangulation lines used, Profile positions, cliff-top/dune break lines for 1900 and 1978 and MHWS (+2.8m OD) for 1978, 1990 and 1992.





Profile: A
Date: 4-SEP-90
Site: BAR POINT

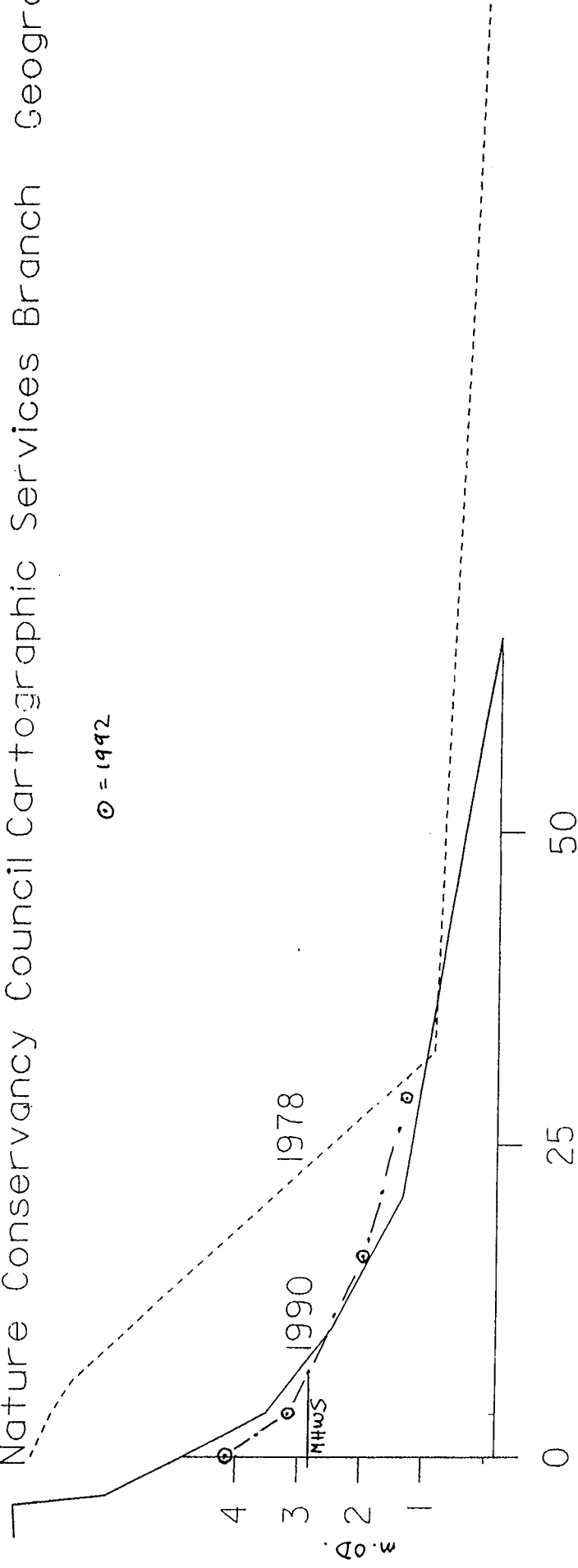
Vertical max: 8.2620metres
Vertical min: .3670metres
Horizontal length: 51.7610metres
Vertical



Profile: B
Date: 4-SEP-90
Site: BAR POINT

Vertical max: 6.0330metres
Vertical min: .5950metres
Horizontal length: 53.4710metres

Vertical



Profile: C

Date: 4-SEP-90

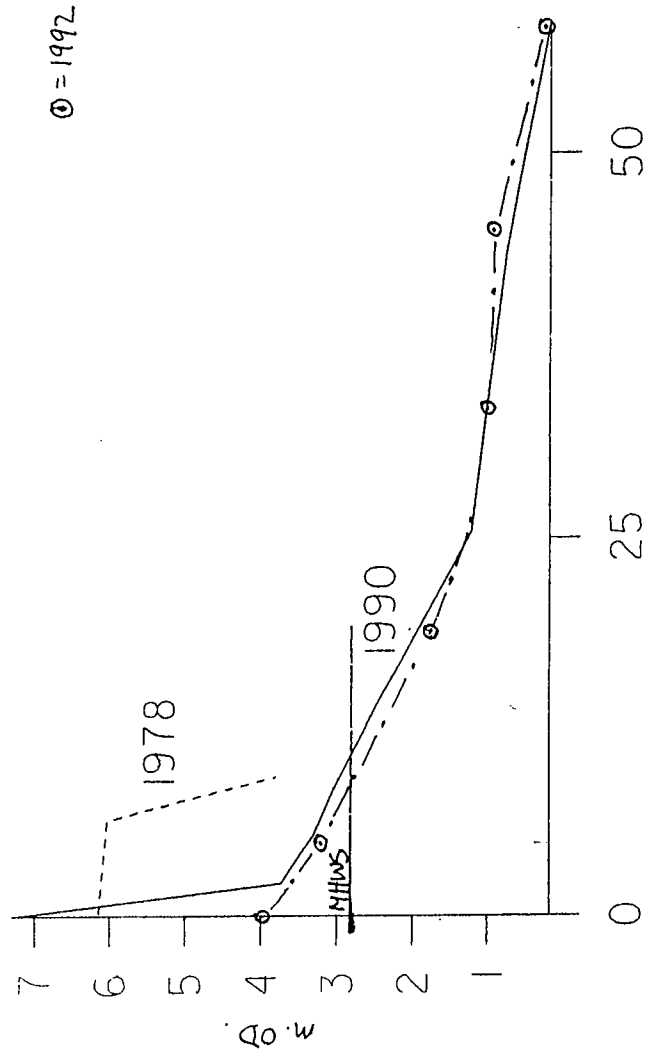
Site: BAR POINT

Vertical max: 4.8550metres

Vertical min: -.1790metres

Horizontal length: 65.5860metres

Vertical



Profile: D

Date: 4-SEP-90

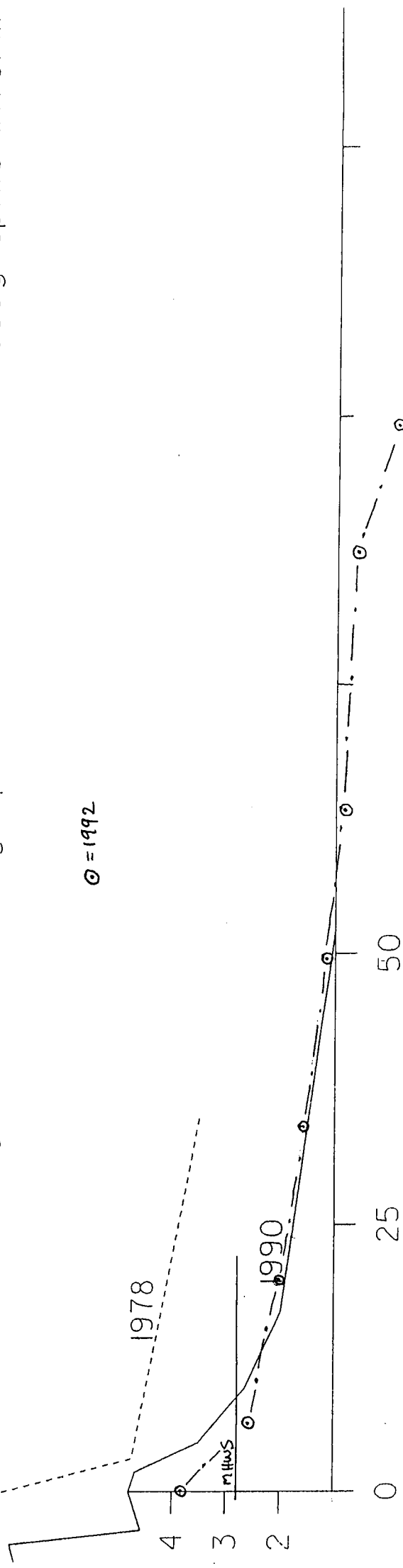
Site: BAR POINT

Vertical max: 7.3000metres

Vertical min: .1750metres

Horizontal length: 58.6760metres

Vert



Profile: E

Date: 4-SEP-90

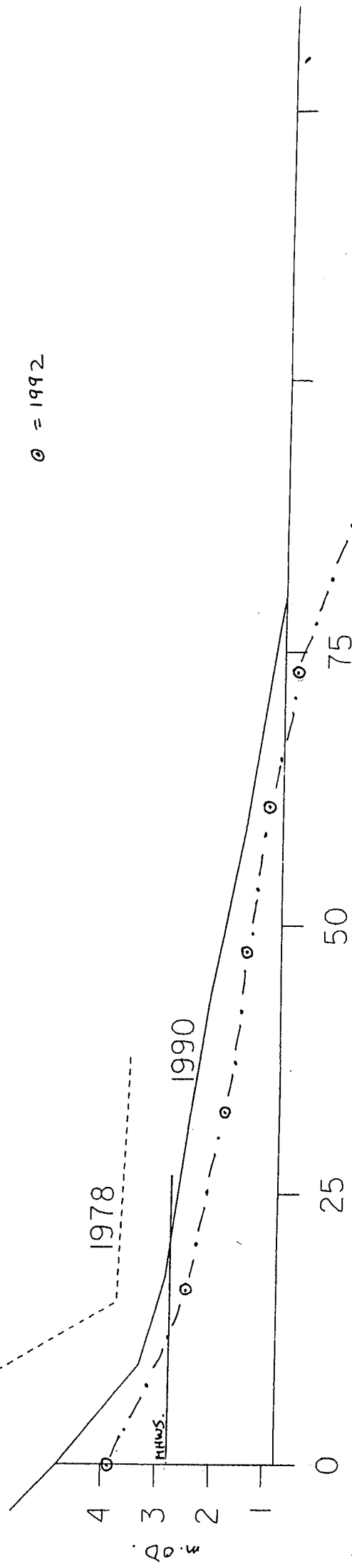
Site: BAR POINT

Vertical max: 4.8120 metres

Vertical min: 1 metres

Horizontal length: 51.9480 metres

Vertical ex

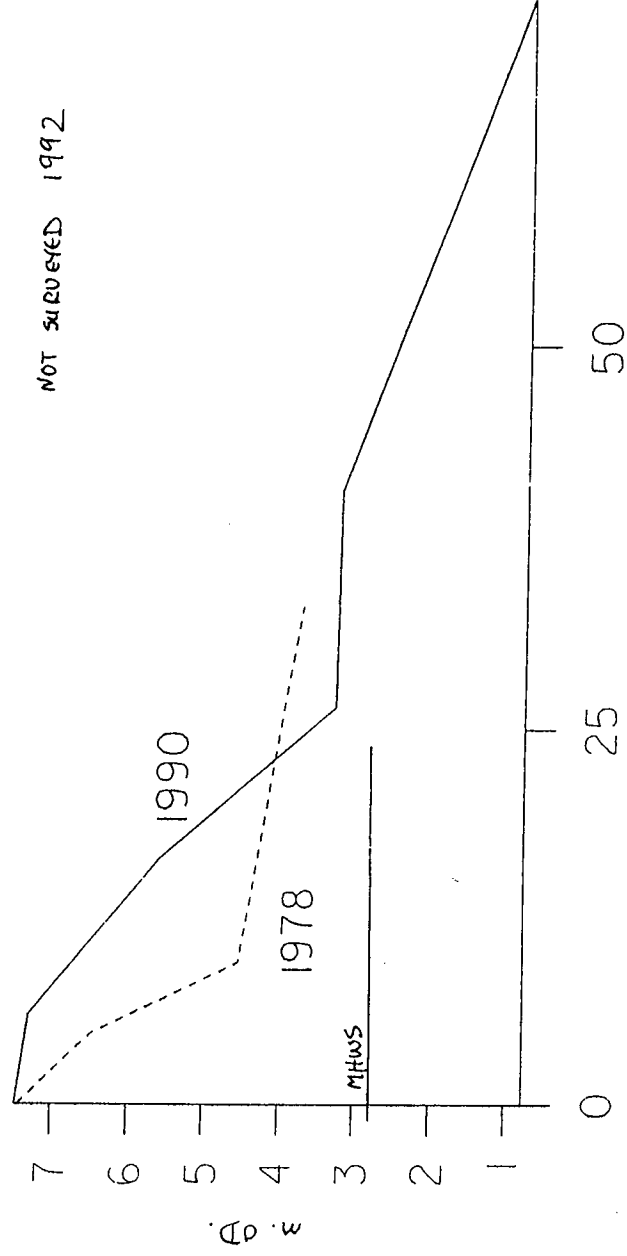


Profile: F

Date: 4-SEP-90

Site: BAR POINT

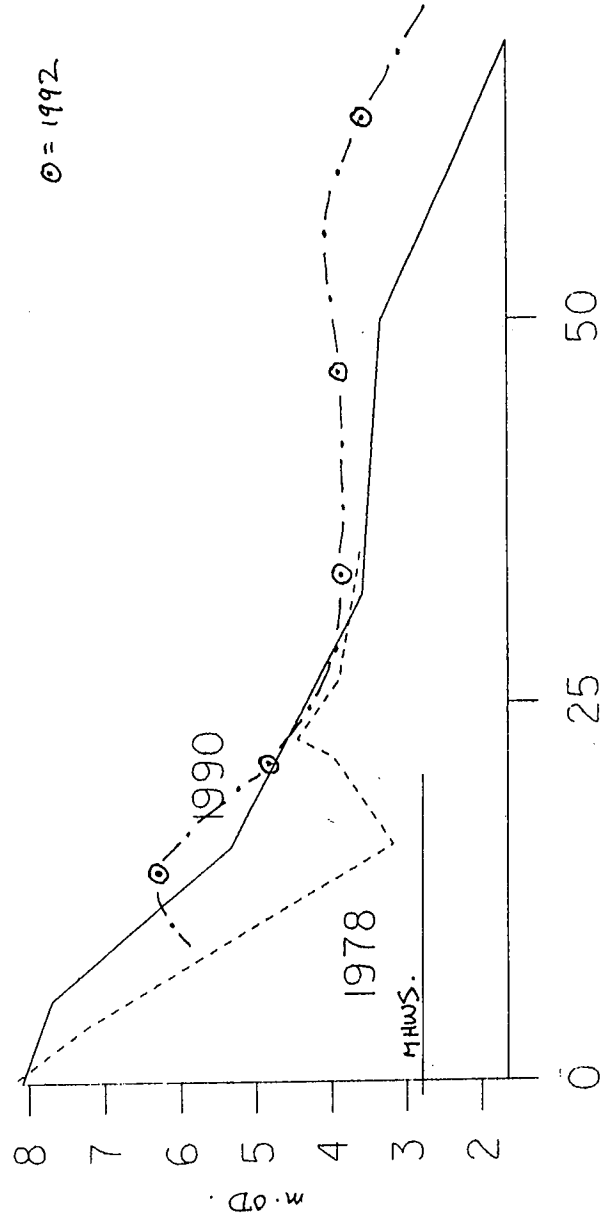
Vertical max: 4.8120metres
Vertical min: .7720metres
Horizontal length: 80.0590metres



Profile: G
Date: 4-SEP-90
Site: BAR POINT

Vertical max: 7.4700metres
Vertical min: .7720metres
Horizontal length: 72.9540metres

Vertic



Profile: H

Date: 4-SEP-90

Site: BAR POINT

Verticalmax: 8.0810metres

Verticalmin: 1.6530metres

Horizontal length: 68.0810metres

Vertical

THE STATUS OF SEA GRASS (*ZOSTERA MARINA*) ON THE ISLES OF SCILLY

Prepared for: The Isles of Scilly Marine Park Committee

By

Brian Cleator, MSc.
(on behalf of Coral Cay Conservation)



NON TECHNICAL SUMMARY

The seagrass *Zostera marina*, also known as eelgrass or sedge, is a perennial, true flowering plant similar to terrestrial grasses. Its range extends throughout Atlantic coasts occurring in European waters from Norway to the Mediterranean. It forms dense beds in shallow marine habitats from LWS to -4m on sheltered sand, gravel or mud.

Extensive seagrass beds are found in the shallow waters of the Scilly Isles archipelago some 25 miles south west of Lands End. These beds are recognised as having great significance for the marine biology of the islands and are amongst the best examples of their kind in the country.

