

**Caribbean Planning For Adaptation To  
Global Climate Change  
(CPACC) Project.**

**“Monitoring Coral  
Reefs for Climate  
Change Impacts”**

**Technical meeting on Caribbean  
Observations in a Global Context,  
27<sup>th</sup> Feb. to 1<sup>st</sup> March 2001, Barbados.**

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# CPACC Project Objectives

*To support Caribbean countries, in preparing to cope with the adverse effects of global climate change, in particularly sea level rise, in coastal and marine areas through:*

- ✓ vulnerability assessment,*
- ✓ adaptation planning, and*
- ✓ capacity building linked to adaptation planning.*

# **Component 5**

## **– specific objectives.**

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- † Determine most appropriate methodology.**
- † Establish and maintain monitoring sites in The Bahamas, Belize and Jamaica**
- † Ensure that coral reef monitoring continues beyond the life of the CPACC project.**
- † Strengthen existing institutions (public, private, and NGO) in coral reef monitoring.**
- † Increase public awareness.**
- † Ensure benefits and lessons learnt are transferred to the other CPACC countries.**

# The Aim of Component 5:

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To improve our understanding of the impacts of climate change on coral reefs in order to

- (i) assess vulnerability, and
- (ii) provide policy relevant information for the sustainable management of coral reef resources.

( Provide data for current management needs).

# Coral Reefs are Economically & Socially Valuable ...

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1. Tourism.
2. Fisheries.
3. Aesthetic and recreational activities.
4. The protection of beaches & coastal infrastructure by reducing wave energy reaching the coastal.
5. The production of sand that forms the white-sand beaches

**Coral reefs are of critical importance to the the economic development of states in the Caribbean Region.**

# Environmental conditions for Healthy Coral reefs:

1. Low rates of sedimentation:  
**<1 to 10 mg/cm/day.**
2. Water Temperature: **23 - 30° C.**
3. Low concentrations of organic & inorganic nutrient.
4. Salinity : **25 to 40 p.p.t.**
5. Shielded form excessive levels of UV-B radiation.

## TEMPERATURE.

- Corals live near to their upper lethal temperature limit e.g e.g. Jamaica - **29.2 ° C**  
e.g. Great Barrier Reef - **30° C**
- Transient temperature increases may prove lethal.

# Global Climate Change & The Corals' Environment.

## Sources of Climate Stress.

### 1. Sea Level Rise:

5 mm/year +/- 2 to 9 mm/yr.

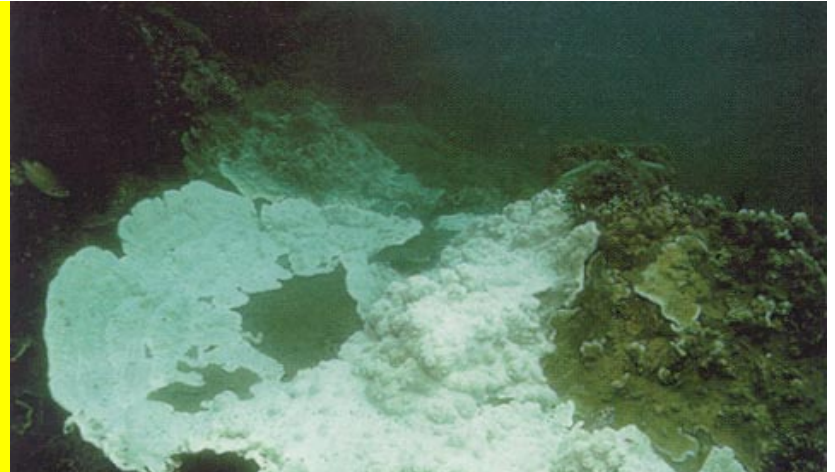
### 2. Increased Temperature:

1.5° to 6° C/ 100 years.

### 3. Increased Atmospheric CO<sub>2</sub> Concentrations:

14 - 30% reduction in calcification rates.

(Adapted from Wilkinson & Buddemier, 1994)



Global Climate Change may impose new stresses on reefs, or it may interact synergistically with more direct anthropogenic pressures to accelerate environmental damage.

# Designing the Monitoring Programme.

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**Choosing Parameters to be Monitored.**

**Table 1: Global Climate Change Phenomena & Their Effects on Coral Reefs.**

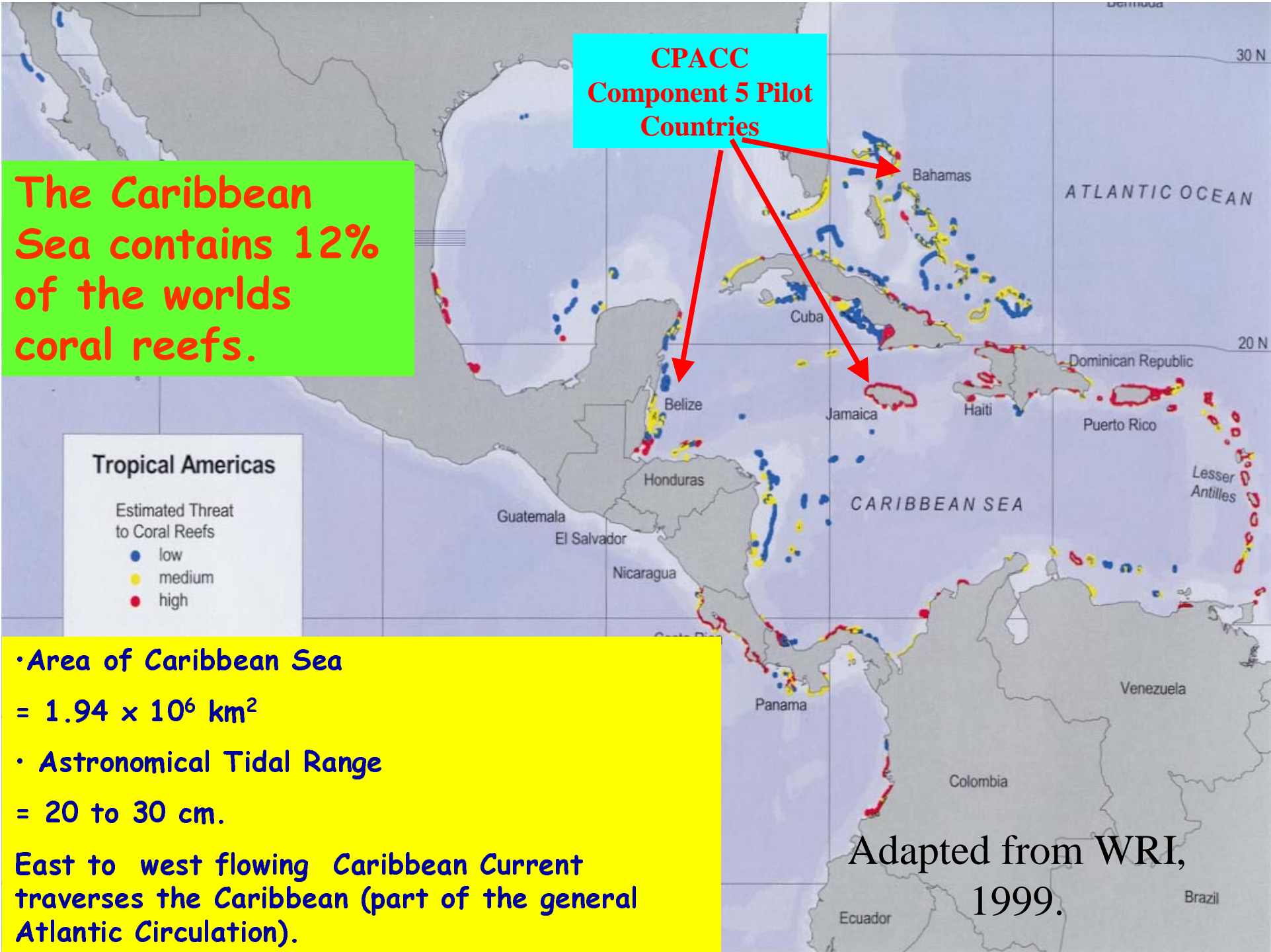
INCREASE IN ...	EFFECTS	MONITORING
CO <sup>2</sup>	Carbonate Balance	Growth Calcification PH
Temperature	More coral bleaching and mortality	Temperature (Θ) Bleaching events Coral Mortality Coral Abundance Community health
UV B (ozone loss)	More coral bleaching and mortality	Coral Abundance Community health
Sea Level	Landward shift of zones Upward growth of reef flats	Reef break waters <i>A. palmata</i> health
Storms	Physical damage especially to branching corals	Community character
Cloudiness	Reduced growth	Growth
Circulation Changes	Effects on growth if cooler/warmer	Growth, community
Terrestrial Run Off	More sedimentation & turbidity: coral decline	Turbidity Coral health, abundance

