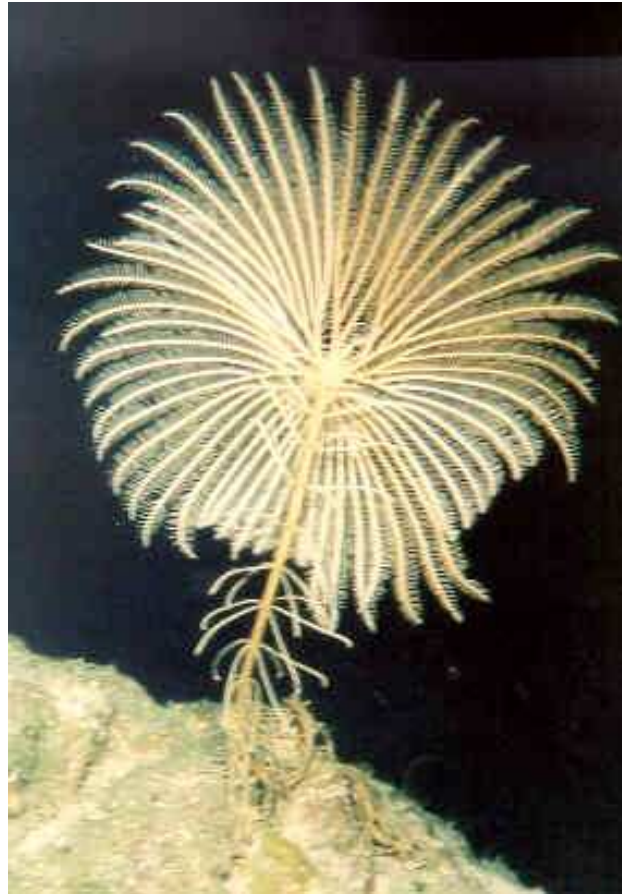


# TROPICAL DEEP REEF PROGRAM

(DEEP REEF)



Stalked Crinoid 800 feet deep Exuma Sound

*A long-term program of research, exploration, monitoring and education on the deep reefs of Cape Eleuthera, Bahamas*

January 2008

## OVERVIEW

### ORGANIZATION

The DEEP REEF project is proposed to be a partnership between the Cape Eluethera Institute, The Island School and Deep Sea Adventures LLC of West Palm Beach, Florida.

### MISSION STATEMENT

*The mission of the DEEP REEF project is to provide a low cost research submersible and other support to the scientific community to study the heretofore, little known ecology of the tropical deep reef of Exuma Sound, Bahamas.*

### INTRODUCTION

Tropical reefs are normally considered in terms of coral cover within shallow warm southern waters. Coral reefs have been studied extensively over the past twenty years which has shown a steady and precipitous decline in the overall health of tropical coral reef ecosystems worldwide. It is estimated, by some of the scientific community, that up to 70% of the world's corals are adversely affected.



The decline in tropical reef systems have many causes, but result from global changes, that in no small part, are the result of anthropogenic insults. Population growth, and migrations to coastal regions has put increasing pressure on reef systems, even in relatively remote regions of the globe. Such things as dredging, agricultural runoff, urban pollution, over fishing, deforestation, soil erosion from poor land management practices all contribute to the tropical reef decline. Perhaps the over

harvesting of reef organisms is as big a problem as any other reason. The removal of grazing fish along with the massive decline from diseases of the sea urchin, for instance, has left many areas of shallow coral reefs in the Caribbean covered with macroalgae

Recent global warming trends, that are due in large part to atmospheric greenhouse gasses from industrial and transportation activities, are thought to be mainly responsible for recent and persistent shallow coral bleaching events since 1983. Global Climate Change and its ubiquitous effects on the oceans may well bring higher worldwide seawater temperatures to levels not seen in human recorded history. In 1987 and again in 1990 scientists in the Bahamas recorded bleaching of not only stony corals, but soft corals, sponges, anemones and other organisms from near the surface to 200 feet in depth. This resulted in significant mortality within the population of affected animals. Other bleaching events have and are continuing.