Natural fluctuations in the extent of these beds occurs as a result of storms and other natural events. However, one of the main factors affecting seagrass abundance is a wasting disease which decimated populations on both sides of the Atlantic during the 1930's and 1940's. The Isles of Scilly beds were badly depleted but recovered to an extent by the 1960's. However the disease has re-appeared and was noted during routine monitoring of the seagrass beds in 1991.

This study was carried out in August 1992 to assess the health of the seagrass beds in four locations on the Isles of Scilly. At three of the four sites surveyed, 100% of the plants examined were infected, representing a significant deterioration in the health of seagrass on the Isles of Scilly in comparison with the 1991 survey.

The disease is thought to occur due to the plants being stressed and loosing resistance to infection. Of the many potential causes of stress, two are considered relevant; a combination of low light/high water temperature and water pollution.

There are few sources of pollution on the Isles of Scilly and the water quality is thought to be very good. It is therefore unlikely that contamination has played a part in the infection, although in the absence of a monitoring programme and reliable data this conclusion remains subjective.

Analysis of meteorological data for the period 1985-1991 indicates that generally, the summers become warmer and sunnier until 1990. The following summer of 1991 was very dull, although not excessively cooler by comparison. The occurrence of the lowest tides in the Islands are in the middle of the day exposing plants to the highest temperatures and most intense sunlight, causing desiccation to which this particular seagrass species is very susceptible. The dull summer of 1991 could also have caused stress by decreasing the efficiency of photosynthesis, especially if it coincided with increased seawater temperatures. Although there has been an increase in southern, warm water species in the Western Channel, there was no upward trend in the monthly maximum seawater temperature during the period 1985-1991.

Therefore, from the evidence, it is not possible to suggest a single factor which may have induced the epidemic with any degree of confidence.

It is possible that the seagrass could recover from seed although recruitment from this source is known to be poor in subtidal seagrass populations similar to those on the Isles of Scilly.

The recent records of Japweed (*Sargassum muticum*) on the Isles of Scilly give considerable cause for concern as this aggressive species is known to supplant seagrass where the beds are damaged or denuded.

The seagrass on the Isles of Scilly provide a valuable habitat for fauna and flora and is important to the ecosystem of the Islands. It may also play a role in reducing erosion of sediments.

It is suggested some action is taken to increase our understanding of the biology and ecology of this species and take active measures to prevent further damage and depletion occurring. It may be possible to rejuvenate areas by replanting with mature seagrass plants germinated from seed collected from the Isles of Scilly populations.



Plate 1: A typical bed of the seagrass Zostera Marina on the Isles of Scilly

INTRODUCTION

The seagrass *Zostera marina* L. is a true flowering plant and one of three *Zostera* species recorded in British coastal waters. It is distributed throughout Atlantic coasts, in Europe occurring from the Arctic to the Mediterranean. In the British Isles *Z. marina* is found in fully marine situations and occasionally estuaries from LWS to -4m, favouring intertidal/shallow subtidal habitats on firm substrate, typically sand or sandy mud. The plants resemble terrestrial grass with strap-like leaves up to 1m long. They grow in dense aggregations or beds which can cover significant areas of seabed (*Plate 1*). All *Zostera* species are perennial although they may adopt an annual strategy under certain conditions. Flowering occurs from June to October but recruitment from seed is likely to be limited (Churchill 1983), vegetative propagation being more important.

Extensive *Z. marina* beds are found on the Isles of Scilly in the shallow water between the main group of islands. On a large scale, these beds are dynamic with advancing and receding edges and changes in coverage. Storms and other forms of disturbance can effect some of the fluctuations observed. Historically however, more extreme changes in the abundance and distribution of *Z. marina* have occurred due to the so called 'wasting disease' which severely and simultaneously affected this species on both sides of the Atlantic during the 1930's. This condition is recognised by black lesions on the leaf surface which quickly spread, causing the leaf to die within a few weeks. After two or three seasons of constant defoliation, the rhizomes will become discoloured and perish (Den Hartog 1987). A slime mould of the

genus *Labyrinthula* is recognised as being responsible for the condition (Vergeer and Den Hartog 1990).

Muehlstein *et al* 1988 found four *Labyrinthula* species present in *Z. marina* beds of which only one was pathogenic and produced the symptoms of the disease. Due to the difficulties in differentiating between *Labyrinthula* species it has previously been concluded that the pathogenic organism is usually present in some other less aggressive form (Short *et al*, 1988). Alternatively the disease may be consistently pathogenic in the *Z. marina* populations but at a lower level of infectivity. Examples of wasting disease lesions have been found from herbarium specimens of *Z. marina* dating back to well before the 1930's (Den Hartog 1989), (Vergeer and Den Hartog 1990). It is evident therefore that a factor or factors exists which stimulate the epidemic. A reduction in disease resistance caused by stress or disturbance is one likely mechanism. Some of the potential causative agents considered are as follows: low irradiance, temperature, alterations in current flow and pollution (Short *et al* 1988). From evidence in the literature, ie Buchersbaum *et al* 1990 and Burkholder *et al* 1992, it is speculated that stress may cause a metabolic imbalance in the plant reducing the production of complex organic compounds which are involved in preventing infection and epiphytism. However no common stressing factor has been identified which would account for the ubiquitous and simultaneous occurrence of the infection.

Although the underlying cause is not fully known there is evidence from the western Channel and North Sea that once again *Z. marina* is in decline (Short *et al* 1988).

The *Z. marina* populations on the Isles of Scilly are recognised as being of national conservation importance and regarded as probably the best examples in the country, both the epibiota and infauna are well developed and diverse (Hiscock 1983). On the Scilly Isles seagrass was little affected by the outbreak of the wasting disease in the early 1930's but declined significantly in the late 1930's and early 1940's. However, Lously (19--) indicate that a recovery had occurred by 1952. Observations made in 1991 by Fowler (1992) indicated that *Labyrinthula* infection has re-occurred. The extent of infection was investigated by counting the number of infected plants in a 0.25m² quadrat in two locations English Island and Old Grimsby Harbour. The proportion of infected plants was 26.8% and 27.2% respectively. By comparison, no infection was noted during a 1988 survey.

The decline reported is therefore likely to be indicative of a significant deterioration in the status of *Z. marina* on the Isles of Scilly. Since seagrass beds are regarded as important habitats extensive deterioration of *Z. marina* populations may have serious ramifications for the marine ecology of the Islands.

The aims of this study were to assess the extent of infection within the *Z. marina* beds on the Isles of Scilly and to develop survey methodologies for use in subsequent investigations.

The following investigation was conducted in co-operation with English Nature as part of the Coral Cay Conservation Isles of Scilly Expedition. The work was mainly carried out by volunteer divers who had participated in conservation work as part of the Coral Cay's programme of work in Belize.

METHODS

Three *Z. marina* beds were located in different areas of the Scilly Isles, to the west of English Island, Old Grimsby Harbour and to the south west of Appletree Point in the Bryher Tresco Channel as illustrated in *figure 1*. Each site was marked with an anchored buoy and fixed by compass bearing.

A pair of divers was assigned a randomly generated bearing and three random distances between 0m and 50m. Once on the sea bed the diver pairs attached a 100m tape to the anchor and swam in the direction of their bearing until reaching the first assigned distance. A 0.25m² quadrat, divided into quarters (0.0625m²), was placed against the tape and each diver counted the number of infected/uninfected plants and blades in each quarter of the quadrat. If no *Z. marina* was evident at the assigned position the divers were instructed to continue their swim along the bearing or to search up to 5m either side of the tape until some was located. Having completed the first distance the dive pair moved on to the next position along the tape.

Score	Description
1	No infection
2	Slight infection, small unconsolidated dots.
3	Moderate infection, separate patches.
4	Severe infection, consolidated patches.
5	Very Severe infection, Majority of blade covered.

Table 1. Qualitative scale of seagrass condition.

Labyrinthula infection was recognised as dark brown marks on the blade surface. An example was illustrated to the divers before the survey commenced. Some plants were covered with an epiphytic filamentous brown algae which had to be carefully removed to expose the surface of the blade beneath.

Counting the blades as they moved in the current proved to be difficult and the survey teams adopted the practise of one member holding the blades clear whilst the other counted. It should be emphasised that this method was designed to avoid harming the *Z. marina* plants.

A qualitative score from 1-5 indicating the extent of infection as detailed in *table 1* was given to each quarter and the results recorded. In addition notes were taken on any biological or physical features evident in the survey area. The data were analyzed using Single Factor Analysis of Variance.

Climate data for hours of sunshine, mean monthly maximum temperature and the number of gales were also examined. In addition figures for Monthly Maximum Sea Temperatures for the area 40.0N, 50.5N, 003W, 007W of the Western Channel were analyzed for the same period.

The Isles of Scilly

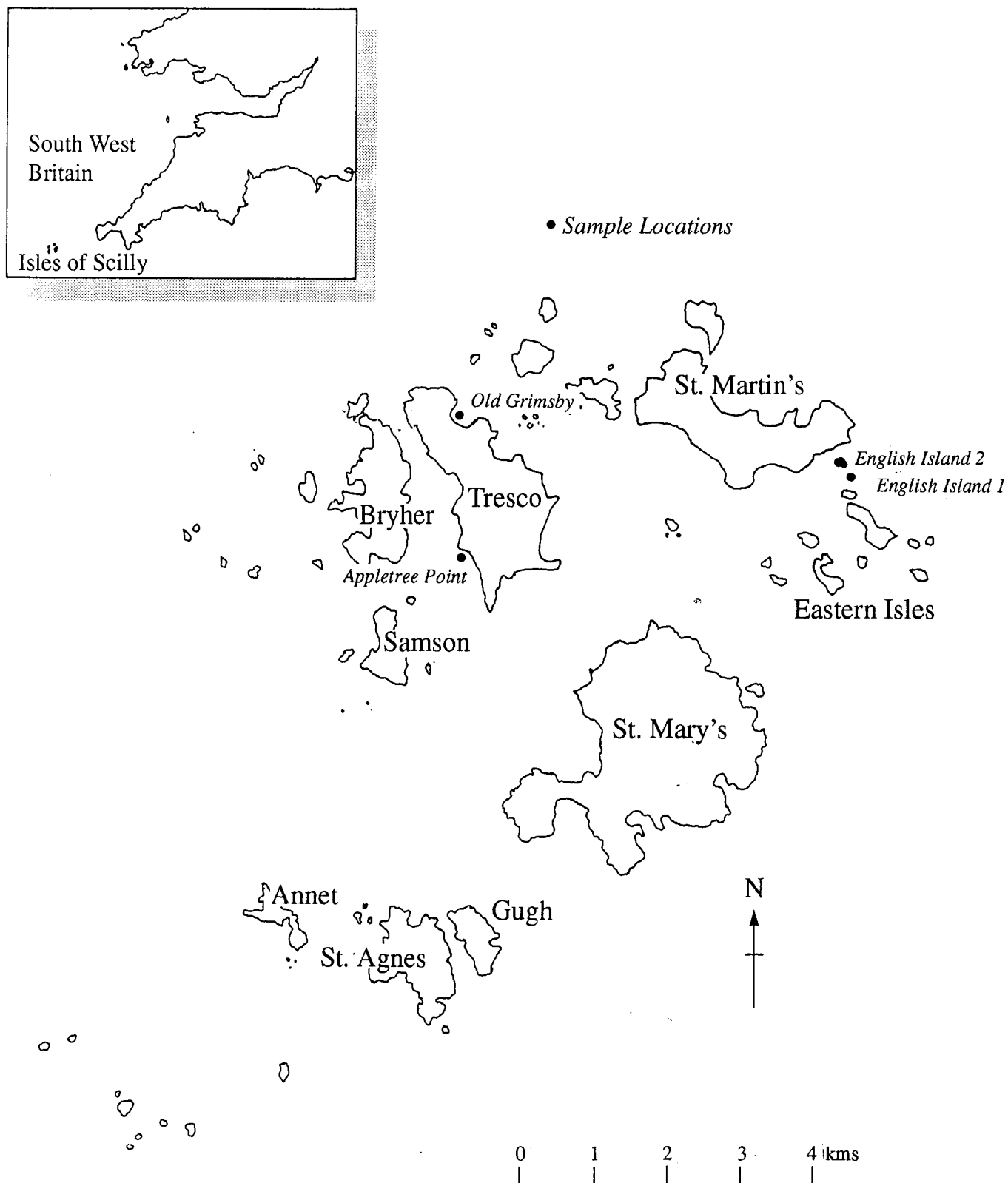


Figure 1: Diagram of Sampling Locations

RESULTS

The sampling programme was severely limited by the extreme weather prevalent during the survey. Some difficulty was experienced in locating large areas of *Z. marina* and the beds generally appeared to be fragmented, consequently two sites were surveyed at English Island (English Island sites 1 and 2) the first being the smaller. Similar problems were encountered at the Appletree Point site although further sampling was prevented by bad weather. Overall the most extensive beds were located at English Island and Old Grimsby.

All the *Z. marina* beds sampled were severely affected. At three of the four sites, 100% of the surveyed plants had infected blades. The remaining site at Appletree Point had 45% of infected plants (*table 2.*). This site was peculiar in that a larger number of very young shoots were noted, a number of which appeared healthy and uninfected.

In general divers reported that growth of epiphytic filamentous brown algae was wide-spread. Specimens of *Sargassum muticum*, a fast growing brown macroalgae, were also noted particularly at English Island and in the Bryher Tresco Channel. All sites were in the high sublittoral or low intertidal zones with poorly mixed, medium to coarse sand substrate. The depth measurements, made by divers depth gauge, are considered accurate to $\pm 0.5\text{m}$.

As a measure of the extent of infection the mean percentage of infected blades was correspondingly high at all sites ranging from 71% at the Appletree Point to 90% at English Island site 1.

A single factor analysis of variance of the percentage infected blades was carried out to test the Null Hypothesis: *Equal mean percentages of infected blades between the four sampling locations.*

The results indicated that there was no significant difference between the mean percentage infected blades at all four sites at the 95% confidence level.

The condition factor scores were variable within each site. The extent of infection ranged from 1 to 4 occurring at each location. Infection was also varied between the blades of an individual plant. It was noted that the younger blades tended to be less severely infected than the more mature examples.

Observations on the climate of the Isles of Scilly between 1985 to 1991 indicate that the weather became generally warmer and sunnier during the period 1985-1990, with particularly fine weather in the summers of 1989 and 1990. The summer of 1991 was particularly dull with 116 hrs total of bright sunshine, compared to an 50yr average for July of 207hrs. By comparison the bright sunshine figures for March and October were 128.7 hrs (50yr average 129hrs) and 117.3 hrs (50yr average 117hrs) respectively. The winter of 1989 -1991 was notably stormy with gales on 7 days. The monthly trends for hours of bright sunshine, mean monthly maximum °C and number of gales are illustrated in *figs 2, 3 and 4.*

No significant trends were established in the maximum seawater temperature data over the period studied (*fig 5*). Small yearly variations in summer temperatures were noted, 1985 and 1989 being slightly warmer in comparison with the other years.