**Table 2: Methods for Monitoring the Environmental Parameters on Coral Reefs.**

<b>Parameter</b>	<b>Monitoring Method</b>	<b>Comments</b>
Salinity, pH, Dissolved Oxygen, Turbidity, Temperature (max/min).	Portable measuring equipment e.g. YSI Meter.	Appropriate methodology will be site dependent. This aspect of methodology can be kept simple. Explore in country capacity to monitor these parameters.
Water circulation.		
Turbidity.	Secchi Disk.	
Rain, % cloud cover, Hours of sunshine, Temp(max/min), Wind speed direction.	Data should be accessible from national or institutional meteorological station. Country averages. Rain gage may be sufficient.	
Nitrate, Phosphate, BOD, Chlorophyll, Sedimentation.		May not warrant monitoring if no CC induced run-off at remote site.
Adjacent land use.	Info from physical planning units, land use maps, GIS surveys.	Implications for site selection.
On site water activities.		An in country consideration.

**Table 3: Methods for Monitoring Coral Reefs for Global Climate Change Impacts.**

Parameter/Factor	Monitoring Method	Comments
Site selection		Each country selects its own sites. A gradient from less to more impacted sites. A mix of remote and accessible sites. Consider economic & ecological importance.
Depth (existing reef monitoring activities)		(a) Bahamas: 2m -5 m (b) CARICOMP: 7 m - 13 m (c) Belize: Seventeen fore reef sites at 15 m. Nine years of Patch reef data for one site. Expand depth range to improve between country comparability by adding five patch reef sites.
Community composition	(a) Video  (b) Point intercept line	Preferred method most logistically simple & practical space occupier record.  Backup method 10 x 10 m transects/site/habitat Permanent (a la CARICOMP).
Coral health	(a) Point intercept line  (b) Random swims, photo records, aerial photography	Bleaching, disease, recently dead, length & size frequency by modifying transect. One time estimate of proportional occurrence of health. <i>A. palmata</i> . Ground truth.
Urchins, Map corals	Expanded transect	
Coral growth	Sclero-chronology	<i>M. annularis</i> , (10 -20 heads)/ 5 to 20 yr.



The Caribbean Sea contains 12% of the worlds coral reefs.

CPACC  
Component 5 Pilot  
Countries

**Tropical Americas**  
Estimated Threat to Coral Reefs  
● low  
● medium  
● high

• Area of Caribbean Sea  
=  $1.94 \times 10^6 \text{ km}^2$   
• Astronomical Tidal Range  
= 20 to 30 cm.  
East to west flowing Caribbean Current  
traverses the Caribbean (part of the general  
Atlantic Circulation).

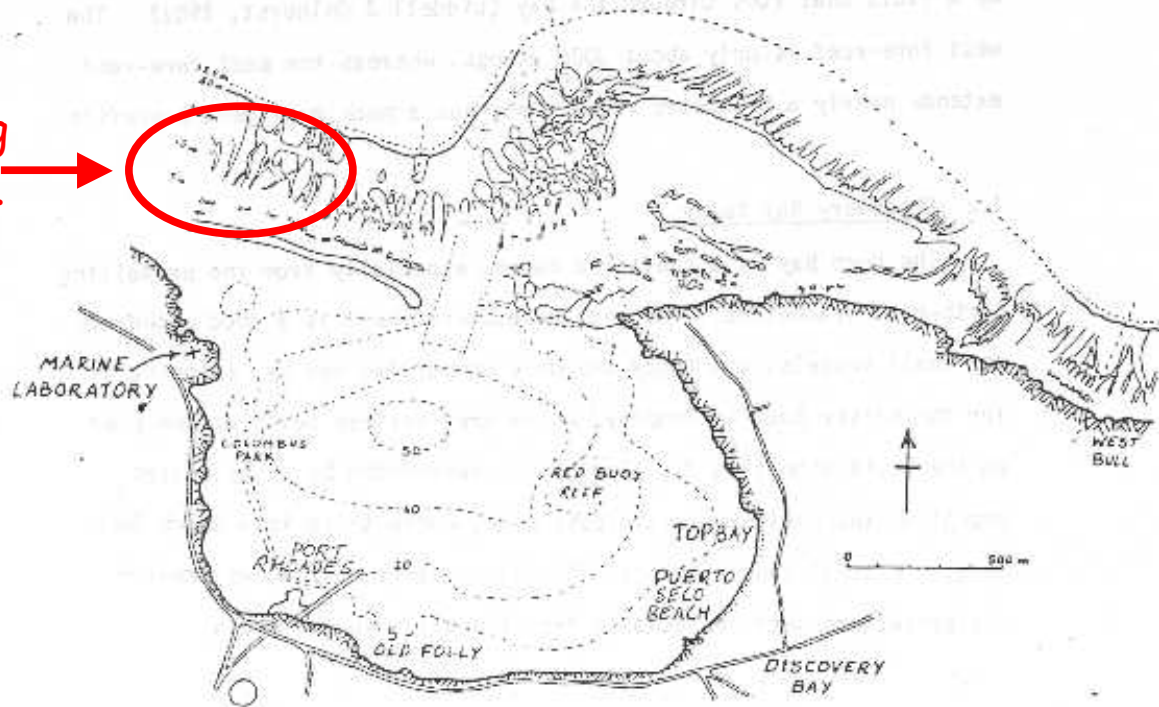
Adapted from WRI,  
1999.

