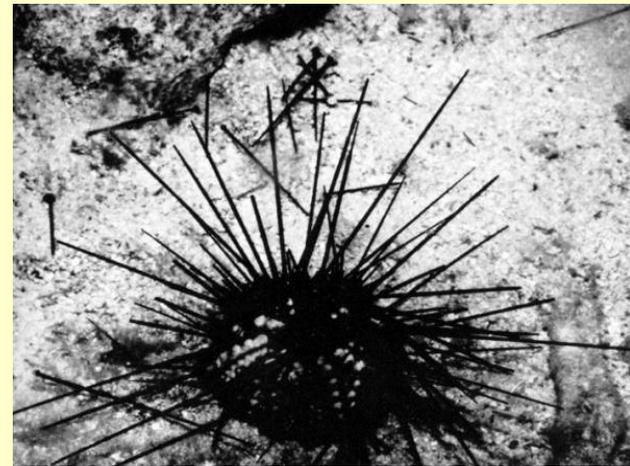


# DISEASES IN CORAL REEF ORGANISMS: CURRENT STATUS AND INFORMATION GAPS

**Ernesto Weil, Ph.D**

Department of Marine Sciences, University of Puerto Rico



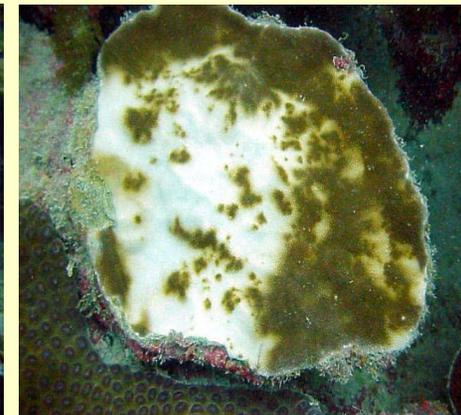
# DISEASE

- “Any impairment of an organism’s vital organ, system and/or body functions”.

- **Infectious diseases:** caused by parasites / pathogens.



- **Non-Infectious diseases:** caused by factors other than pathogens (genetic – environment- nutrition)