Figure 2 Maximum Hours of Sunshine 1985-1991 (inclusive)

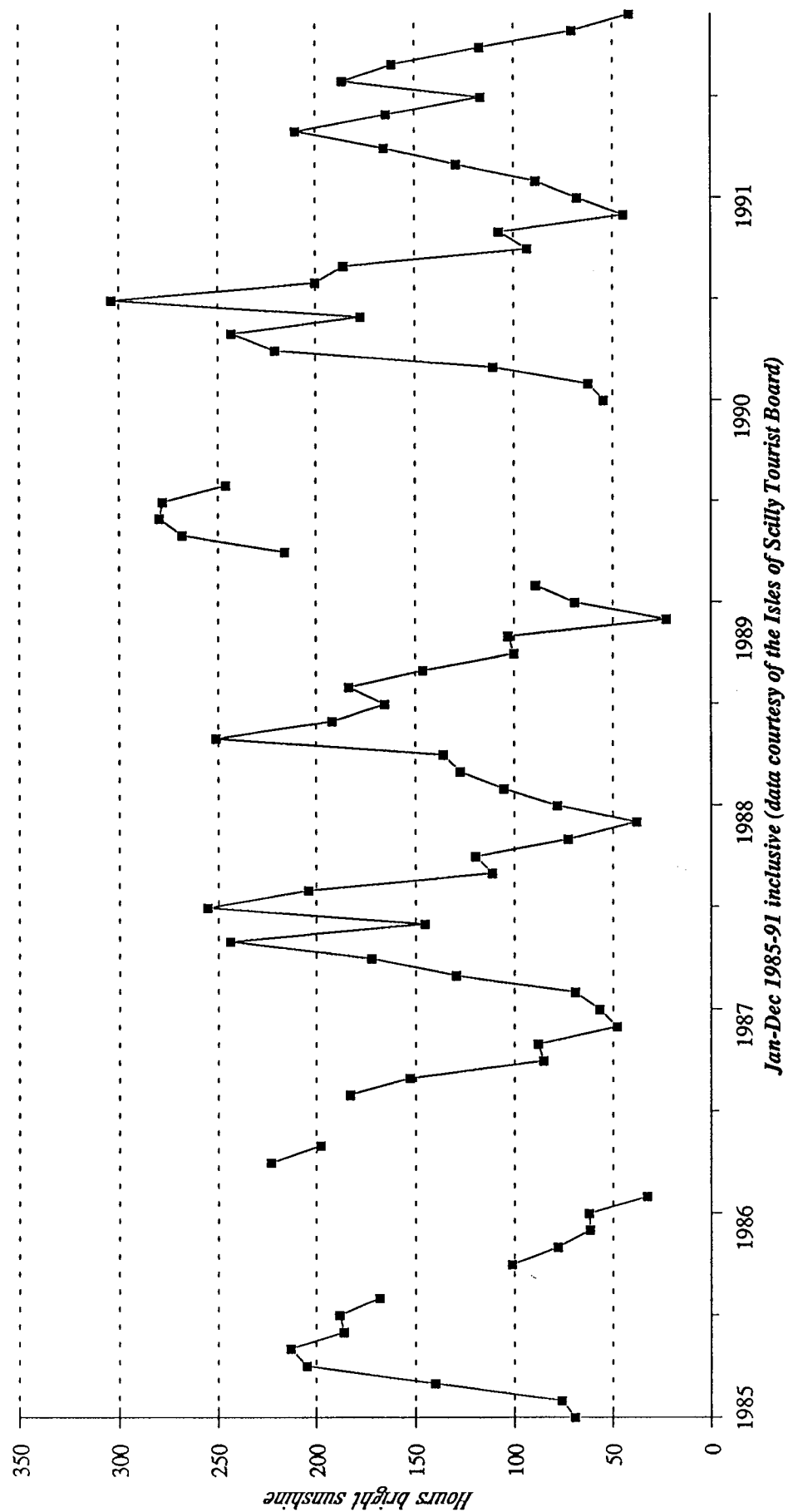


Figure 3 Monthly Maximum Temperature from 1985 - 1991 (inclusive)

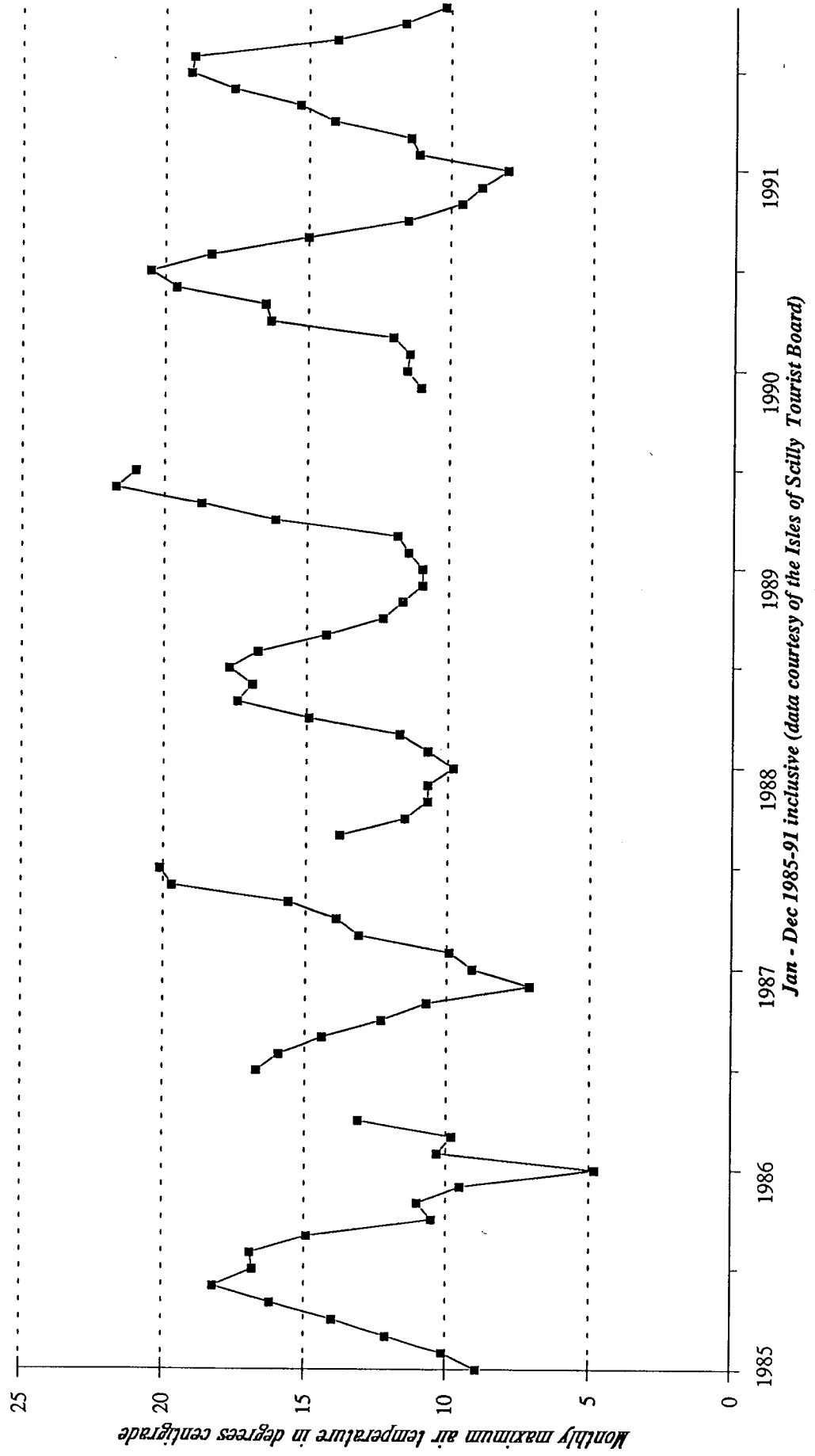


Figure 4 No. of Gales 1985-1991 (inclusive)

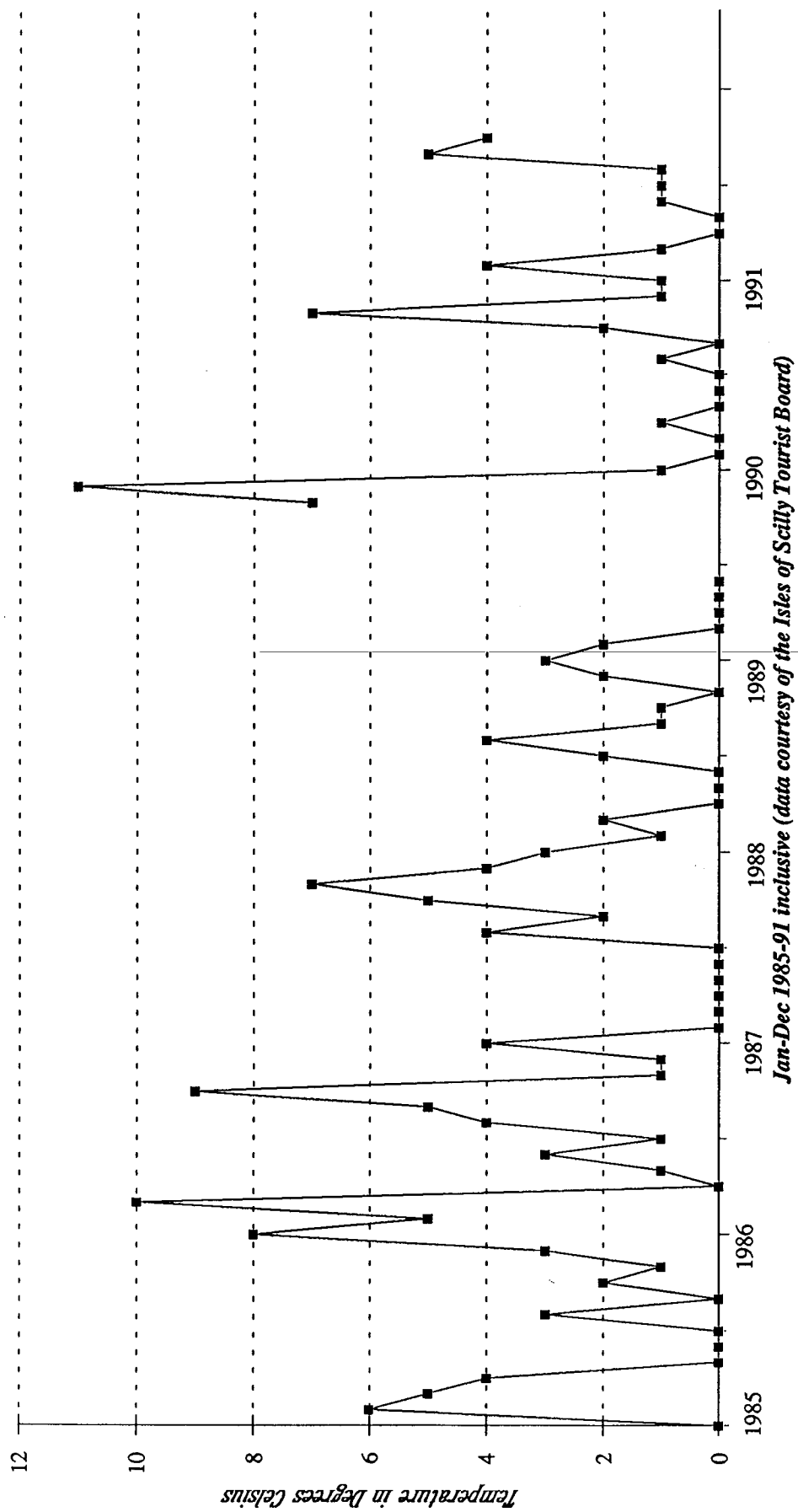


Figure 5 Maximum Sea Temperature 1985-1991 (inclusive) for the area 40.0N, 50.5N, 003.0W, 007.0W

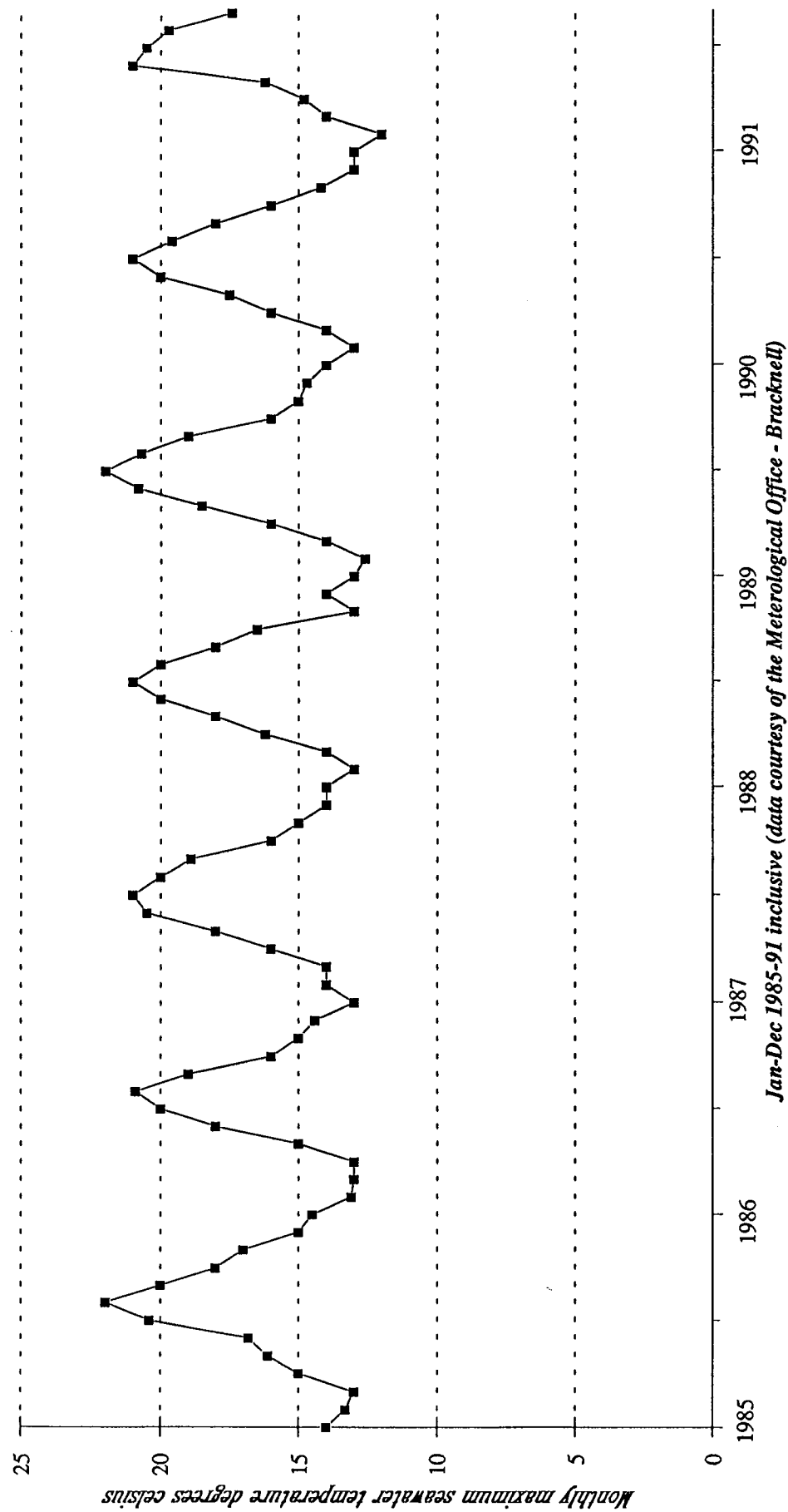


Table 2: Summary of Results

	English Island 1	English Island 2	Old Grimsby	Appletree Point
Position	49° 57' 36N 006°16'25W	49° 57' 42N 006°16' 40W	49° 57' 56N 006° 19' 60W	49° 56' 60N 006° 20'39W
Site description	Towards the eastern end of Higher Town Bay, St Martins, approximately on the location of the English Nature Site. Diffuse patches of <i>Zostera marina</i> . Epiphytic algae noted.	Slightly inshore and to the west of English Island 1. The <i>Zostera marina</i> more dense and consistent here than in English Island 1. Some <i>Sargassum muticum</i> noted. Epiphytic algae noted	North west of Block House Point, Tresco in Old Grimsby Harbour. Small boat mooring nearby. Dense, consistent beds present covering a relatively wide area. Epiphytic algae noted.	In the Bryher Tresco Channel south west of Appletree Point. The <i>Zostera marina</i> beds in this location were patchy but had relatively large proportions of young plants. <i>S. muicium</i> noted in area. Epiphytic algae noted.
Depth at LAT	+0.7m	-0.7m	-0.2m	+0.9m
Mean No. of infected plants	100	100	100	45
Mean % of infected blades	90	76	87	71
Mean condition factor (range)	N/A	3 (1-4)	2 (1-4)	2 (1-4)
No of quadrats sampled	6	15	18	7

DISCUSSION

The condition of the *Zostera* beds on the Isles of Scilly appears to be poor. The Appletree Point site is slightly healthier than the others with a much lower proportion of plants infected. However, the infection amongst individual blades, although on average the lowest recorded, is not significantly different from the other sites as measured by the analysis of variance. This may be accounted for by a comparatively large number of infected blades amongst the older plants and low infection in the younger shoots. In general smaller leaves from other sites appeared to be less badly infected in comparison with older specimens.

It has been suggested that the end-of-year die-back of summer leaves may resemble *Labyrinthula* infection, complicating diagnosis (Den Hartog 1989). However the survey of by Fowler (1992) was conducted in September (1991) when such degeneration would be more advanced, yet the levels of infection were less than noted during this study. In addition during the 1992 survey, a large numbers of smaller leaves were infected and the characteristic brown spot lesions, on the less severely affected blades, were noted at all sites.