# The CPACC Monitoring Regime.

1. Reefs are being monitored in 3 countries:
  - The Bahamas,
  - Belize,
  - Jamaica.
2. Three types of reef location are being monitored in each country:
  - pristine,
  - mildly impacted,
  - heavily impacted.
3. The **fore reef slope** is the target habitat that is being monitored at each reef location:
4. Monitoring is conducted once per year at each site to document (a) coral reef health (b) water temperature.

# A CPACC Monitoring Area.

Monitoring Site No. 1. →



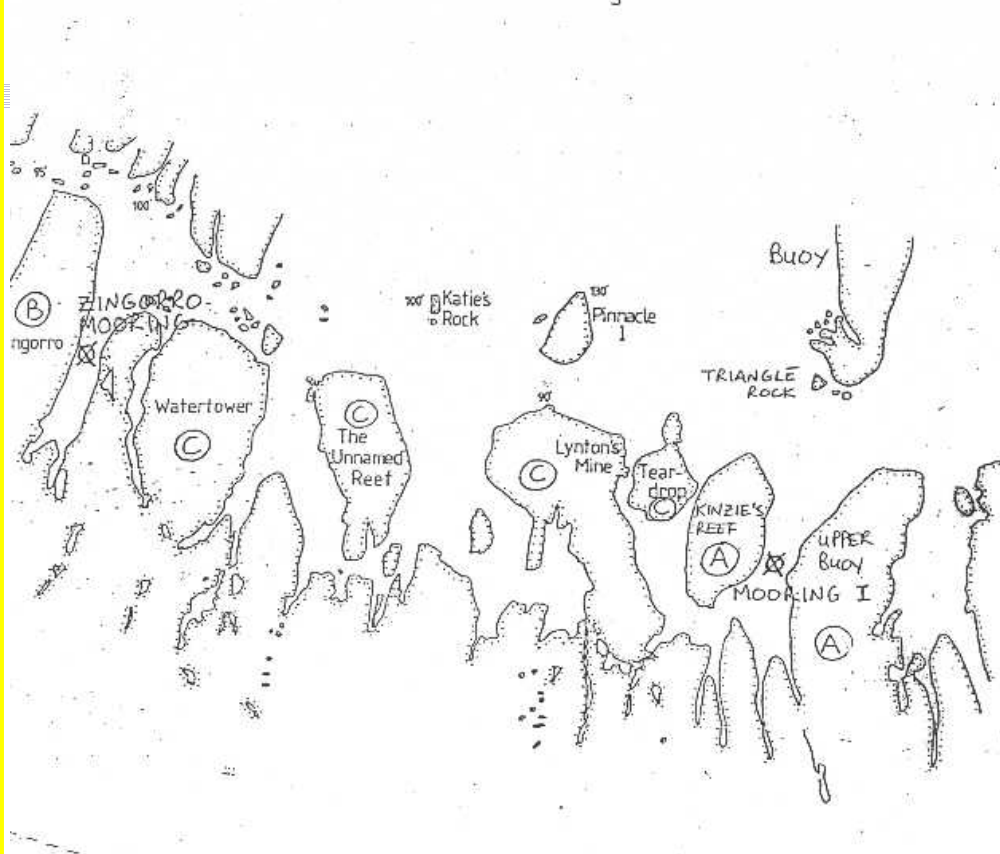
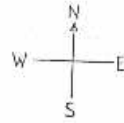
**Monitoring Site: West Fore Reef,  
Discovery Bay, Jamaica.**

**Reef Location: Mildly Impacted.**

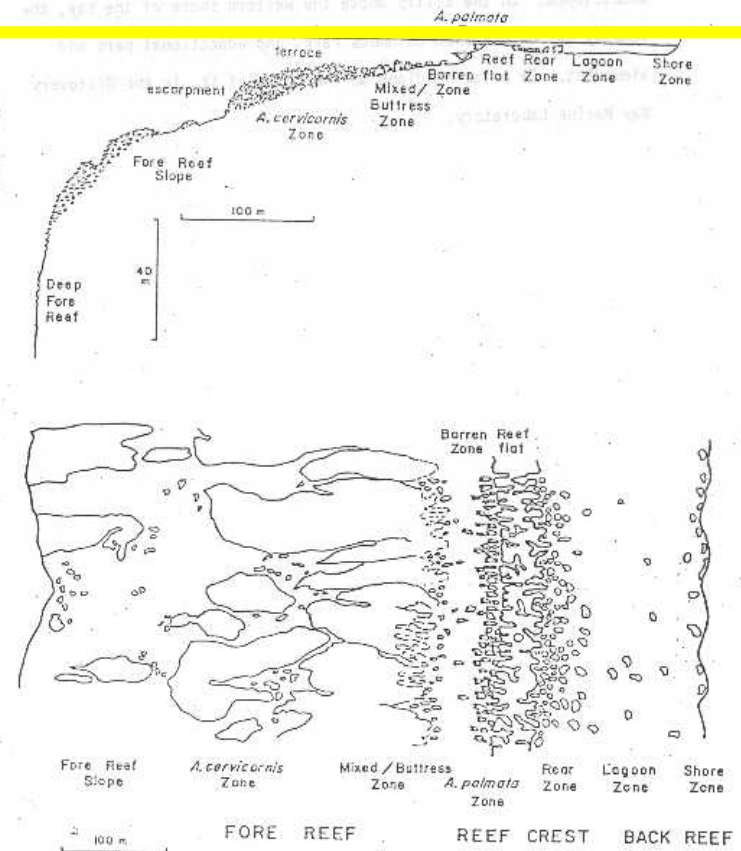
# Target Habitat: Fore Reef Slope, between Depths of 5m and 15m.