## **PROBLEM**

Implementation of a Global Coral Reef Monitoring Network is part of the objectives of the U. S. Coral Reef Initiative and the Coral Reef Task Force. Researchers are now attempting to systematically quantifying precise changes in selected locations of shallow tropical reefs. The goals of this program are to provide the knowledge necessary to establish an integrated management approach for coral reef ecosystems. Little is known, however, about the deeper reefs that are, most likely, linked to their shallow counterparts in multiple ways and should be an integral part of any monitoring program.

Throughout the Caribbean, the typical continental margin is very narrow, measuring from just feet to several miles wide. It is here that most of the shallow corals are found. Beyond the edge, the slope drops almost vertically to about 500 feet deep, after which it slopes at less of an angle, but still very steep to several thousand feet deep. It is on this slope to about 1000 feet that has escaped much research. From a practical standpoint, any depth beyond 100 feet or so, where much of the slope starts, is not practical for diver scientists to work due to time constraints. Additionally, most submersible and ROV operations are limited by costs, and conventional sampling from a surface ship on the steep Caribbean slopes is difficult at best.

From a biological standpoint, the typical vertical slope of the Caribbean and Bahamian continental margin is almost unknown. The same is true of its linkages to the shallow reefs. Such things as intraspecific variability and comparisons of the two ecosystems, temporal and spatial patterns in recruitment processes, nutrient exchanges, species identification and assemblages are all virtually unknown.

Over the long term oceanographic conditions and changes are not well measured and analyzed on any deep reef system. The coupling of biological and physical/geochemical processes and their small scale perturbations in the deeper parts of a reef may have profound effects on shallow reef organisms and visa versa. The lack of monitoring of the deep reef in

conjunction with the shallow reefs can only tell us in part the processes that control the interactions between the two systems.

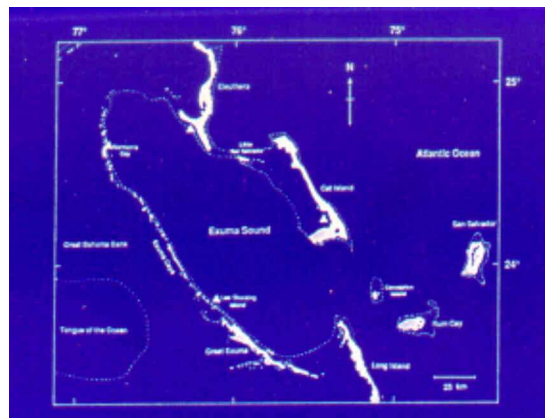
## **RATIONALE**

- 1) **Science**-the long-term monitoring, exploration and study of a tropical deep reef is essential to ultimate management and sustainability of these systems, including: a) understanding the extent of changes in the system; b) addressing, for the first time, the shifts in bio-community structure and the mechanisms of physical parameters on and near the vertical slopes of the Caribbean region; c) recording infrequent episodic events such as storms, diseases and temperature swings; d) separating natural from man induced perturbations in the deep reef system.
- 2) **Education**-the educational aspects of the program is essential to give first-hand experiences to students and the general public that will help them understand the importance of the marine environment to their social-economic future. Participants will be students, policy makers, educators,

## **PROGRAM CONCEPT**

The DEEP REEF Project will offer an opportunity for scientists to employ conventional scuba diving techniques and a research submersible to both conduct scientific investigation and monitoring of the deep reef off the coast of Cape Eleuthera, Bahamas and to provide opportunity for educational dives. Following a prepared strategic plan and protocol scientists and educational institutions will apply for use of the submarine and facilities. The package will include. 1) The use of the submersible to conduct scientific operations to 1000 feet; 2) Shore based lab facilities 3) Educational dives in the submersible for up to two passengers. Similar to the operation of the Nekton Gamma off Exuma Sound that set almost 90 experiments to a depth of 1000 feet, the frequency of dives by the 1201 will allow scientists to develop a deep monitoring and experimental program never before achieved. Additionally, one dive off Andros Island in which the Deep Diver lockout sub parked on a terrace at 210 feet, a diver-scientist locked out and dove to 300 feet collecting fish for one hour. Of the fifteen species collected, seven were new to science; illustrating the extent of this unknown region of the oceans, including the wall of Eleuthera Island.