It is suggested that infection is likely to be more severe later in the season as the condition of the plants start to deteriorate (Short *et al* 1988), further emphasising the decay observed in seagrass condition in comparison with the 1991 survey.

The reasons for the outbreak of the wasting disease in Scilly are not clear. There are potential sources of pollution on the islands, particularly from sewage during the summer, fertilisers and pesticides from the flower industry and antifouling materials from the boats. However, it is thought the amount of pollution discharged within the archipelago is small and the dispersion good. The Old Grimsby site was the most likely to be affected by contamination due to the boats moored in the harbour and the nearby dwellings but the *Z. marina* was no worse infected than at the other locations. Although the epiphytic growth observed on the blades was reasonably extensive at all sites, no other potential indications of nutrient enrichment were noted or have been reported.

Stress due to unusual climatic conditions could provide an alternative explanation. In general the water temperature around the Isles of Scilly is influenced by oceanic water from the Atlantic. However, maximum temperatures in the Western Channel between 1985 and 1991 did not indicate an upward trend. This is interesting in the light of the increased success of warm water species in the Scilly Isles (Fowler 1992) and along the south coast in general which tends to indicate that there has been a warming of the Western Channel.

Although, during the summers of the late 1980's, local warming of shallow waters would have occurred, temperature alone is unlikely to have stressed the seagrass significantly (Giesen *et al* 1990). However a combination of high water temperatures and low irradiance may encourage infection. Unfortunately, no data on inter-island water temperatures are available and therefore a definitive conclusion can be made.

It may be significant that the low spring tides occur around the middle of the day exposing the plants to the brightest sunlight and highest temperature when the water is at its shallowest, therefore increasing the risk of desiccation to which *Z. marina* very susceptible. In this case it would be expected that the beds higher up the shore would be worst affected. Levels of

infection did not appear to be related to shore height although the most exposed beds may have already receded before the survey was undertaken.

There is therefore no clear indications as to the cause of the *Labyrinthula* epidemic on the Isles of Scilly. The very dull summer of 1991, coupled with the severe storm damage of 1989-1990 and the increased risk of desiccation during the late 1980's, may have been sufficient to stress to the local *Z. marina* populations. The role of pollution cannot be completely ignored until a detailed study of contamination on the islands has been carried out.

There is genuine cause for concern that *Labyrinthula* infection is posing a serious threat to the seagrass beds studied. Some North Atlantic populations of *Z. marina* were completely destroyed in the 1930s and recolonisation has not taken place.

One concern would be the effect of *Z. marina* die-back on sediment stability. Increased erosion would be expected with subsequent dispersion of seed and nutrient rich sediment, possibly creating conditions unsuitable for recolonisation.

The brown macroalgae, *Sargassum muticum*, is known to supplant *Z. marina* in areas where the beds have been damaged. *S. muticum* was frequently observed growing amongst the *Z. marina* beds in the Isles of Scilly and could form an alternative climax community if they were significantly reduced. It is also suggested that the green algae, *Enteromorpha* sp. may recolonise depleted *Z. marina* beds although there is no evidence this is happening in the study area. The presence of *S. muticum* is the most significant difference between the decline in the late 1930s and the current situation and may prevent reestablishment of extensive *Z. marina* beds. Recovery of the seagrass community would depend on the ability of the *Z. marina* to recolonise and recruitment of other species from the plankton and relict populations. Some species may not be able to successfully recolonise and may become locally extinct.

The location of the Isles of Scilly infers a special importance on the *Z. marina* beds as they may act as corridor habitats for species migrating north from *Z. marina* populations in warmer water. There is evidence to suggest that this may already have occurred following the unconfirmed sighting of a wrasse species normally associated with seagrass beds in the Mediterranean (Fowler 1992)

On the Isles of Scilly, limited regeneration is possible from the seed store although recruitment from seedlings is poor in *Z. marina*. Therefore in the event of a complete decline of *Z. marina* it may be necessary to reestablish the beds by artificial means although this would require collection and storage of viable seed from the Isles of Scilly populations which may be genetically distinct from those of other locations around the British Isles.

FURTHER WORK

Given the importance of the *Zostera* beds on Scilly it is strongly suggested that a program of further work is established. This program would consist of two parts: Monitoring and Research.

Monitoring

- The methods used in this survey could be improved by removing the plants for examination on the surface. This would allow a more detailed analysis of the extent of infection in each plant and any subsequent relationship with age.
- The extent of the beds should be accurately mapped possibly by using aerial photography.
- Permanent survey stations should be established.
- The health of the beds should be studied throughout the year, if possible including stations from the inside and bed margins. It may also be instructive to follow the course of infection on individually tagged plants.
- The spread of *S. muticum* should be monitored.
- This monitoring should include a detailed analysis of the epiphyte communities as they can be indicative of nutrient enrichment.
- A programme of environmental monitoring is introduced to Scilly. In the first instance nutrients, turbidity, salinity and temperature should be measured at regular intervals. Additional analysis for pesticide residues and TBT should also be carried out. This work should include monitoring of tissue burdens in the *Z. marina* plants.
- Further locations should be studied particularly the beds in St Mary Harbour. As this is likely to be the most polluted site this may allow comparisons to be made with other cleaner locations.

Research

- Viable seed should be collected to allow reintroduction experiments to be carried out.
- The significance of *Z. marina* in modifying sediment transport and flow regimes should also be investigated. This may assist in artificial recolonisation attempts and could help predict the consequences of severe die-back.
- The ecology of *Labyrinthula* should be examined.
- The function and occurrence of protective phenolic compounds should be investigated as this may be affected by stress and so allow infection.

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**4.3 PRELIMINARY ENVIRONMENTAL ASSESSMENT OF
DESALINATION PLANT OUTFALL,
St. MARY'S, ISLES OF SCILLY**

Prepared for: The Isles of Scilly Marine Park Committee

By

Brian Cleator, MSc.





Plate 1: Base of ram cliff showing origin of transect and point of discharge.

INTRODUCTION

During the late 1980s the Isles of Scilly suffered a long period of below average rainfall. The length and severity of the drought threatened the water supply from the underground aquifer on the main island of St Mary's, particularly during the summer months when the island's population was increased by visitors. In response, the Isle of Scilly Council purchased and installed a de-salination plant on the east coast of St Mary's to insure continuity of supply.

This assessment is concerned with the impacts of the discharged de-salination waste water on the intertidal and nearby coastal environments. A brief habitat survey was carried out along a transect from the cliff base to the lower shore. The transect marks used and the discharge are illustrated in plate 1. Identifications were carried out in the field and the common species noted.

SITE DESCRIPTION AND EFFLUENT DETAILS.

The de-salination plant is situated to the south of Pelistry Bay on the east coast of St Mary's. The outfall is located just north of Gap Point at the base of a 'ram' head cliff and discharges beneath a number of large boulders onto the upper shore. The outfall is not visible and was inactive during the visit. The path of the effluent, which trickles between the boulder at low tide, was indicated at the top of the shore by a white discolouration on the rocks taken to be crystallised salt.

The shore at this location is exposed to the east and the substrate consists of a bedrock outcrops and rounded boulders 2-3m in diameter. Numerous crevices, with some cobbles and sand, were noted between the boulders; there were however very few rock pools. The shore remained very uniform down to the sublittoral fringe. *Plate 2* features the view towards the origin of the transect from the *Fucus serratus* zone.

The components of the effluent are detailed in *table 1*. In total approximately 450m³ of effluent would be discharges during a twenty four hour operational period.

Component of effluent	Constituent	Volume
Brine reject	Brine at 55 ⁰ /∞ salinity Scale inhibitor, polyphosphate	17.7m ³ /h
Filter washwater	Seawater cationic polyelectrolyte	11m ³ /dy
Cleaning chemicals	0.2% HCl 0.1% EDTA/NaOH 0.25% H ₂ O ₂ /acetic acid 0.5% Caustic detergent.	?

Table 1: Effluent details.

COMMON SPECIES IN MAJOR BIOLOGICAL ZONES

The survey was carried out over two hours from 1200 hrs BST on the 29/8/92. Low tide was at 1330 hrs BST. (Devonport) and was predicted at LAT + 0.1m.

The upper and mid shore were dominated by prosobranch molluscs and barnacles. Further down, algae dominated. In general, algal cover became increasingly dense and was observed to grow higher up vertical rock faces with distance from the top of the shore. In the lowest level, the *Fucus serratus*/*Laminaria digitata* zones, very little rock was exposed .

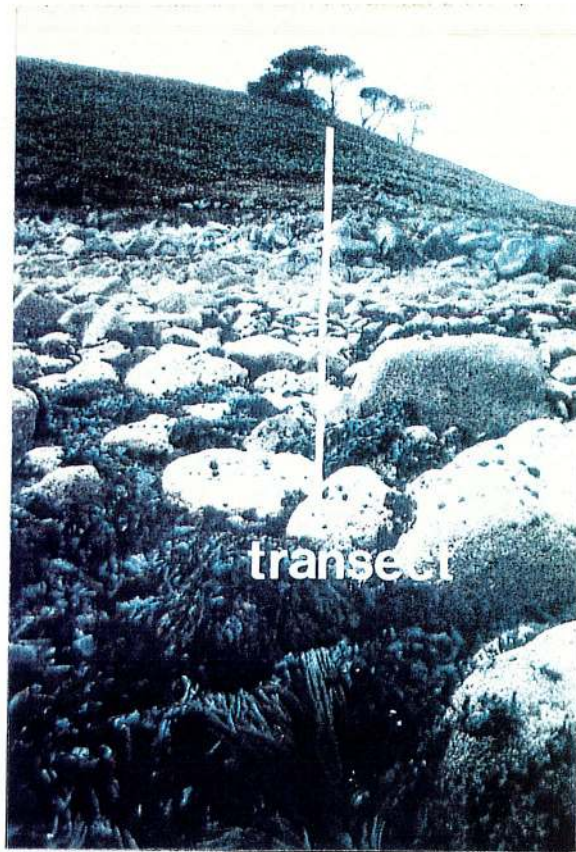


Plate 2: View towards the origin of the transect from the *Fucus serratus* zone.

Pelvetia Zone:

The substrate consisted of rounded boulders of 1-2m in diameter and some cobbles. The tops of the boulders were dominated by prosobranchs and lichens, with some *Pelvetia canaliculata*.

Species List

Lichina pygmaea ✓
Verrucaria maura ✓
Pelvetia canaliculata ✓
Fucus Spiralis ✓
Littorina saxatilis ✓
Monodonta lineata ✓
Patella vulgata ✓

Patella Zone

Boulders 1-2m in diameter with some cobbles (20cm wide) between. The tops of the boulders were dominated by prosobranchs. A number of limpets were observed which may be *Patella depressa*. *F. vesiculosus* and the red algae *Laurencia pinnatifida* were also noted from the crevices between the boulders.

Species List

Enteromorpha sp.
Ulva sp.
F. vesiculosus
F. spiralis
Laurencia pinnatifida
Encrusting red
Littorina mariae
Gibbula umbilicalis
Patella vulgata
P. depressa?

Fucus Vesiculosus Zone

In general the boulders were of a less regular size. Algal cover is very sparse.

Species List

Enteromorpha sp. ✓
Colpomenia peregrina ✗
F. vesiculosus
Corallina officinalis
Lomentaria articulata ✓
Gigartina stellata ✗
Chondrus crispus ✗
Palmaria palmata ✗
L. mariae ✗
P. vulgata ✓
Nucella lapillus ✓
P. depressa?
Chthamalus sp ✓
Actinia equina ✓

Fucus serratus Zone

Boulders of 1-2m in diameter with some cobbles and gravel between. Algal cover is more consistent.

Species list

Enteromorpha sp.
Fucus serratus

C. peregrina
Himanthalia elongata
 Encrusting red
Lomentaria articulata
G. stellata
C. crispus
L. pinnatifida
P. palmata
Callophyllis laciniata
Gastroclonium ovatum
Spirorbis sp.
N. lapillus
Gibbula cineraria
P. vulgata
P. aspersa
Pisidia platycheles?
Chthamalus sp.

Laminaria digitata Zone

More rounded boulders of less regular size between 3m-0.5m in diameter. Some very large *P. vulgata* were noted. Rock surfaces almost totally obscured by a dense growth of brown algae with *Cladophora* and red algal turf (plate 3) as an understorey.

Species List

Enteromorpha sp.
Ulva sp.
Cladophora rupestris
H. elongata
Laminaria digitata
F. serratus
G. stellata
Membranoptera alata
Gibbula sp.
P. vulgata
L. mariaae
Chthamalus sp.
A. equina
 Porifera (Orange) ?



Plate 3: Algal understorey on the lower shore.

IMPACT ASSESSMENT.

Shore communities

The rocky shore communities of this site are similar to the 'Fairly sheltered shore' type (51, 5b) of Hiscock 1983. With the exception of the possible presence of dark footed limpets (*P. depressa*) found in the *Patella* zone, none of the species recorded were considered rare or unusual and have all been previously identified from the Isles of Scilly.

A tentative identification of *P. depressor* was made on the basis of the dark coloration of the foot and the shape of the shell. The characteristic chalky coloration of the tentacles round the mantle margin was however not apparent. Despite subsequent examination of the specimens by the National Museums of Scotland, Curator of Molluscs, Dr David Hepple the identification remains unverified. If a positive identification could be made, the site would be considered of local conservation importance.

Impact of discharge

Further information on the components of the effluent would be required before it is possible to comment on the overall impact of the discharge. Certain constituents have the potential to be acutely toxic if discharged in sufficient concentrations. In particular adjustment of pH

would be critical and should be carefully controlled.

The discharge of polyphosphonate and the caustic detergent may cause some very local nutrient enrichment. No mention of the Chemical Oxygen Demand (COD) was made on the discharge information provided by the manufacturer, however this is unlikely to be significant.

At low tide the effluent is likely to trickle amongst the boulders to the lower shore without coming into contact with the fauna and flora to any significant extent. Although many intertidal organisms can withstand an increased in salinity and temperature for short periods of time, organisms where effluent accumulated would be vulnerable. However no rockpools were found in the effluent path. If the effluent flows over surface rock it is likely to cause mortality of sessile biota. There may also be some localised increase in the growth of green algae, for example *Enteromorpha sp* due to reduced grazing and increased nutrient supply.

At high tide under calm conditions, the effluent may form a discreet flow of dense hypersaline water moving offshore over the seabed; this stream could continue for some distance before becoming fully mixed with the surrounding seawater. Under these conditions of low dilution the biota over which the effluent passes could be impacted. Under more energetic wave conditions the hypersaline water flow would be dissipated quickly.

One additional area of concern relates to public exposure to the effluent which is in close proximity to the coastal footpath.

MITIGATION

If there is concern over the impact of the discharge it is suggested that the following actions are taken:

- Measure salinity periodically in the vicinity of the outfall over different locations and tidal conditions.
- Verify the identification of *P. depressa*.
- Analyse the discharged effluent periodically.
- Seek detailed toxicity data. If this was not available acute toxicity tests such as Microtox or LC₅₀ should be undertaken.
- Strict guidelines for the use of chemicals in the plant must be implemented to avoid accidental discharges.
- Resurveyed the site after a prolonged period of discharge.

If necessary dispersion of would be improved by discharging below LAT on the surface so that mixing of the effluent occurs through the water column. This would be possible through a small bore flexible pipe buoyed at the surface.

REFERENCES

Hiscock, K., 1983
NCC report on sublittoral monitoring on the Isle of Scilly



5.1 EXPEDITION LOG

Friday 21 August: Five members of the group met at the Dolphin pub in Penzance last night. Pete, Bill, Richard, Gordon and Carolyn swapped diving stories until late but didn't quite manage to change Bill's mind about his weighting system!

Up at 07.15 hrs. today to meet the rest of the group at the dock. Amazingly, no one was late - even the British Rail overnight-sleeper disgorged Geoff and Cath on time. The boat was loaded onto the Isles of Scilly Steamship Company Ferry, the Scillonion III, together with a container-load of expedition equipment and stores. The Scillonion sailed at 09.45 hrs. A running commentary from the Bridge kept us all amused and 2 hours later we caught sight of the Isles of Scilly - what a fantastic place!