DISCOVERY BAY

Scale 1:2000



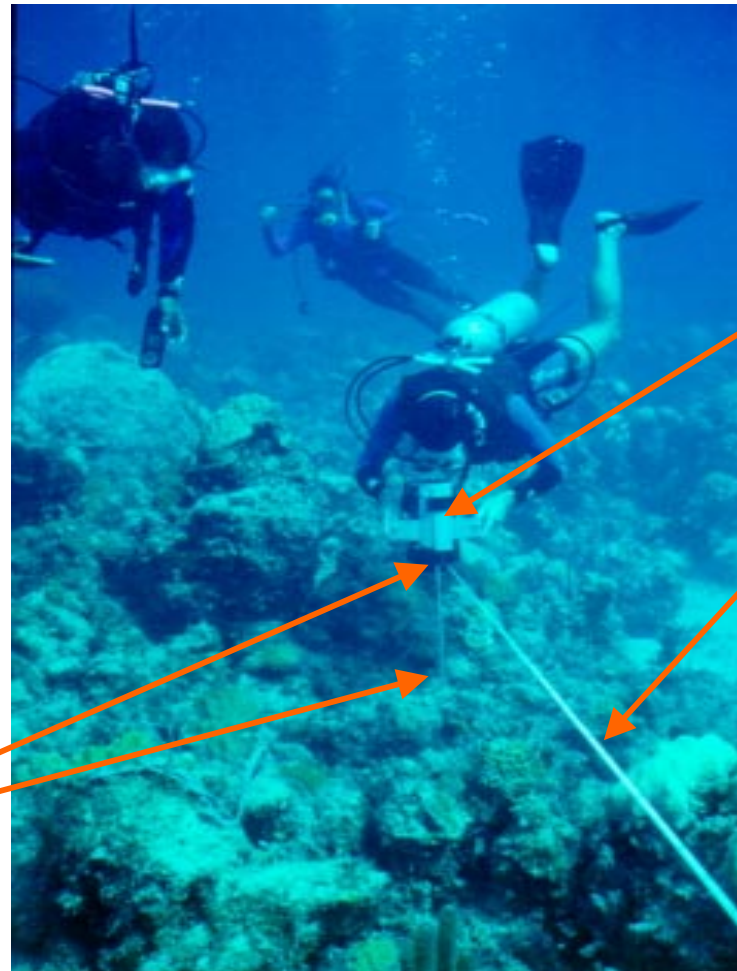
**Aerial View: West Fore Reef.**



**Profile: West Fore Reef.**

# The Monitoring Method.

A Digital Video Camera is used to record coral reef data for analysis.



Digital video camera in U/W housing.

Tape marking 20 meter transect line to be monitored.

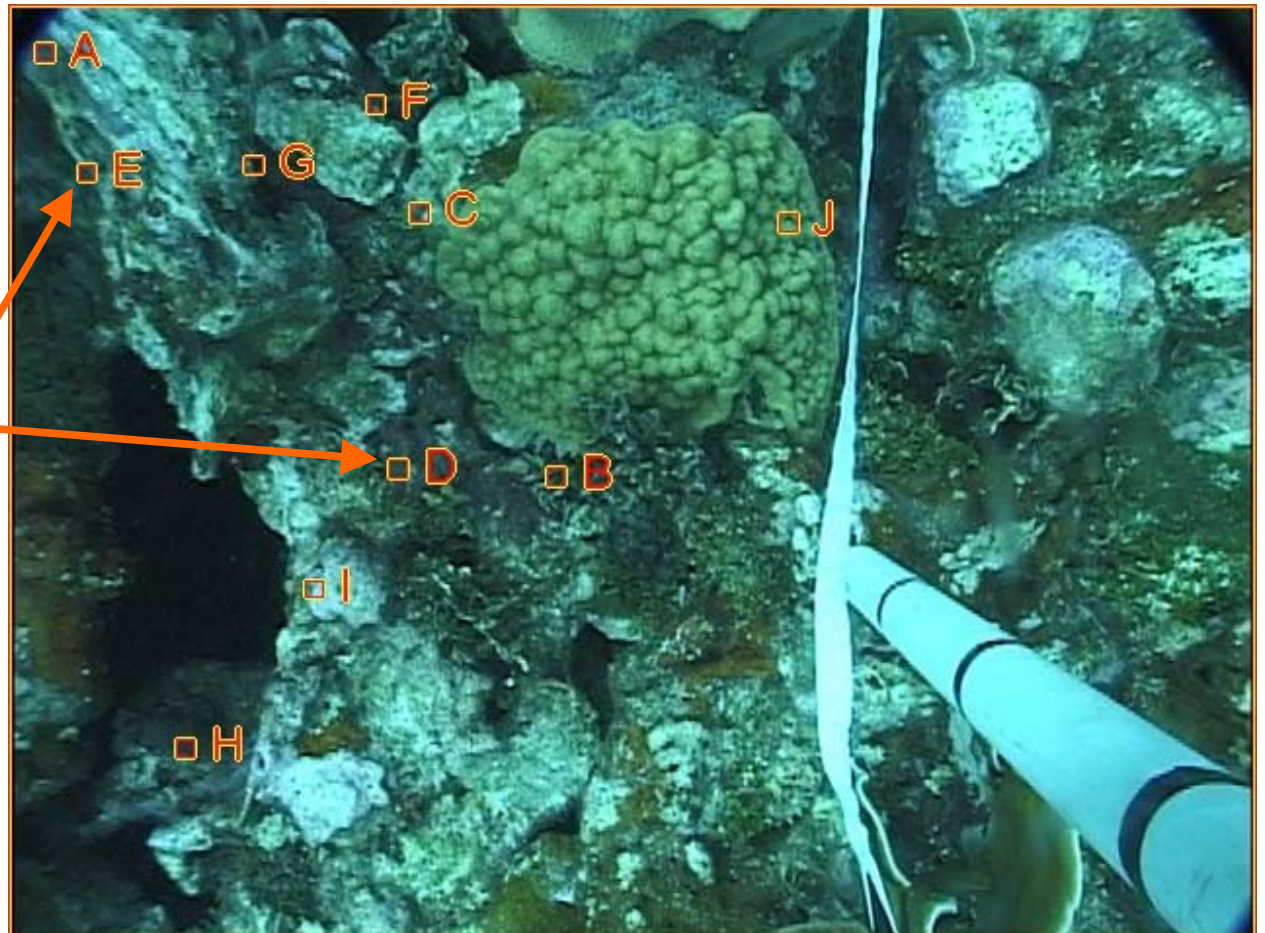
40 cm wand for gauging distance from substrate.