## **SITE**



The site selected is on the very tip of Cape Eleuthera on the southwestern end and leeward side of the Bahamian Island of Eleuthera, facing Exuma Sound. This is also the site of the Island School, the parent educational organization of the Cape Eleuthera Institute. Within one mile of the Institute is a fairly deep water, underutilized man-made harbor and inlet (25-30 feet). The deep reef escarpment is less than one-half mile from the mouth of the inlet. The bottom is typically a shallow bank from the shoreline to about 40 feet depth at the edge, sloping more acutely to about 80-100 feet depth and then in excess of 45 degrees to about 500-600 feet were the escarpment, although severe, is less than the shallower “wall”. To the north of the Cape is an expansive shallow ooid shoal.

The combination of nearby shallow and deep reefs, protected harbor with adequate space and utilities, will allow the sub to be operated with out the need for a costly support vessel. The relatively calm sea state that signifies this region also make the operations possible on a year round basis with little down time. The proximity of the Island school with its support facilities and professional personnel will be essential to the project.

## **FACILITIES**

**Submersible** - Designated PC-1201 is a robust submarine capable of carrying one pilot and two observers. Recently PC 1201 was totally refurbished to The American Bureau of Shipping standards and has been outfitted with a large manipulator and eight position sampling carousel. PC-1201 is large enough for passengers to able to stand on the deck of the sub while at sea. This makes loading and unloading the sub easy and only a small Avon type boat is needed for this process. Following a dive, crew members who will be following the sub with a larger vessel standing by to remove the samples/experiment for swift recovery and transfer back to the shore facility. Typically a dive is about two hours in duration but can be as short as twenty minutes and can last as long as eight hours if need be.





PC 1201

**Harbor** - The man-made protected harbor at the very tip of Powell Point on Cape Eleuthera is about  $\frac{1}{2}$  miles long and  $\frac{1}{4}$  miles wide and 25-30 feet deep. The inlet is about 1000 feet wide and just as deep. The southern side of the harbor is lined with continuous dock space with 220 and 110v power and water available. A flow through system allows mild tidal action that flushes and keeps the harbor clean and clear. The proximity of the inlet to shallow and deep reefs allows vessels and submersible to be on a research site within minutes.



Cape Eleuthera Harbor and Dock

**Cape Eleuthera Institute/Island School** - The newly formed Cape Eleuthera Institute is an offshoot of the Island School that has been operating in the region for the past five years. Aside from its educational program for 10<sup>th</sup> and 11<sup>th</sup> grade students, the School, through the Cape Eleuthera institute will initiate and support research projects on alternative energy systems, the environment, mariculture and coral reefs. Only one mile from the harbor, the Institute has a teaching and support complement numbering over thirty-five, dormitories, classrooms, eating facilities, boats and diving equipment.



**Island School classroom and cafeteria**

## **OPERATIONAL CONCEPT**

**Submersible one-atmosphere dives** - The operation of the submersible will begin at the harbor dockside where it will be launched by a marine lift. The sub will then be towed to the dive site by a small boat, where the pilot and up to two scientists or other passengers will enter the sub, secure the hatch and make the dive. Communications with the surface vessel,



**Nekton Gamma on wall of Exuma Sound**



**Nekton Gamma being launched from shore**

which remains nearby, will be maintained throughout the dive. Dives can last for up to 6 hours and range several miles along the slope. The crew already has vast experience with this type of low-cost submersible operation, having made over 600 scientific dives in the Nekton Gamma submersible from a shore side launch and retrieval system.