A bunch of very friendly and helpful dock-hands off-loaded our kit and delivered it to the Old School House on St. Mary's. The boat was towed around to the beach and moored on a mooring kindly provided by English Nature, who also provided us with a large store room located on the quay for storage of expedition diving and scientific equipment. On the quay we met Colonel Robertson, the Duchy of Cornwall's representative, and Terry Tiler, the Harbour Master. At the School, we met the by now famous Caretaker, 'Smudge' Smith. We are 'camping out' in the local school hall. No problem here except that the kitchen is also the access point for the local library.

Jim Heslin, who runs a dive operation on St. Mary's, has agreed to supply us with air, although we might have some difficulty in getting the afternoon 'empties' to him before he closes shop for the day. Tonight we dine at the Pier House Cafe.



Saturday 22 August: Day 1 of the expedition and everyone was up at 06.00 hrs. One of us was found asleep in the kitchen having been driven out of the main sleeping area by walrus-like snoring from a certain individual! Breakfast came and went.

One of the engines on the Rib is playing up which Pete spent most of the morning fixing (blocked carbs.). No diving this morning which was just as well as it's been pouring buckets. We walked back to the school and made up survey quadrats for use later in the week. A small gale cruised through Scilly which blew out one of the windows of the Mermaid pub. Things look a little dodgy for a while, but by 14.00 hrs. the weather had cleared and we headed around to Deep Point for our first dive in Scilly (and Dave's "best ever dive in the UK".).

Having locked our gear away for the night, we retired to the pub. On returning to the school, it was discovered that Pete had forgotten to buy any 2-stroke oil, so it looks like someone is in for an early morning walk tomorrow to the petrol station (well volunteered Pete!).

Sunday 23 August: Today it rained - very hard! Admittedly, it was dry when we first awoke to the sound of Bill's melodic alarm clock at 05.00 hrs., but by the time the first wave of divers left the dock at 07.30 hrs (actually 08.30 - they were obviously working to GMT not BST!), it was really coming down.

Today's task was to begin sediment surveys at Bar Point. A series of leading-lights were placed on the shore to mark the locations of underwater survey transects. However, on arrival at the site the second wave of divers were rather alarmed to find that the sophisticated set-up of old crates and sticks which served as transect markers were being removed by a passer-by who had erroneously assumed them to be discarded litter. A variety of non-standard dive signals and shouts from the divers served only to confuse further the completely baffled beach-comber. The survey was completed without further incident and after a well-deserved shower(Carolyn 'mistakenly' ended up sharing hers with an entire Cricket Team from New Zealand!) we retired to the local to blow the throth off a few cool ones.

Monday 24 August: Today's 'Day Group' won the race for the earliest risers as Cath had set her alarm for 05.30 hrs. The smell of fresh coffee, tea etc. had the rest of the team stirring by 06.00 hrs. Rain in the morning was followed by more of the same in the afternoon.

Despite poor weather, strong tides, drifting marker-buoys and GPS problems, we have now successfully completed 70% of the surveys at Bar Point. A BIG thankyou to Cyril Nichols, who kindly offered us the use of the good ship Melsa, owned by English Nature. Cath & Dave saw a seal during their survey dive - a female aged 4-5 years according to Cyril. She circled once to have a closer look, then came in close to nibble Cath's fin. According to Cath, she had beautiful eyes.

The day's surveys finally ended at 1930 hrs. and by the time we had refilled tanks, and filled out survey recording forms back at the school, it was 21.30 before we staggered to the Bishop & Wolfe for some nose-bag and a pint. It was revealed that "Auntie" Babs, Kenna and Gareth have covertly been conducting surveys of a less scientific nature since their arrival in Scilly, and we are assured that their report, entitled "The Good Food and Drink Guide to St. Mary's" will be made available at some future date.

Tuesday 25 August: The dawn rolled in with all the majesty of a Reliant Robin - a very damp start to a very damp expedition. Last night fourteen of the fifteen volunteers finally fell asleep at 05.45 hrs. when Bill's gargantuan adenoids shuddered to a halt for a few minutes rest. Breakfast despatched, we set about the tasks before us, which for the Day Group included making elephant noises and strange sandwiches.

The survey's went ahead without any hitch whatsoever (!) and we completed the Bar Point surveys. Cyril, accompanied by his two daughters, Coral and Crystal, lent us his expertise (and boat) for the day. Brian, Rob and Crystal disappeared to Bryher to collect some scientific items; they also 'collected' a drifting speed boat!

A film crew from TV Southwest filmed us in action today.

Wednesday 26 August: Up with the sparrows (guess what the weather is like today!). A mammoth bout of snoring by Bill kept many awake for most of the night, and was abated on briefly when Brian rather rashly planted a big wet kiss on Bill's smacker!

In celebration of completing the Bar Point work, we did a "fun-dive" off Gap Point - fantastic marine life. Unfortunately, the boat electrics have been playing up and unknown to us, the transmit button on the VHF had jammed on much to the annoyance of Terry the Harbour Master!

Pete and Carolyn did some filming with yet another film crew, this time from IMMedia Ltd who were making a promo for IBM computers. A dolphin jumped clear of the water whilst filming.

The afternoon was dedicated to surveying Eel-grass beds near English Island. Not a bad site for the work although Brian thinks we should look for an alternative location. Pete and Carolyn continued their underwater 'acting' for IMMedia.

The last wave of divers left for the survey site at 17.30 hrs - another long day!

Thursday 27 August: Dave had enough of the snoring and beat a retreat to the luxury of a B&B. We continued eel-grass surveys, completing 18 in the morning. However, a very low tide in the afternoon made it almost impossible to do any surveys - the site of fully-kited divers wallowing about in less than 2ft of water was hilarious. The afternoon was spent analysing sediment samples collected from Bar Point. Pete and Carolyn continued filming - an attempt to shoot Pete typing on a submerged IBM computer in the harbour at night was aborted. Brian and Rob braved the elements to make a trip over the Bryher, and in the evening we all gathered in the Bishop & Wolf for refreshments.

Friday 28 August: The day it DIDN'T rain, and the film crew finally left us in peace. We continued with Eel-grass surveys - only a few more to complete. The first wave was jinxed: Gordon's HP hose burst, a strong current made diving impossible at one site and we couldn't locate much Eel-grass at the alternative location, topped off by Cath loosing her weight belt (which was heroical retrieved by Brian). The second wave managed to get marooned on Tresco because of a very low tide and were forced to take refuge in the pub! Wave three to the rescue: this bunch of dedicated divers managed to complete most of the remaining surveys.

To the Pub, where Carolyn valiantly subdued a ferocious Jumbo Sausage. This being Cath's last night with the expedition, the majority returned to the School after being finally turfed out of the pub, woke Gareth up and persuaded him to part with his stash of rum. Pete came up with the brilliant idea of drinking this on the beach in time-honoured CCC fashion, but it turned out that this is one custom which really doesn't translate too well from Belize to the UK, and the bunch of frozen revellers were soon beating a hasty retreat to the sanctuary of the kitchen.

Saturday 29 August: The luxury of an extra half-hour in bed was much appreciated, especially by last night's revellers. Cath, who was up early for Day Group duties, was so struck by how attractive everyone looked lying on their backs snoring that she recorded the moment on video, much to the annoyance of Brian (who, as anyone unfortunate enough to witness the site will agree, looks particularly suave first thing in the morning, especially when trying to stuff his t-shirt inside his Y-fronts).

Fun-diving today - this time on the Lady Charlotte, a large but broken-up wreck thought to be carrying oil. The rest of the day was a bit of a wash-out - literally! The engines on the Rib also started to act-up and so the afternoon's diving had to be cancelled. We waived farewell to Cath, who returned to the mainland this afternoon.

Sunday 30 August: Bit of an uneventful day. Some fun diving and a bit of packing-up done in anticipation of our departure tomorrow. There is a general feeling of sadness and depression amongst the team, many of whom consoled themselves with a walk around the island.

Monday 31 August: Some of us spent the morning diving from Jim's boat. We dived a wreck site, followed by a swim with seals - what a fantastic experience, although one young female took a dislike to Mark and bit through his dry suit.

Back on St. Mary's we all indulged in some frantic packing and cleaning activity. The boat was loaded onto the Scillonian III, followed by a series of good-bye's to all those we had got to know during our time in Scilly. The Scillonian landed us safely back in Penzance late in the afternoon and we were soon heading our own separate ways home.

We are all indebted to the generous support offered by the inhabitants of St. Mary's and everyone who helped make the expedition such a success.



THE SCILLONIAN III - ISLES OF SCILLY STEAMSHIP COMPANY

5.2 BUDGET

Income:	Expedition Fees	£2300.00
		<u>£</u>
Expenditure:	Ferry transportation	550.00
	Transportation - St. Mary's	30.00
	Accommodation	280.00
	Car parking	24.75
	Breathing air refills	246.00
	2-stroke outboard oil	57.73
	Fuel	405.51
	GPS batteries	36.09
	Printing	13.75
	Food	173.00
	Report production	300.00
	Misc.	<u>102.51</u>
	Total	<u>2219.34</u>
Balance:		£80.66

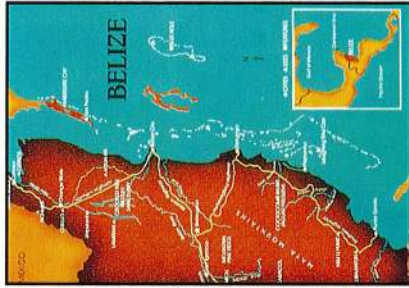
5.3 CORAL CAY CONSERVATION BROCHURE

WHAT IS CORAL CAY CONSERVATION?

Coral Cay Conservation (CCC) is an independent, non-profit making organisation established to provide the government of Belize with scientific expertise and resources to assist with the development of management initiatives for the protection and sustainable use of the country's coastal marine resources. The CCC Charitable Trust has been established to provide funds for training of Belizeans in resource management skills.

WHY THE BELIZE BARRIER REEF?

The reef, the second largest in the world and described by the United Nations Environment Programme as "unique in the Western Hemisphere on account of its size, its array of reef types and the luxuriance of corals thriving in such pristine condition", is now under threat.



WHAT IS THE PROBLEM?

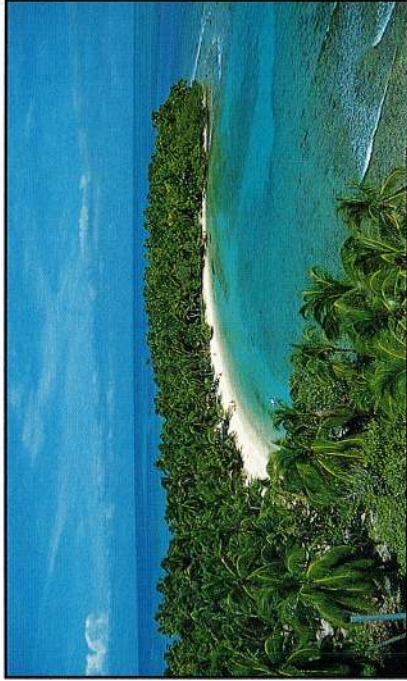
Rapidly increasing tourism together with industrial and agricultural development are contributing to the destruction of this important ecosystem. The projected sea level rise as a result of global warming will have a major impact on this rich resource.

WHAT ARE WE DOING ABOUT IT?

CCC has been asked by the Government of Belize to establish the country's second marine reserve at South Water Cay and devise management plans for the protection of the marine resources around the Sapodilla Cays. This will be achieved by teams of volunteer divers working under the guidance of qualified marine scientists, and in collaboration with research centres worldwide.

THE EXPEDITIONS

Coral Cay Conservation (CCC) is looking for volunteers with a keen interest in conserving one of the World's greatest barrier reef systems, to join one of a series of major scientific expeditions to Belize. Expedition volunteers will be based at CCC's field station on the barrier reef for an initial period of four weeks.



Satellite expeditions are based on Hunting Cay

Volunteers remaining on an expedition for more than four weeks may be asked to join one of several satellite expedition teams to survey remoter parts of the reef. There will be an average of two dives a day, when the conditions are appropriate, with the majority of dives dedicated to survey work.

Volunteers will be expected to participate in every aspect of the expedition, from cooking and cleaning to general maintenance and repair. Each expedition is divided into teams, with each team having responsibility on a rotational basis for one or more aspect of expedition life, including organisation of dive teams, preparation, operation and maintenance of equipment as well as daily tasks such as cooking and cleaning. Each month volunteers are encouraged to visit sites of interest on the mainland such as the virgin rainforests, the Mayan ruins and the jaguar and howler monkey reserves.

THE SURVEY METHODS

The survey methods adopted by CCC are specifically designed to be used by non-scientifically trained divers.



Divers surveying reef communities

During the training period, new arrivals dive with more experienced volunteers from the previous months expedition in order to provide one-to-one training.

Surveys take place along transects which are accurately fixed using Global Positioning Systems (GPS). At each survey site detailed information about the bathymetry of the sea bed, the relative abundance of marine species in the area, and obvious human impacts is recorded. Information gathered in the field is transferred to a GIS (Geographical Information System) database specifically designed to handle this data. Remote sensing technology (utilising satellite images) has been successfully applied to the inventory and management of coastal marine resources, and the data gathered by CCC is used to classify images of the reef. Remote sensing also offers a non-intrusive method of monitoring changes within and between habitats that may be subject to disturbance.

Long-term monitoring of marine habitats will be accomplished by establishing a series of permanent monitoring sites in the southern sector of the reef.

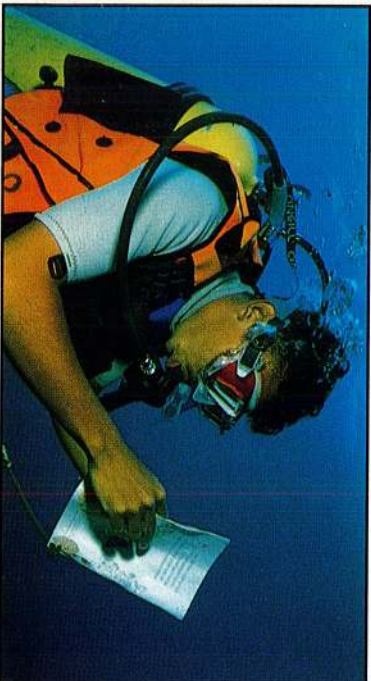
COLLABORATION AND TRAINING



A Belizean trainee

One of the priorities of CCC is the provision of training for Belizean nationals in order that much of the survey work currently being undertaken by CCC can be run entirely by Belizeans. CCC currently offers 24 Scholarships annually which include dive training and development of marine identification and survey skills.

CCC has also signed a working agreement with the University College of Belize (UCB) whereby CCC will assist UCB with the establishment of a marine research station, and the development of UCB's marine studies programme.



A Belize trainee using U/W ID book

The CCC Charitable Trust has been established to provide funds to support the training scholarships. The Trust was launched in 1991 at the London Zoo and is administered by Trustees in the U.K. and Belize. Funds for the Trust are raised through donations from the private and public sectors, and from the proceeds of fund-raising events.

"Well I'm home now and sun obsessed. The expedition was everything I'd hoped that it would be. As my awareness of conservation rose so did my determination to do my 'bit' for something I believed required preserving."

ANN HARDY - BRITISH AIRWAYS MAGAZINE, OCTOBER 1991

"I will never forget my first dive....when I looked under the surface at this underwater universe I gasped - I don't think I've been so wide-eyed and amazed since I was five years old."

LIZ HOWARTH - THE GUARDIAN, JULY 1991

.....