# Data Samples.

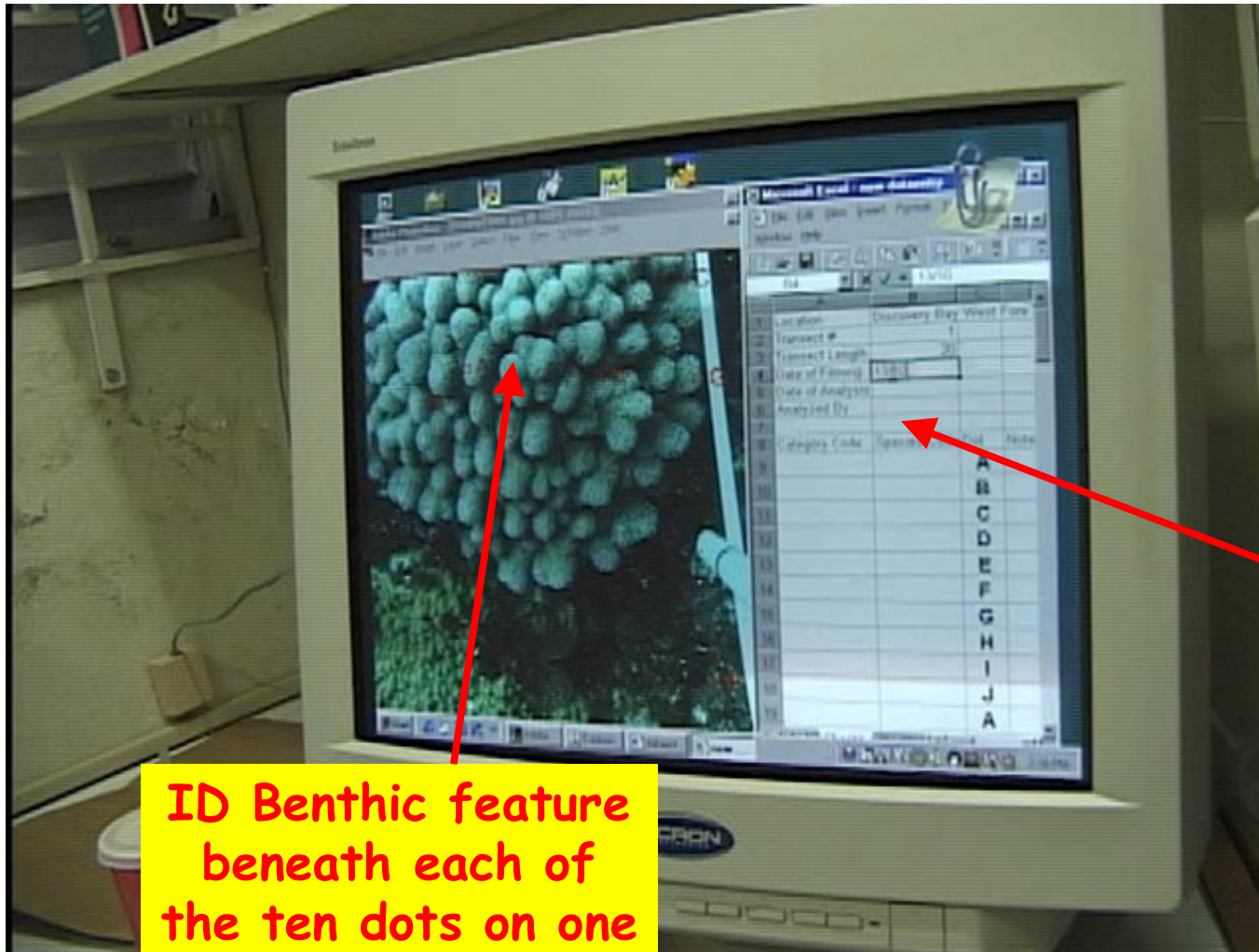
• Fifty (50) unique images record the coral reef community under each 20 meter transect.

• 10 random points identify the features to be used to describe the condition of the reef in each image.

10 Random Points / Image



# (14) Data Analysis

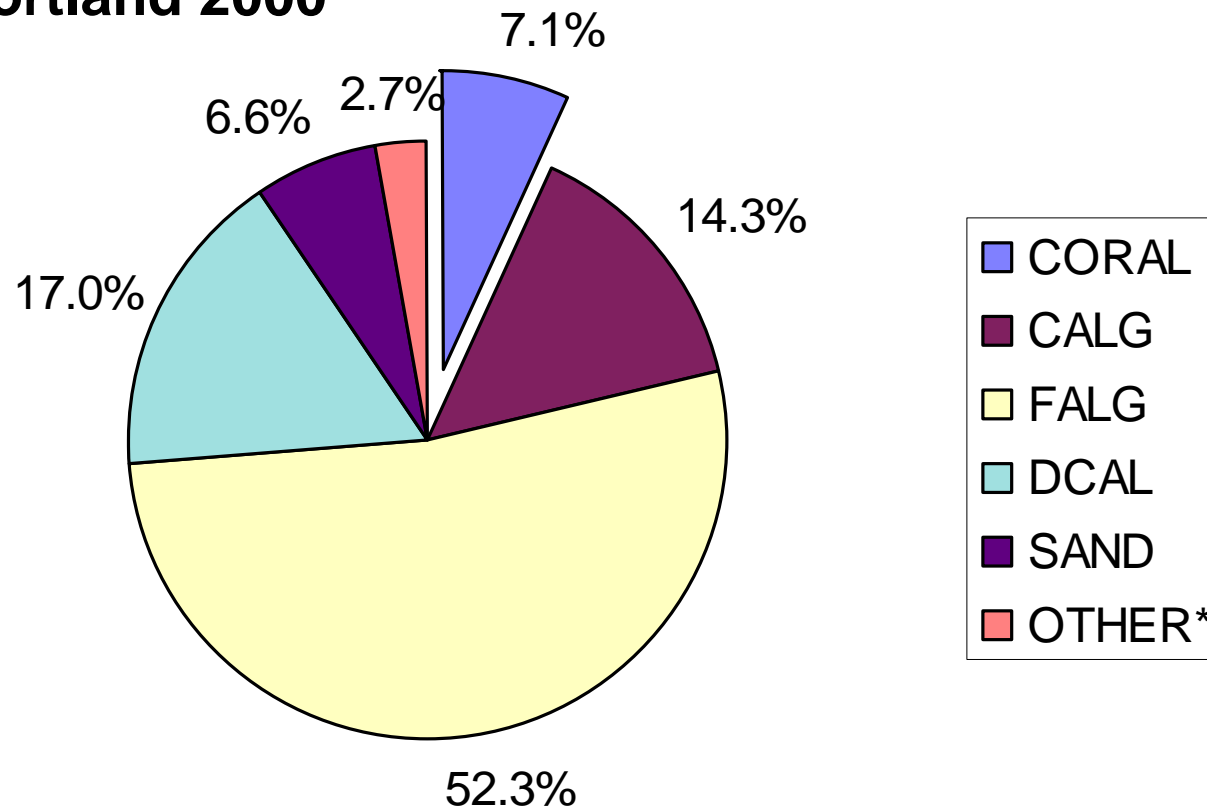


ID Benthic feature beneath each of the ten dots on one unique image.

The spreadsheet is used to record the identity of the benthic feature under each randomly placed dot on the image.

# Portland, Jamaica, 2000.

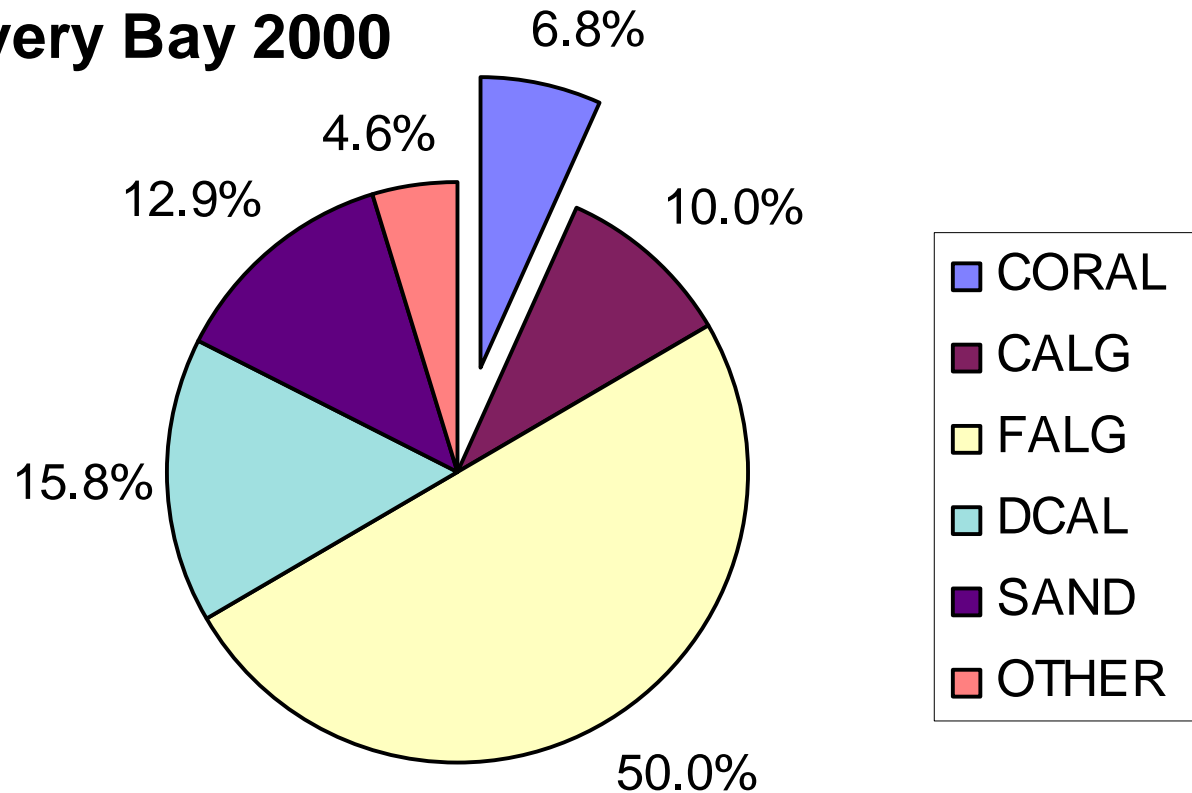
Portland 2000



# Discovery Bay, Jamaica, 2000.

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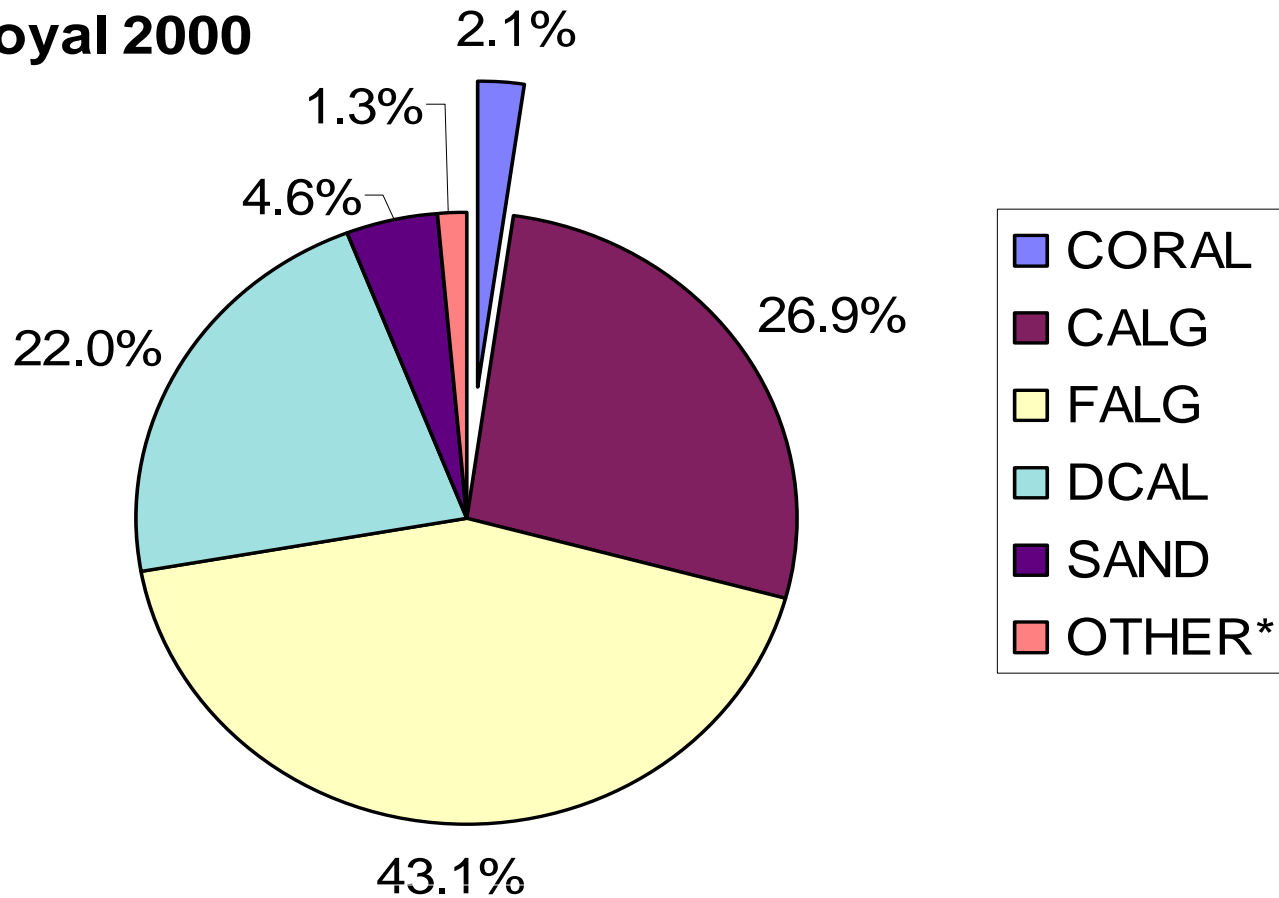
Discovery Bay 2000