MEMBERSHIP FEES

The cost to join a Coral Cay Conservation Expedition is :

PERIOD	COST (Fully Inclusive)
28 DAYS	£1675
56 DAYS	£2600
84 DAYS	£3200

To find out more about Coral Cay Conservation contact:

CORAL CAY CONSERVATION
THE SUTTON BUSINESS CENTRE
RESTMOR WAY
WALLINGTON
SURREY
SM6 7AH
TEL: 081 669 0011
FAX: 081 773 9656

FAVORITES

PRESIDENT:
Prof. David Bellamy

HONORARY PRESIDENT:
Jonathan Porritt

PATRONS:

Field Marshal Sir John
Chapple, CCB CBE (President,
Zoological Society of London)

David Macmillan (British
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Prof. Stewart Sutherland
(Vice-Chancellor, University of
London)

Prof. Eric Sunderland (Vice-
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Prof. Struther Arnold (Vice-
Chancellor, University of St
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(Commander, British Forces
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Brigadier Christopher Elliott
(Commander, British Forces
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Belize, Designate)
Derek Ellerty (Chairman,
British Sub-Aqua Club)

Mike Holbrook
(National Diving Officer, British
Sub-Aqua Club)
Dr Nick Trembling (Science
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Christian Ide (President
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SCIENCE ADVISORS
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Advisor, IUCN)
Professor Paul Ryan
(President CMAAS Scientific
Committee)

Andrew Phillips (Mullard
Space Laboratory)
David Gray (GIS Expert)

ENVIRONMENTAL POLICY
ADVISOR
Sarah Davidson (LSS -
Environmental & Scientific
Consultants)

EXPEDITION ADVISOR
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(Director, Raleigh International)

DIVING ADVISOR:
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Ltd)

Ragna Thorsen (President,
CMAAS Technical Committee)

MEDICAL ADVISOR:
Dr John Foreman (Sub Dean,
University College & Middlesex
School of Medicine)

FINANCIAL ADVISOR:
John Maitre (Manager,
National Westminster Bank
plc)

CORAL CAY CONSERVATION



DIVING EXPEDITIONS:-

THE BELIZE BARRIER REEF

Since 1990 Coral Cay Conservation has been taking volunteer divers to Belize to survey the world's second largest barrier reef. The survey work is undertaken on behalf of the Government of Belize to assist with the establishment of Marine reserves.

This is your chance to get involved.



1992
Winners

DIVE TO CONSERVE



Coral Cay Conservation Ltd
Sutton Business Centre
Restmor Way
Wallington
Surrey
SM6 7AH, UK.
Tel: 081-647 8848
Fax: 081-773 9656

CORAL CAY CONSERVATION NEWSLETTER



NUMBER ONE
JAN/FEB 1993

President:
Prof. David Bellamy

Honorary President:
Jonathon Porritt

Patrons:
Field Marshal Sir John Chapple,
GCB CBE, President,
Zoological Society of London.

David Mackilligan
British High Commissioner,
Belize.

Prof. Stewart Sutherland
Vice-Chancellor,
University of London.

Prof. Eric Sunderland
Vice-Chancellor,
University of Wales.

Prof. Struther Arnot
Vice-Chancellor,
University of St. Andrews.

Brigadier Richard Lambe, MBE
Chief of Staff, UNFICYP.

Brigadier Christopher Elliott
Commander, British Forces
Belize.

Derek Ellerby
Chairman,
British Sub-Aqua Club.

Mike Holbrook
National Diving Officer,
British Sub-Aqua Club.

Nic Flemming, Ph.D.
Science Advisor, CMAS.

Christian Ide
President, CMAS.

Science Advisors:

Andrew Price, Ph.D.
Special Advisor, IUCN.

Prof. Paul Ryan
President, CMAS Scientific
Committee.

Andrew Phillips
University College London.

**Environmental Policy
Advisor:**

Sarah Davidson, Ph.D.
ISS-Environmental &
Scientific Consultants.

Expedition Advisor:

Major Peter Ormerod
Director, Raleigh International.

Diving Advisors:

Bjorn Thorsen
President, CMAS Technical
Committee.

Gerry Pearce
Director, UWI Ltd.

Medical Advisor:

Dr. John Forman
Sub-Dean,
University College
& Middlesex School of
Medicine.

Financial Advisor:

John Maitre
Manager,
National Westminster Bank plc.

NEW 'FRONTIERS' FOR CCC!

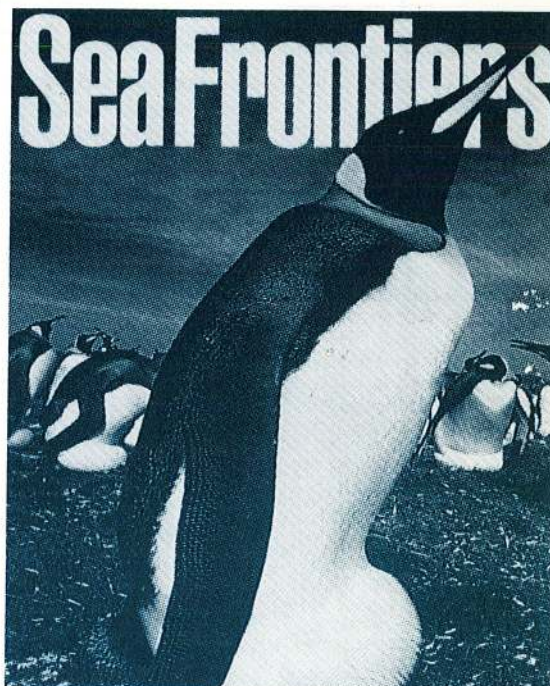
Welcome to CCC's new-style newsletter for 1993, sponsored by SeaFrontiers magazine. The new Newsletter will contain features and articles (together with photographs) about our expeditions to the Belize barrier reef, and our progress towards establishing new marine reserves there.

The CCC newsletter will also keep you updated with what's going on here in the UK, including diving weekends organised by the Sub-Aqua Club, exhibitions and many other events, and will be an ideal way of keeping in touch with the other members of your expedition.

Volunteers will also be encouraged to submit articles and photographs about their own experiences in Belize, and to publicise forthcoming fund-raising events and re-unions.

The new newsletter will be compiled and edited entirely by CCC volunteers and we hope that you will join us in making this new and exciting venture a success.

SeaFrontiers is published by the International Oceanographic Foundation (USA) and Macmillan Magazines (UK) and contains exciting articles about our marine environment, including regular features on marine conservation and protection issues.



SeaFrontiers is one of the most popular marine interest magazines in the USA and its popularity here is growing fast.

The Newsletter will be published bi-monthly and will be sent to you with a copy of SeaFrontiers magazine. The annual subscription to SeaFrontiers is usually £24.00, but the combined CCC Newsletter/SeaFrontiers subscription is yours for only £12!

To subscribe to SeaFrontiers and obtain your copy of the new CCC Newsletter, please return the enclosed application form. The new Newsletter will only be available through this unique subscription scheme.



CCC's Belizean scholars on South Water Cay

LATEST SCIENCE ADVISOR

We are delighted to add Andy Phillips to our list of Science Advisors. Andy was a volunteer on the 1989 CCC expedition and has helped us run the programme from the UK ever since.

Andy is completing his Ph.D. at the Mullard Science & Space Laboratories (Imperial College, London) and his sphere of expertise is in computing. Over the past 18 months, Andy has installed all of the computer hardware and software used by CCC to keep track of our expeditions, and has been instrumental in designing and refining the CCC Science Database. Andy will be returning to Belize in April.

BDMLR TALK

The British Divers Marine Life Rescue are Britain's (if not Europe's!) leading active marine conservation 'task force'. They have been involved in a wide variety of marine conservation and protection projects, including the recent attempts to save Beluga whales from the clutches of the Russian military, and more recently with efforts to save wildlife affected by the catastrophic oil spill in the Shetland Isles.

Representatives from the BDMLR will be presenting a talk on their work at the next Sub-Aqua Club meeting at 8.00pm, 2nd February in the cellar bar at the Oporto Pub (Covent Garden, London).

CCC SUB-AQUA CLUB NEWS

CCC SAC COMMITTEE

Chairman: Jon Ridley (081 647 8848)
Diving Officer: Pete Raines (081 647 8848)
Secretary: Tony Pates (081 861 0373)
Membership Secretary: Hydyn Tanner (071 586 4281)
Treasurer: Debbie Moore (0480 473638)
Training Officer: Tony Dobinson (0243 673387)
Conservation Officer: Dave Gunnersen (0923 248911 x.203)

EVENT ORGANISERS

Mark Evans 021 472 8232
Bill Williams 081 444 6706
Sue Gilbard 081 675 7428
Richard Hall 0924 272611



THE CLUB

The SAC has a membership of over 70 people, comprised of past, present and 'about to be' volunteers. The aim of the club is to provide an opportunity for past volunteers to apply their newly-learned underwater survey skills to conservation projects in the UK, and as a way of keeping in touch with members of your own expedition.

The club also encourages participation from divers who have not been on an expedition but who want to do something useful with their diving. It is also an ideal medium for volunteers who have been accepted for a future expedition to meet with past expedition volunteers and gain 'hands-on' experience in underwater surveys prior to their departure.



CCC-SAC on expedition in the isles of Scilly

CCC SAC DIVING

The SAC diving season usually kicks off in March with a number of training weekends designed to help improve your marine ID skills, and introduce you to the Marine Conservation Society's "Seasearch" programme. The Seasearch programme aims to survey the entire coastal resources of Britain, and we are actively contributing to this worthy effort.

Despite last years poor weather, CCC did manage to survey a section of the W. Sussex coastline as part of the MCS Seasearch programme, and undertook a very successful 10 day research project to survey coastal erosion and seagrass bed communities in the Isles of Scilly, for the IOS Environmental Trust.

This year, we will be continuing the MCS Seasearch surveys along the W. Sussex coast, and will also be returning to the Isles of Scilly.

Other exciting venues include diving Britain's first marine reserve at Lundy Island, the Farne Isles, Skomer Island and the First World War wrecks at Scapa Flow. Members are encouraged to organise diving weekends for the club, and we are always open to suggestions and help.

HOW DO I JOIN IN?

The Membership Fee is £30.00 per year. The club has its own 5.35 Ribtec boat (plus trailer) fitted with twin 40hp outboards and GPS navigation equipment, and is charged out to the club at £5.00 per day per diver.

So, if you fancy getting up to your snorkel in cold, murky water on a UK-based conservation project to map the distribution of Beer Barrels (a gastropod species, honest!), or having your dry-suit nibbled at by an over-amorous seal in the Isles of Scilly, then complete the enclosed membership application and come along to our next club meeting in London. The SAC committee and members meet regularly at 8.00pm on the first Tuesday of each month at the Oporto Pub, Covent Garden.

GET DIVING

For those fortunate enough to already be a member and who want to get involved with some of the great events we have lined up for this season, please indicate this on the enclosed form and return it to CCC.

CORAL CAY CONSERVATION WOULD LIKE TO THANK THE FOLLOWING:

IN BELIZE

Rt. Hon. George Price,
Prime Minister
Hon. Florencio Marin,
Deputy PM
Hon. Michael Espat,
Minister of Agriculture &
Fisheries
Hon. Glenn Godfrey,
Minister of Tourism & the
Environment
The Coastal Zone
Management Unit
Programme for Belize
Belize Centre for
Environmental Studies
Belize Audubon Society
Belize Zoo & Tropical
Education Centre
British Forces
British High Commission
Marelico
Pelican Beach Hotel

UNIVERSITIES, RESEARCH INSTITUTIONS & SOCI- ETIES

British Ecological Society
Imperial College (University
of London)

Joint Nature Conservancy
Council
Marine Conservation
Society
Natural Resources
Institute/ODA
Nature Conservancy
Royal Geographical Society
Silsoe College
Smithsonian Institute
UNESCO
University College of Belize
University College London
University of Edinburgh
University of Wales
University of St. Andrews
Wildlife Conservation
International
World Underwater
Federation (CMAS)

IN THE UK

A.P. Valves Ltd
Airline Publishing
Aldus UK Ltd
ALR Ltd
American Travel Centre
Aqua-Lung UK Ltd
Aqascan International Ltd
Belize High Commission
Boeinger Ingelheim Ltd

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Bridon Fibres Ltd
British Airways
British Sub-Aqua Club
Burton & Smith Ltd
Cameron Books Ltd
Canon UK Ltd
Columbus Travel Insurance
Compass Marine Ltd
Continental Airlines
Coral Marine Ltd
Crown Fasteners & Fixings
Ltd
Dacor
E.P. Barrus Ltd
Earth Images Productions Ltd
Elonex Ltd
Encore Studios
Fathoms & Leagues Ltd
Fyffes Group Ltd
G.G. Searle & Co Ltd
Grasby Dynamics Ltd
Greenaway Marine
Hamworthy Pneumatic Ltd
Hawkins & Manwaring
Horniman Museum
IBM
ICI Pharmaceuticals Ltd
Immedia Ltd
Isles of Scilly Steamship Co.
Isles Of Scilly Environmental

Trust
J. W. Automarine Ltd
Jimmy Green Marine
Kellogg's Ltd
Kodak Ltd
Konica UK Ltd
Longrofts Chartered
Accountants
Magellan Systems (UK)
Maya Airlines
Mayo Motifs Ltd
MMD (Shipping Services)
Ltd
Molyndke Ltd
Navico Ltd
Nikon UK Ltd
O'Brien Haggerty Design
Ocean Voice International
Ocean Optics Ltd
Outboard Engineering Ltd
Pains-Wessex Schermuly
Photofusion Gallery
Provincial Metals
Raleigh International
Raytheon
Rhône-Poulenc Rorer Ltd
Ribtec Ltd
Safeway Stores Plc
Scuba Diving Magazine
Scubapro
SeaFrontiers Magazine

Seahawk Products
Shadowfax Technology Ltd
Sony UK Ltd
Sowester Ltd
Stanley Tools
Stephens Innocent Solicitors
Streamline Props
SustainAbility
Swiftch SL Ltd
T & J Harrison Ltd
Tate & Lyle Plc
TFH Publications
The Wellcome Foundation
TPR Photographic
Trimble Navigation Europe
Ltd
Uniglobe Travel Services
Unilever Export Ltd
Upjohn Ltd
UWI Ltd
Vacation Work Publications
Viking Direct Ltd
Waddington Games Ltd
Wittering Divers
Yacht Parts
Zodiac UK Ltd
Zyma Healthcare

ELSEWHERE

Days Inn Hotels
El Capitan Sport Centre

SAC-EVENTS

JANUARY 23-24 Stoney
Cove (Leicestershire). Fun(!)
diving. Tony Pates

FEBRUARY 2 SAC Meeting
Presentation by British Divers
Marine Life Rescue

7-8 North Wales Quarry/Ice
diving. Mark Evans

MARCH 2 SAC Annual
General Meeting Election of
new committee (nominations
welcome) Charts &
Navigation Workshop by
Tony Dobinson

6-7 W. Sussex MCS
Seasearch Training
Dave Gunnersen

13-14 Swanage (Dorset)
U/w Photography Workshop
Jon Ridley

27-28 W. Sussex MCS
Seasearch training weekend
Dave Gunnersen

APRIL 3-4 Swanage (Dorset)
MCS Marine ID Course
Dave Gunnersen

6 SAC Meeting
9-12 Farne Islands
(Northumberland) Fun diving
Jon Ridley

17-18 W. Sussex
MCS Seasearch
Dave Gunnersen

MAY 1-3 S. Devon Fun
diving Tony Pates

4 SAC Meeting
8-9 W. Sussex MCS
Seasearch
Dave Gunnersen

15-16 Hands-deep
(Plymouth) Fun diving Jon
Ridley

29-31 Lundy Island
(off Cornwall) Fun diving
Dave Gunnersen

JUNE 1 SAC Meeting
11-14 Skomer Island
(W. Wales)

Fun diving Bill Williams
19-20 W. Sussex MCS
Seasearch. Dave Gunnersen

26-27 S. Devon Fun diving
Sue Gilbard

JULY 3-4 Bognor Regis
(W. Sussex) Fun diving
Tony Pates

6 SAC Meeting
10-11 W. Sussex MCS
Seasearch. Dave Gunnersen

17-31 Isles of Scilly
Expedition. Surveys on behalf
of the IOS Environmental Trust
Pete Raines

AUGUST 3 SAC Meeting
7-8 W. Sussex
MCS Seasearch
Dave Gunnersen

14-15 Bridlington (E. Yorks.)
Fun diving Richard Hall

21-22 Farne Islands
(Northumberland)
Fun diving Jon Ridley

28-30 St. Abbs Head (E.
Lothian) Fun diving
Mark Evans

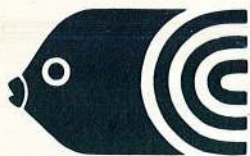
2 SEPTEMBER
7 SAC Meeting
11-12 W. Sussex MCS
Seasearch

Dave Gunnersen
18-26 Scapa Flow
(N. Scotland)

Fun diving Tony Dobinson
OCTOBER 5 SAC Annual
Dinner, Rebato's Restaurant,
London SW8. Pete Raines

NOVEMBER 2
SAC Meeting

DECEMBER 7 SAC Meeting
& Christmas Party



Coral Cay Conservation Ltd
Sutton Business Centre
Restmor Way
Wallington
Surrey
SM6 7AH, UK.
Tel: 081-647 8848
Fax: 081-773 9656

CORAL CAY CONSERVATION NEWSLETTER



NUMBER THREE
MAY/JUNE 1993

President:
Prof. David Bellamy

Honorary President:
Jonathon Porritt

Patrons:
Field Marshal Sir John Chapple,
GCB CBE, President,
Zoological Society of London.

David Mackilligin
British High Commissioner,
Belize.

Prof. Stewart Sutherland
Vice-Chancellor,
University of London.

Prof. Eric Sunderland
Vice-Chancellor,
University of Wales.

Prof. Struther Arnott
Vice-Chancellor,
University of St. Andrews.

Brigadier Richard Lambe, MBE
Chief of Staff, UNFICYP.

Brigadier Christopher Elliott
Commander, British Forces
Belize.

Brigadier Iain Johnstone, OBE
CBF (Designate)

Derek Ellerby
Chairman,
British Sub-Aqua Club.

Mike Holbrook
National Diving Officer,
British Sub-Aqua Club.

Nic Flemming, Ph.D.
Science Advisor, CMAS.

Christian Ide
President, CMAS.

Science Advisors:

Andrew Price, Ph.D.
Special Advisor, IUCN.

Prof. Paul Ryan, President,
CMAS Scientific Committee.

Andrew Phillips
University College London.

David Gray
GIS Consultant

Environmental Policy Advisor:

Sarah Davidson, Ph.D.
Rendel Scientific

Expedition Advisor:

Major Peter Ormerod
Director, Raleigh International.

Diving Advisors:

Bjorn Thorsen, President,
CMAS Technical Committee.

Gerry Pearce
Director, UWI Ltd.

Medical Advisor:

Dr. John Forman, Sub-Dean,
University College & Middlesex
School of Medicine.

Financial Advisor:

John Maitre, Manager,
National Westminster Bank plc.

A FISHY FUTURE

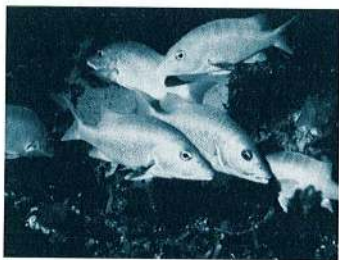
With CCC's baseline survey work around the South Water Cay area drawing to a close, emphasis is now being placed on surveying fish populations. This new survey data will compliment previous CCC data and will be included into the CCC GIS database.

The techniques employed have been developed as a progression of a project undertaken in November '92 in collaboration with the Natural Resources Institute (NRI). Following consideration of a number of fish census techniques which have been employed in previous surveys, and upon advice given by Dr Barry Blake of the NRI, new techniques have now been devised for use by CCC volunteers.

To summarise: CCC dive teams survey transects (100m long) recording the total numbers of fish seen within a 5m wide band. To make things manageable, each diver is only allocated a particular fish group (eg. bottom dwellers) and can therefore concentrate on obtaining accurate counts without being distracted by fish elsewhere in the water column.

The data gathered is numerical (rather than abundance ratings from 0-5) so that an accurate picture of the fish communities will be built up quickly. This will allow us to investigate both the way in which communities vary across the lagoon and reef areas, and to study the changes that may occur over time.

In their efforts to establish correct survey techniques the CCC science team received much help. Special



thanks go to Dr Barry Blake - NRI, Callum Roberts - University of the Virgin Islands, and Rupert Ormond - Tropical Marine Research Unit (York University).

CCC TRAINING SCHOLARSHIPS BEGIN

The 1993 scholarships began in April with Martin Lino and Jorge Kotch being the first two candidates for the two week course. During the course they will learn to dive, undertake a course in tropical marine ecology, and learn to undertake marine survey work.



At present there are another 16 young Belizeans due to come on the course, with the final number who will attend during 1993 being around 24. The scholars come from diverse backgrounds, including government workers, teachers, and members of the tourist industry. We hope that all involved enjoy the training course and go on to use their newfound skills to protect the barrier reef over future years.

The administration of the scholarships takes place through the Fisheries Department and applicants are asked to submit an essay explaining why they feel conservation of the barrier reef ecosystem is important.

The following is taken from one such essay by Sharon Hall: "People must realise that we need to start protecting our barrier reef. Belize boasts the second largest barrier reef in the world. But we have to take care of what we have. The Tourist industry is growing as well as commercial fishing. Whether one realises it or not, the barrier reef contributes a lot to the success of these two industries...."

If the reef is not protected it will quickly disintegrate, robbing Belize of one of her most beautiful natural resources. This would also cause the decline of tourism, commercial fishing, and we would lose the chance to sustainably exploit our barrier reef. Failing to conserve our barrier reef would be disastrous and shameful to the country of Belize"

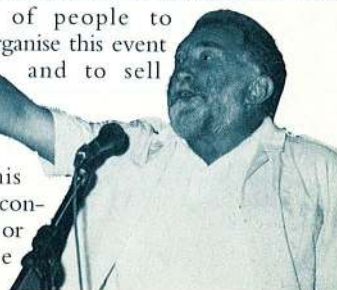
YOUR PRESIDENT WANTS YOU - TO PARTY !!!

A mammoth fund raising event is being planned to raise money for the training of young Belizeans in marine ecology and marine survey techniques. We are recruiting people who want to get involved in the organisation of this bonanza party.

If you have skills in the following areas — Entertainment (recruiting bands, limbo dancers, etc), Sponsorship (attracting sponsorship from drink manufacturers, printers etc), Copywriting, Printing, Designing, Accounting, PR, and feel that you would like to get involved please get in contact. The main criteria is that you will need to work to tight dead-

lines, and have loads of enthusiasm. We need heaps of people to organise this event and to sell

tickets so if you feel that you would like to help organise this event please either contact the office direct, or David Copplestone on 081 673 4027.



TAKE ME TO YOUR LEADER

Tony Read will be leading the July, Aug, September expeditions. Tony splits his time between his careers as a building contractor and a diving instructor, and will be looking forward to meeting the expedition members at the Feathers pub on 12th June at 11.30 am.

SAVE THE WHALES: PART II

We probably all thought that Whales were finally able to roam the oceans of the world free from the threat of attack by Whaling fleets. Sadly this is not so as several countries have expressed their intent to begin Whaling again. If you want to voice your protest over this horrific prospect please write to: Embassy of Norway, 25 Belgrave square, London SW1X 8GD. Embassy of Japan, 101-104 Piccadilly, London W1V 9FN. Tell them why you want them to stop! Further information is available from Greenpeace 071 354 5100.

PROGRAMME FOR BELIZE

While CCC focuses on Belize's underwater world, Programme for Belize (PFB) is concerned primarily with it's forests. CCC actively supports PFB in the UK through assisting their fund-raising efforts and through other collaborative efforts.

The forests of Belize are teeming with wildlife and are home to many endangered species including jaguar, margay, jaguarondi, tapir and crocodiles; they also provide wintering grounds for a large percentage of North America's songbirds.

Programme for Belize is urging everyone to "do their bit" and donate £25 to save an acre of Rainforest. That certainly seems a small price to pay and they are constantly being asked "does it really only cost £25?". The answer is yes! Well it did at the time land acquisition was negotiated, back in 1988. PFB now owns over 202,000 acres of tropical forest, largely made possible by a loan from the US non-profit organisation, The Nature Conservancy. They are now in the process of paying back the loan and fund-raising has gone so well that they are hoping to purchase additional parcels of land in the future which will adjoin the land already owned.

It is unlikely that the forest will be this cheap in the future, but for the moment you can remain assured that £25 will actually purchase an acre of tropical forest. And that's not all! you will also receive a personalised certificate and newsletter twice a year giving you up to date information. They produce a wonderful poster too, as well as a number of teaching aids for Schools.

Programme for Belize in the UK is a project of The World Wide Conservation Trust, which is a registered charity (No. 100129). For an information pack write to PFB, PO Box 99, Saxmundham, Suffolk, IP17 2LB or Telephone 072877 771.

FIELD RESEARCH WORKSHOP CO-SPONSORED BY CCC

CCC's newly formed collaboration with the University College of Belize (UCB) has already thrown up a number of exciting projects which will come to fruition over the coming months.

The first of these projects is a workshop entitled "An Introduction to Field Research in Environmental Sciences" which is co-sponsored by the UCB/ University of Montanna Project, CCC, and the Ministry of Natural Resources.

The workshop will be run over two days on the 3rd/4th May and will cover the following subjects: coral reef ecology, mangrove ecology, mapping techniques (including: use of GPS; remote sensing; use of aerial photography; GIS), design and statistical analysis of data, theory of sediment analysis.

The practical part of the workshop will involve a trip to Middle Long Cay (which is leased by UCB)

and will include work on mangrove ecology, differential GPS (DGPS) data collection, and sediment sampling. The workshop concludes with DGPS data post-processing, and sediment analysis.

CCC will have a number of representatives demonstrating at the workshop including Peter Raines and Andy Phillips who will be giving workshops on DGPS, Denise McCorry who will be giving the coral reef ecology talk, and Dr Rob Nunny who will be running the sediment sampling and analysis, theory and workshop. Dave Gray a GIS expert and science advisor to CCC, will be presenting the section on GIS.

All of the participants deserve thanks for their involvement in this most worthwhile workshop, and thanks go to Phillip Morgan (UCB), for his hard work in organising the workshop.

A QUESTION OF VALIDATION

The CCC survey techniques have proven to be very "user friendly" since first being employed in 1990. However, to answer questions being asked in some quarters of the scientific community principally "just how good is the data" the CCC science team established a data validation programme.

On investigating what validation work has been undertaken by other organisations employing similar survey techniques, it was found that surprisingly little had been carried out. Therefore, the task set before CCC was to devise validation techniques which would stand the test of being judged by the scientific community - in the form of a published "paper".

The validation work took place through the months of February and March and involved 6 teams of 4 divers undertaking 14 surveys (84 surveys in total), and the data gathered is currently being analysed (preliminary analysis of the data looks very promising). Not only will the validation exercise provide useful information on the validity (and limitations) of the CCC data, but it will allow CCC to encourage other countries with similar marine resources to utilise volunteer divers to undertake surveys of their marine habitats.

Throughout the researching of the validation techniques the CCC science team pestered many overworked academics who all responded most kindly

and enthusiastically, many thanks to Dr Barry Blake and Cliff Gay - Natural Research Institute, Dr's Hiscock and Davies - Marine Nature Conservation Review, Dr Kathleen Sullivan - University of Miami, Walter Jaap - Florida Marine Research Institute, Dr David Mills - Joint Nature Conservation Committee, Ezra Nadasen - Port Erin Marine Laboratory.

THANKS TO:

SIMON DAY a solicitor departing for Belize with the May 93 expedition. Simon offered his help with CCC's office move, and expecting to be given a paint brush, was instead swiftly coerced into unravelling the intricacies of the commercial lease. Many thanks to Simon for applying his planet sized brain to our lease agreement, and good luck in Belize.

Thanks also to Isabelle Evans-Freke, Jonathon Hillary, Sharon King, Terry Osborn, Tony Pates, Debbie Ashford, Hilary Minor, Janet Lennard, Sylvie Tops, Mette Lampcov, Fiona Hanaphy, Esmond Foster, Rebecca Jay, Simon Williams, Jacqueline Pearce, Debbie Moore for helping out at the Wembley Dive Show and the Green Show. Also to all of our usual office helpers and interviewers.

MAPPING THE CAYS OF BELIZE - WITH TRIMBLE NAVIGATION

Obtaining accurate position fixes for the transects surveyed by CCC volunteers in Belize has always been a problem, as has the installation of "control points" on various islands for the geometric correction of aerial photographs and satellite images - until now!!

Trimble Navigation, the foremost manufacturer of GPS equipment has taken the decision to support CCC's work in Belize by making available (on a loan basis) Differential Global Positioning System (DGPS) equipment for six months. This means that CCC will be able to install control points in a number of locations which will allow for the geometric correction of images onto which CCC survey data will be overlaid for display as maps. Helping us do this is Remote Sensing Analyst, Mark Baker of Silsoe College. Mark recently won the "Spot



CCC Volunteers

Challenge" competition, giving him a free SPOT satellite image of the Sapodilla Cays. With DGPS ground-control points, we should be able to produce maps accurate to within 10m.

CCC will also utilise this equipment to assist a number of other projects within Belize such as the mapping of the rainforest at Gallon Jug, correction of existing mangrove maps, and mapping of Maya ruins at the Northern end of Ambergris Cay.

CCC hopes that the use of the DGPS equipment in Belize will not only result in the accurate mapping of CCC survey areas, but will also demonstrate to various natural resource managers within Belize the benefits of utilising such easily transportable, highly sophisticated equipment, in their task of mapping the natural resources of Belize.

CORAL CAY CONSERVATION MANAGEMENT TRAINING EXPEDITION WITH GEC

CCC has been working with the major industrial group GEC, to provide a team of the company's young managers with the opportunity to test their skills of teamwork and leadership whilst undertaking survey work as part of CCC's ongoing survey programme.



The CCC/GEC Expedition originated from a meeting in 1991 when Barry Roberts (the Development Training Coordinator at the GEC Management Training College) approached CCC to discuss how CCC might find useful work for a group of young management trainees.

Following this meeting Barry advertised the expedition throughout the GEC group of companies. By mid-May 1992 Barry had gathered together a large group of hopeful applicants who, over a long and sleepless weekend, were put through a series of selection exercises to see which members of the group displayed good teamwork and leadership skills.

Having selected the final team of 14, Barry's task was then to encourage and cajole the team members into gaining the necessary diving qualifications whilst also raising the funds to cover the cost of their expedition. As well as achieving these goals, the GEC team gained support for CCC in the form of a Marconi Satellite Telephone which will travel to Belize as soon as customs and other details are cleared.

After 12 months of hard work the expedition team was waved off at Gatwick airport accompanied by Barry (in his role as "group facilitator"), Andy Parkinson a diving instructor, and Dr Rob Nunny an expert sedimentologist. The team travelled to

the Sapodilla Cays to undertake survey work overseen by Dr Nunny to examine the distribution of sediment types throughout the area, with the aim of providing the information necessary to utilise sediment analysis as a future means of environmental monitoring.

Dr Nunny became involved with CCC through the CCC Sub-Aqua Club expedition to the Isles of Scilly in 1992 where he supervised a sediment sampling project to examine the impact of a local sand dredging operation.

This important work will ensure that not only is the GEC group contributing to the overall efforts of CCC to support the Coastal Zone Management Unit of Belize, but will also give the team plenty to think about in terms of organising themselves as a group on a day to day basis.

We hope that the experience is a fruitful one for all concerned and that in years to come these young managers become industry leaders who will look kindly on expeditions such as CCC!

UK RESEARCHERS MEET TO DISCUSS THEIR WORK IN BELIZE

The rail strike on 2nd April did not deter a large number of researchers from all over Britain from making their way to the Royal Museum of Scotland for a one day conference on research undertaken within Belize by UK-based scientists.

The conference covered many topics including the use of GIS/Remote Sensing, rainforest and savannah research, much of which has been undertaken by groups from the University of Edinburgh.

CCC science coordinator Peter Mumby gave a presentation on research undertaken by CCC. The feedback from the other delegates was very positive, particularly about how much has been achieved by CCC over the past few years. Meanwhile Jonathon Ridley was present to buy fellow delegates drinks in the many

delightful public houses scattered around the Granite City.

The Conference ended on a very positive note with all delegates agreeing that the chance to meet as a group and discuss current research projects was most worthwhile, and a resolution was passed to repeat the exercise again in the near future, and to make contact with a similar group in the US in order that the dissemination of information be widened.

Thanks and Congratulations for organising such an enjoyable and worthwhile day go to - John Burton - Programme for Belize, Sue Chambers - Royal Museum of Scotland, Peter Furley - University of Edinburgh. Thanks also to Crawford and Sally Anne for putting up Peter and Jon during the conference.

WEDDINGS, BABIES AND MORE GOOEY STUFF

CCC is proud to announce that the first wedding (that we know of) of a couple who met on SW Cay will take place this year between Terry Osborn and Sharon King. Those that remember the meeting of these two on the island will wish them happiness for a long and fruitful marriage and hope that they get a sturdy bed for their honeymoon.