# Port Royal, Jamaica, 2000.

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Port Royal 2000

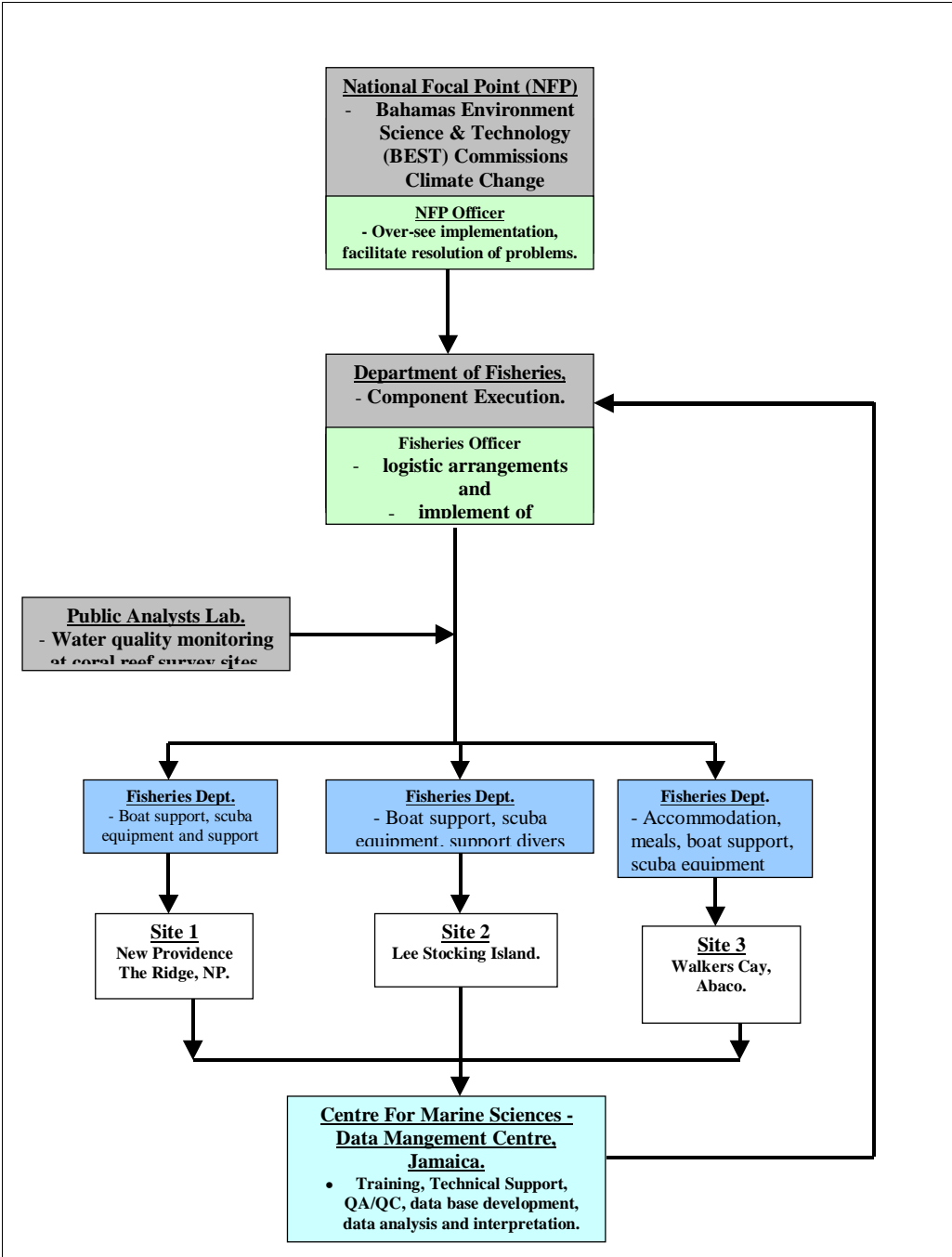


# Data Analysis.

1. % Live coral cover
2. % bleached coral
3. Determine optimal length of transects.
4. Cluster analysis to test characterizations of reef condition.

**The Bahamas.**

**Institutional Arrangements for Implementing Component 5:**



# Status of Implementation: Bahamas.

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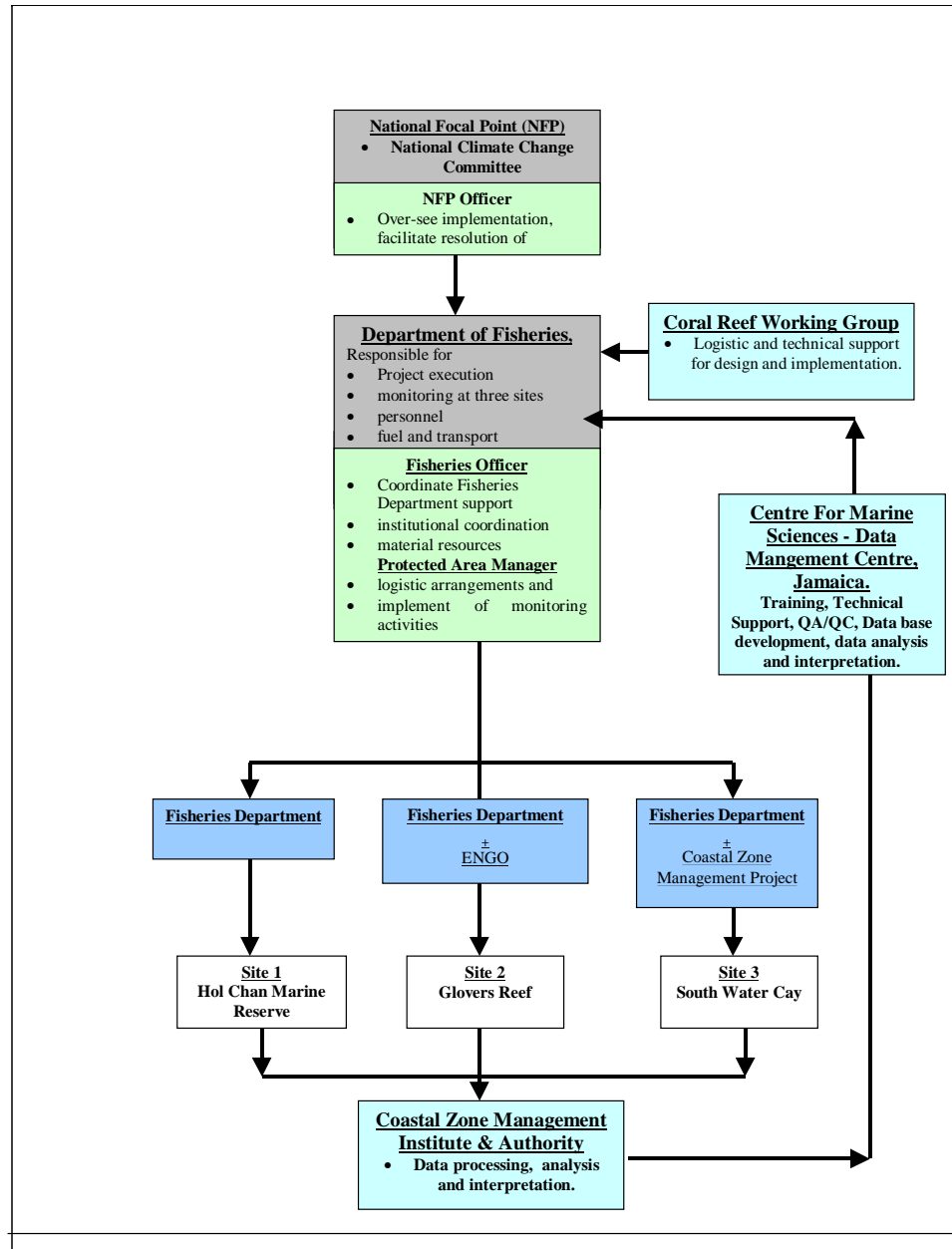
1. Monitoring has been completed at sites off;