Sally-Anne Hunter a Trustee of the CCC Trust Fund is to be married in August of this year to Crawford Hill. Sally-Anne who has helped CCC in many ways including the establishment of the CCC Trust fund, organising the big fund-raising event at London Zoo in 1991, and generally providing no-nonsense advice, actually runs a business with

Crawford based in Edinburgh. We hope that both the marriage and the business are great successes, and that whatever Crawford keeps up his kilt comes in good use during future years.

DR Liam O'Toole, one of the original Directors of CCC, and now a Trustee, and his wife Dr Sarah Davidson, who is a Scientific Advisor to CCC, are to be parents. This happy news started immediate speculation as to whether the child (sex as yet unknown) would be playing rugby for Leicester or London Irish. The immediate division of loyalties between the Irish contingencies and the Northern Counties supporters doesn't override the fact that we are all delighted for both Liam and Sarah.

STATISTICAL ANALYSIS RECEIVES A FILLIP

The CCC science team had cause to celebrate recently when Cocking and Drury (Software) Ltd, announced that they are arranging the long term loan of a "Statgraphics" package to CCC. This will be of invaluable assistance to the science team in their efforts to complete statistical analysis of CCC survey data. Many thanks indeed to Cocking and Drury.

CCC ON GIS

CCC is becoming well versed in the techniques of applying marine survey data to Geographical Information Systems (GIS) and are taking the opportunity to share the knowledge gained with other organisations.

On 4th May Peter Mumby gave a presentation at the RGS one day seminar on GIS for expeditions, where he outlined some of the obstacles which CCC faced in designing a data base which was compatible with the GIS software used in Belize.

CCC president David Bellamy will also be including a section on CCC's work with GIS when he gives the keynote speech at the "GIS 93" conference in Birmingham on May 18th.

NEW CCC OFFICE

CCC will be moving to a new office in early June. The move comes as a result of the need to increase the office space to accommodate the science team and the volunteers who do so much to help with the processing of the survey data.

The new office is in the top floor of a converted warehouse in Clapham, South London, and will include a dedicated "science" room, as well as a lecture room for slide presentations, and a shower and kitchen for sweaty, thirsty volunteers.

As usual we will need help with decorating the new office and in lugging all of our files and computers up two flights of stairs. Any help you can give us in this will be most gratefully received.

'GI'S A GARAGE'

The Club RIB and the ancillary equipment which has so far been stored outside Tone Dobinson's Dad's house in Bognor needs a new home. Whilst we very much appreciate Mr + Mrs Dobinson allowing the club to store the boat outside their home on the South Coast (and especially the tea and biscuits offered to early morning boat towers), the fact that dives are increasingly taking place in all parts of the country means that a more central storage site would be useful.

So anyone who knows of an unused garage or lock-up that would make a suitable storage space for the CCC dive boat don't be shy about suggesting it's use as the storage place for the "Baby RIB" as it is affectionately known.

CCC SUB-AQUA CLUB NEWS

CCC SAC COMMITTEE

Chairwoman: Sue Gilbard (081-675 7428)
Diving Officer: Mark Evans (021-472 8232)
Club Secretary: Tony Pates (081 861 0373)
Membership Secretary: Hydyn-Tanner (071-586 4281)
Treasurer: Debbie Moore (0480 473638)
Training Officer: Tony Dobinson (0243 673387)
Conservation Officer: Dave Gunnersen (0923 248911 x.203)
Equipment Officer: Steve Morris (0582 576834)

EVENT ORGANISERS

Bill Williams 081 444 6706
Richard Hall 0924 272611
Andy Parkinson 0273 463192
Pete Raines (081-647 8848)
Jon Ridley (081-647 8848)

SEASEARCH SURVEYS START SUCCESSFULLY

David Gunnerson's series of Seasearch weekends got off to a successful start on the Sussex coast (where all survey dives will take place this year). David and five other intrepid surveyors undertook the first five surveys of the 1993 season; the work went well although David was bemoaning the lack of fish around the Mixon Hole only to be reliably informed by Tone (Jaques) Dobinson that "Zey must all be at zee Mulberries". Nick and Tone very kindly provided a boat while the club RIB was being refurbished having only just returned back from Belize.

93 DIVING GETS OFF TO A WINDY START

The diving season got off to fairly windy start when 8 members of the club made their way up to Northumberland in the hope of diving the Farne Isles over the Easter Weekend. Sadly the predicted light South Easterly winds actually turned into a sturdy Force 6 due Easterly, causing the sea to provide excellent conditions for surfing but not for diving. Although most of the group did get a somewhat low-visibility dive at Eyemouth, the general consensus was to give up and head south. The voracious appetite for diving was displayed by Mark Evans who drove straight down to the other end of the country to go diving with Nick and Tony of Wittering Divers. Thanks also to Jon's uncle Jim for finding an un-used farm house for us all to sleep in.



NICK AND TONY'S "WITTERING DIVERS" GETS BSAC SCHOOL STATUS

CCCSAC Training Officer (and twice CCC DO in Belize) Tony Dobinson and his partner Nick Fecher have just heard that their dive school on the South Coast — Wittering Divers, has now been officially recognised as a BSAC school (BSAC and PADI training available).

The school is situated right by the sea, has a classroom, shop, hot showers, two dive boats, and a nice line in beards. Congratulations to the boys!

For training or fun-dives call them on 0243 842402 (discounts offered to CCC members).

CLUB TO MEET MORE FREQUENTLY

The CCCSAC meets on the first Tuesday of every month at the Oporto Pub, Endell Street, Covent Garden, London W1. However, club members decided at the April meeting that during the diving season it would be useful to meet twice monthly so that dive trips can be more easily organised. As of May 93 the dive club will be meeting on the first and third Tuesdays of each month at the Oporto Pub.

ISLES OF SCILLY 93 EXPEDITION

Between 17 - 31 July, the club will be returning to the Isles of Scilly to continue marine surveys initiated last year on behalf of the Isles of Scilly Environmental Trust. The Isles of Scilly boast some of the UK's best diving with crystal clear, warm seas, with a wealth of marine life including seasonal exotics such as turtle, blue marlin, and even killer whale.

This year's expedition will concentrate on surveys of eel grass beds, together with sediment sampling and analysis. The cost to join the expedition will be approximately £150.00 (all-in !!). Anyone interested should contact Pete Raines.

CORAL CAY CONSERVATION WOULD LIKE TO THANK THE FOLLOWING:

IN BELIZE

Rt. Hon. George Price, Prime Minister
Hon. Florencio Marin, Deputy PM
Hon. Michael Espot, Minister of Agriculture & Fisheries
Hon. Glenn Godfrey, Minister of Tourism & the Environment
The Coastal Zone Management Unit
Programme for Belize
Belize Centre for Environmental Studies
Belize Audubon Society
Belize Zoo & Tropical Education Centre
British Forces
British High Commission
Marek
Pelican Beach Hotel
The Angelus Press/
Spooner's Photography
The Frame Shop

UNIVERSITIES, RESEARCH INSTITUTIONS & SOCIETIES

British Ecological Society

Imperial College (University of London)
Joint Nature Conservancy Council
Marine Conservation Society
Natural Resources Institute/ODA
Nature Conservancy
Royal Geographical Society
Sisal College
Smithsonian Institute
UNESCO
University College of Belize
University College London
University of Edinburgh
University of Wales
University of St. Andrews
Wildlife Conservation International
World Underwater Federation (CMAS)

IN THE UK

A.P. Valves Ltd
Airlife Publishing
Aldus UK Ltd
ALR Ltd
American Travel Centre
Aqua-Lung UK Ltd
AquaScan International Ltd
Belize High Commission

Boehinger Ingelheim Ltd
Bradt Publications
Bridon Fibres Ltd
British Airways
British Sub-Aqua Club
Burton & Smith Ltd
Cameron Books Ltd
Canon UK Ltd
Cocking and Drury Software
Columbus Travel Insurance
Compass Marine Ltd
Continental Airlines
Coral Marine Ltd
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J. W. Automarine Ltd
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Kellogg's Ltd
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Pains-Wessex Schermuly
Photofusion Gallery
Provincial Metals
Raleigh International
Raytheon
Rhône-Poulenc Rorer Ltd
Ribtec Ltd
Safeway Stores Plc
Scuba Diving Magazine
Scubapro
SeaFrontiers Magazine

Seahawk Products
Shadowfax Technology Ltd
Sony UK Ltd
Sowester Ltd
Stanley Tools
Stephens Innocent Solicitors
Streamline Props
SustainAbility
Swiftch SL Ltd
T & J Harrison Ltd
Tale & Lyle Plc
TFH Publications
The Wellcome Foundation
TPR Photographic
Trimble Navigation Europe Ltd
Uniglobe Travel Services
Unilever Export Ltd
Upjohn Ltd
UWI Ltd
Vacation Work Publications
Viking Direct Ltd
Waddington Games Ltd
Wittering Divers
Yacht Parts
Zodiac UK Ltd
Zyma Healthcare

ELSEWHERE

Days Inn Hotels
El Capitan Sport Centre

SAC-EVENTS

MAY 15-16 W. Sussex, MCS Seasearch
Dave Gunnersen
29-31 Lundy Island (off Cornwall) Fun diving
Dave Gunnersen

JUNE 1 SAC Meeting
5-6 Bognor Regis (W. Sussex) Fun Diving,
Tony Pates

11-14 Skomer Island (W. Wales)
Fun diving Bill Williams

19-20 W. Sussex
MCS Seasearch
Dave Gunnersen

26-27 S. Devon Fun diving, Sue Gilbard
JULY 3-4 Shoreham (W. Sussex) Wreck Diving
Andy Parkinson

6 SAC Meeting
10-11 W. Sussex
MCS Seasearch
Dave Gunnersen

17-31 Isles of Scilly Expedition. Surveys on behalf of the IOS
Environmental Trust
Pete Raines

AUGUST 3 SAC Meeting
7-8 W. Sussex
MCS Seasearch
Dave Gunnersen

14-15 Bridlington (E. Yorks.) Fun diving Richard Hall
21-22 Farne Islands (Northumberland)
Fun diving Jon Ridley

28-30 St. Abbs Head (E. Lothian) Fun diving
Mark Evans

2 SEPTEMBER
7 SAC Meeting
11-12 W. Sussex
MCS Seasearch
Dave Gunnersen

18-26 Scapa Flow (N. Scotland) Fun diving
Tony Dobinson

OCTOBER 5 SAC
Annual Dinner, Rebato's Restaurant, London SW8.
Pete Raines

NOVEMBER 2
SAC Meeting
DECEMBER 7 SAC
Meeting & Christmas Party

NOT THE NEWSLETTER

The restrained nature of the CCCSAC newsletter (as presented here) has become too tame it was decided at the last CCCSAC meeting. It was decided that an "alternative" club newsletter would be written and posted to club members without threatening the good standing of CCC.

It was felt that slightly more irreverence would better describe the feel of the diving weekends organised by club members, Tony Pates (club secretary) has volunteered to write and print the newsletter, so we are now requesting volunteers to translate it into English before it goes out to club members.



CORAL CAY CONSERVATION-SALES



We have a variety of clothing, jewellery and postcards which have been created by CCC volunteers. We also have available reference books on coral reef biology and marine life identification, together with a variety of information and audiovisual aids of help those of you seeking sponsorship raise funds to join a CCC expedition.

Should you wish to purchase any of the items listed below, please complete the enclosed order form and return it to us along with your remittance. All prices include VAT, package and posting.



P1
All T-Shirts have a white back-ground with CCC logo on sleeves.



SWEATSHIRTS AND POLO SHIRTS - (Sizes: M, L, XL)

- P1** White polo shirt with embroidered blue CCC logo - £12.00.
S1 Navy blue sweatshirt with embroidered white CCC logo - £15.00.

T-SHIRTS - (Sizes: L, XL)

- T1** "Coral Reef Preserver" cartoon - £7.00
T2 "The Wall" - £7.00
T3 Colourful Queen Triggerfish with habitat description on back-£8.99
T4 Circling dolphins - £7.99 (Bristol University).



T1

JEWELLERY

- J1** CCC logo pendant
£10.00 (Silver) & £18.00 (Gold)
J2 Turtle pendant
- £11.00 (Silver) & £24.00 (Gold)
(add £1.50 for Recorded Delivery)



J2

POSTCARDS, DIVE LOGS & ACCESSORIES

- P1** CCC Field Centre at South Water Cay (Belize) - £0.50
P2 Dawn over South Water Cay - £0.50
L1 CCC Diving log-book with CCC logo on front cover - £3.00
N1 Waterproof notepad and pencil. Ideal for making notes and communicating with your buddy under water (re-useable) - £5.00.
A1 Gregson first-aid travel pack. Pocket-sized, waterproof first aid-pack including sterile I.V. equipment and detailed instruction manual. Essential for foreign travel -£16.00.

All postcards have a description of the cover photograph and information about CCC printed on reverse side



P1



A1



B5

- B1** Reef Coral Identification - £22.50
B2 Reef Fish Identification - £22.50
B3 Reef Creature Identification -£22.50
B4 Ocean Realm Guide to Corals - £12.00

An unique collection of easy to use identification books by Paul Humann, full of colour photographs and text to aid identification of corals, reef and invertebrates found along the Belize reef. These books are essential reading for volunteers who are about to embark on a CCC expedition to Belize.



B4

B3

B1

B2

- B5.** Waterproof Guide to Corals and Fishes of the Caribbean - £10.00

A useful identification guide by Jerry Greenberg, which can be used whilst survey diving on the Belize reef. Highly recommended for volunteers about to join a CCC expedition in Belize.

CCC AUDIOVISUAL AIDS & INFORMATION

F1 CCC Slide presentation pack. (Hire only)

Over 60 colour slides about CCC expeditions with accompanying notes. Useful for pre- and Post-expedition presentations - £13.50 (includes a £10.00 refundable deposit).

F2 "Belize: Paradise in Peril?"

A video presentation of photographic images illustrating the threats to the forests and reef of Belize, and describing how CCC is helping to protect this unique environment (narrated by William Gray) - £8.99 (or £4.00 for 7-day rental).

F3 "CCC: Diving for Dear Life"

A 15 minute video depicting life on a CCC expedition including interviews with CCC volunteers -£5.00 for 7-day rental.

F4 CCC guide to Fund Raising.

Full of useful ideas and information about how to raise funds for your expedition, with helpful tips from past volunteers - £2.50.

F5 CCC Science Pack. An introduction to the scientific research programme being conducted by CCC in Belize, with background information about marine ecology of the Belize barrier reef - £2.50.

F6 CCC brochures - £1.00 per copy.

F7 CCC Headed notepaper - Specially designed to assure prospective sponsors that you have been accepted onto a CCC expedition - £0.10 per sheet.

DIVING EQUIPMENT

CCC is able to offer a wide selection of scuba equipment and accessories from a variety of manufacturers at special discount rates to our membership. For further information, send a large stamped addressed envelope to the CCC office.

CCC SALES - ORDER FORM



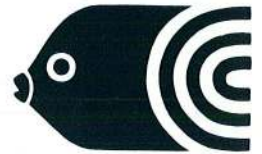
Name _____
Address _____
Postcode _____
Telephone No. _____

Quantity	Item code (including sizes for clothing)	Cost
_____	_____	£
_____	_____	£
_____	_____	£
_____	_____	£
_____	_____	£

Orders for Jewellery, add £1.50 recorded delivery

Signed _____ Total cost £ _____

Cheques payable to: Coral Cay Conservation Ltd.
PLEASE ALLOW 14 DAYS FOR DELIVERY.



Deposits for rental slide packs and videos will be reimbursed on condition that these items are returned in a satisfactory condition and within the agreed rental period.



CCC NEWSLETTER - APPLICATION FOR SUBSCRIBERS

If you would like to subscribe to the new bi-monthly CCC Newsletter and receive a copy of SeaFrontiers Magazine with each issue, please complete the following application form and return it to us at the address below, along with the annual subscription fee of £12.00 (cheques payable to 'Coral Cay Conservation Ltd')

Name _____ Address _____
Postcode _____ Tel No _____



CCC Sub-Aqua Club

☐ Yes, I would like to join the CCC Sub-Aqua Club.

☐ I would like to participate with the following Club events:

DATE	EVENT/LOCATION	ORGANISER
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

I would like to help organise and/or participate with the following:

☐ Interviewing applicants for CCC expeditions ☐ Dive '93 Exhibition (November - NEC Birmingham)