- New Providence,
- Lee Stocking Island,
- Abaco.

2. Data analysis has begun.

# Belize.

## Institutional Arrangements for Implementing Component 5:



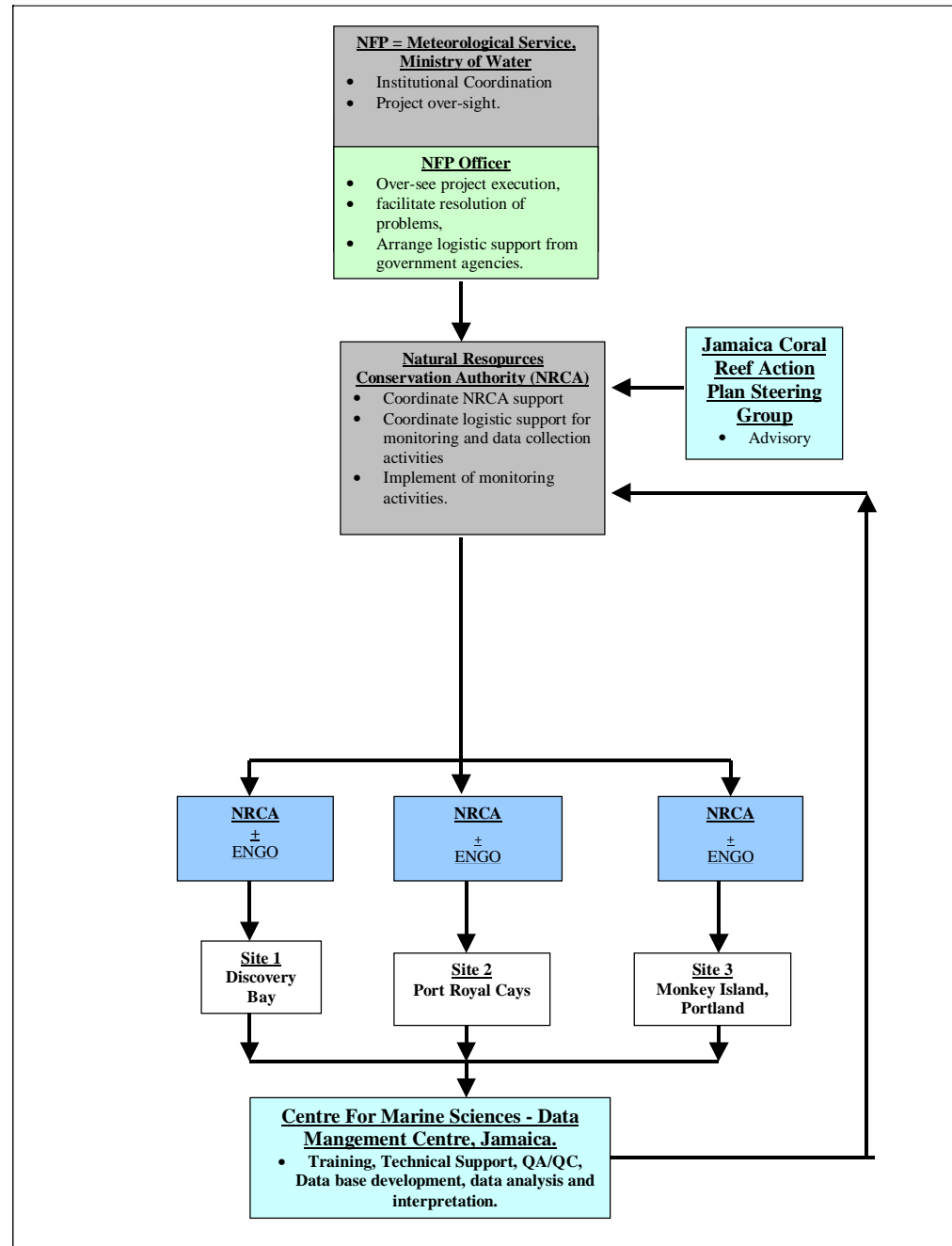
# Status of Implementation: Belize.

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1. Monitoring has been completed at sites at;
  - Hol Chan Marine Reserve,
  - South Water Cay Marine Reserve,
  - Glovers Reef Marine Reserve.
2. Data analysis has been completed.
3. Report for 2000 in preparation.

# Jamaica.

## Institutional Arrangements for Implementing Component 5:



# Status of Implementation: Jamaica.

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1. Monitoring has been completed at sites off;
  - Port Royal Cays,
  - Discovery Bay,
  - Monkey Island.
2. Data analysis has been completed.
3. Report for 2000 in preparation.

## (21) The Centre for Marine Sciences, University of the West Indies.

### 1. Provides technical support in;

- The processing, analysis, evaluation and archiving of **CPACC** data.
- Capacity building
- Quality control and quality assurance.

### 2. Also serves as;

- The **CARICOMP Project's** data management center.
- The regional node for the **Global Coral Reef Monitoring Network (GCRMN)**.

## (22) The Way Forward.

1. Develop **policy relevant indicators** of climate change impact to coral reefs *(May 2001 Planning & Technical Review Workshop)*.
2. Establish **policy interface** between coral reef research, managers and decision makers *(May 2001 workshop)*.
3. *Refine the design of the monitoring and data analysis protocols (Global Networks Meeting Feb 2001 & May 2001 workshop)*.
4. **Transfer capacity and technology** to other CPACC countries and partners in the Wider Caribbean Region *(September 2001 Regional Workshops)*.
5. **Expand geographic scope** monitoring programme *(IMPACC)*.
6. Establish **institutional mechanisms** for sustaining regional coral reef monitoring *(Global Networks Meeting Feb 2001, May 2001 workshop, IMPACC/CCCC), C3, C4*.
7. **Public education and awareness (IMPACC)**.

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[WWW.CPACC.ORG](http://WWW.CPACC.ORG)