Bleaching

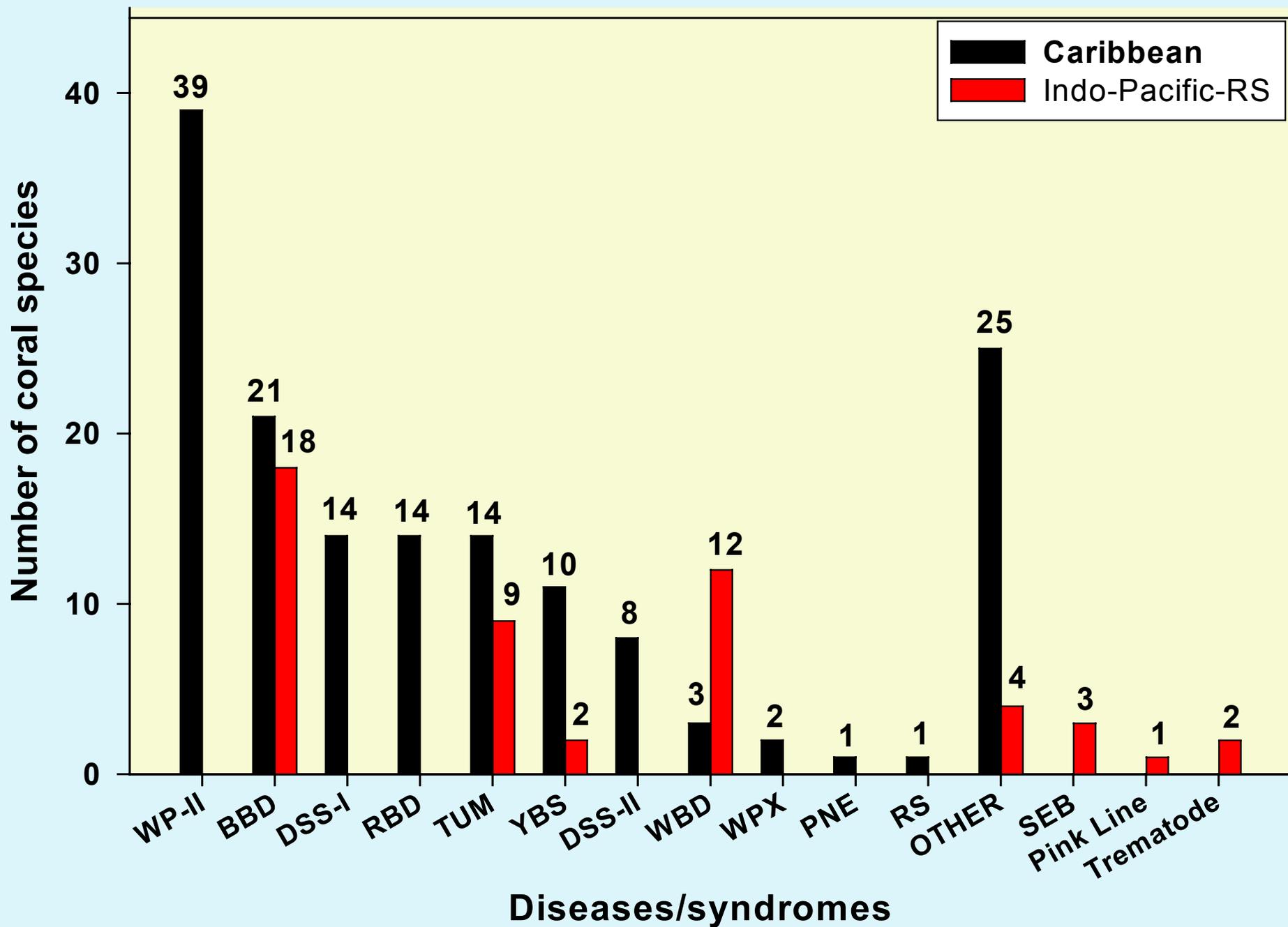
## CURRENT STATUS WORLDWIDE

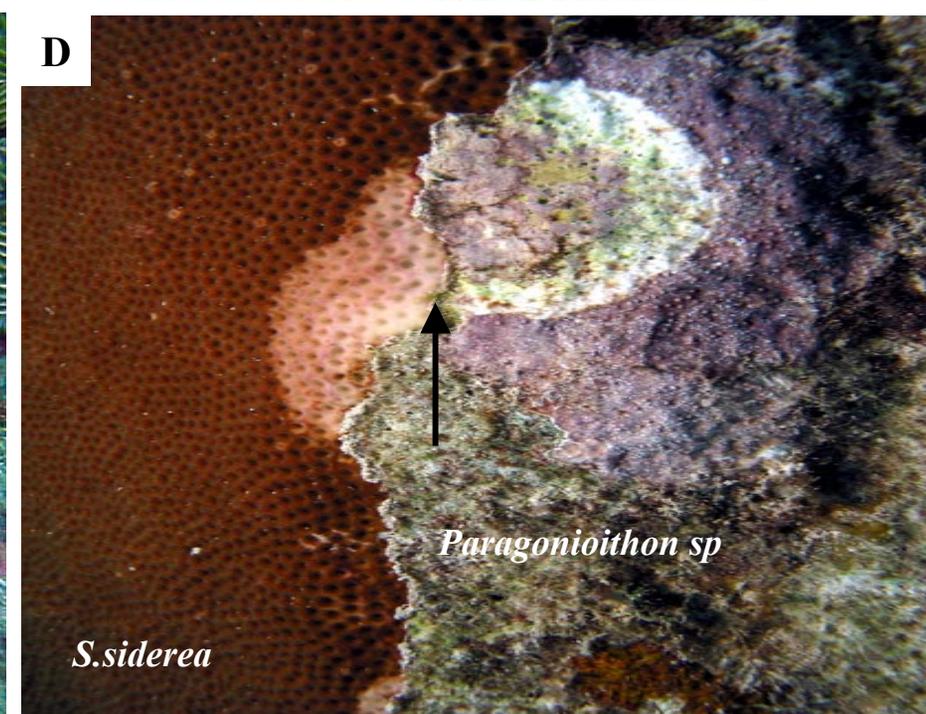
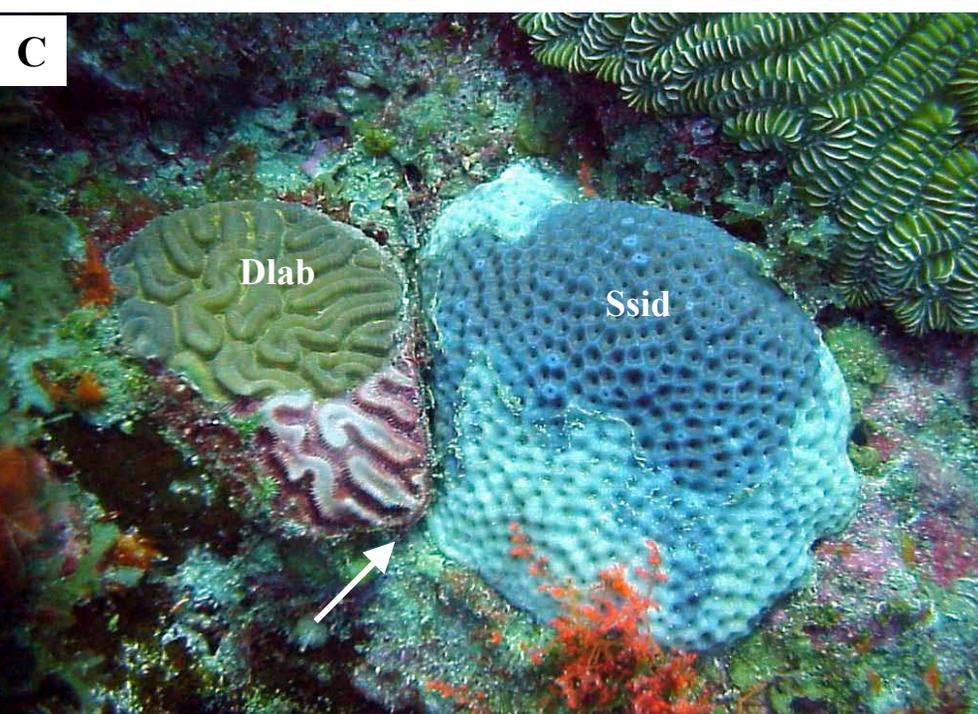
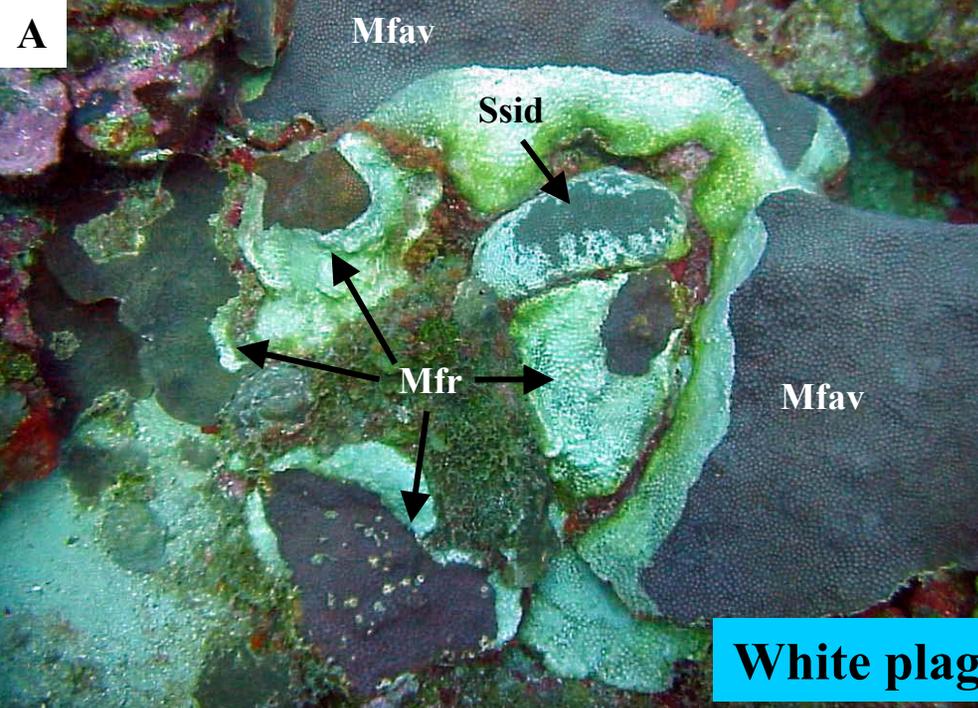
- Over 30 diseases/syndromes reported worldwide - 22 of these in the Caribbean.
- Only nine with pathogens identified (**BBD-WBDII-ASP-WPII-WPX-RBD-Tumors-Bleaching-Pink Band**).
- Only five of these fulfilled Koch's postulates.
- Mechanisms of tissue mortality only known for BBD.
- Reservoirs proposed for 2 diseases (**BBD-ASP**).
- One natural vector identified (*H.carunculata*).

## **CURRENT STATUS WORLDWIDE**

- **Wide geographic distribution in the wider Caribbean. More restricted in the Indo-Pacific.**
- **112 coral spp, 10 octocorals, 11 sponges, 3 hydrocoral and 4 crustose algae species affected.**
- **Wide host ranges for many diseases/syndromes**
- **Contagion across colonies, species and different groups of organisms – big concern.**
- **Proliferation of names without pathological confirmation – a problem for researchers and managers.**

# Number of coral species affected by diseases/syndromes

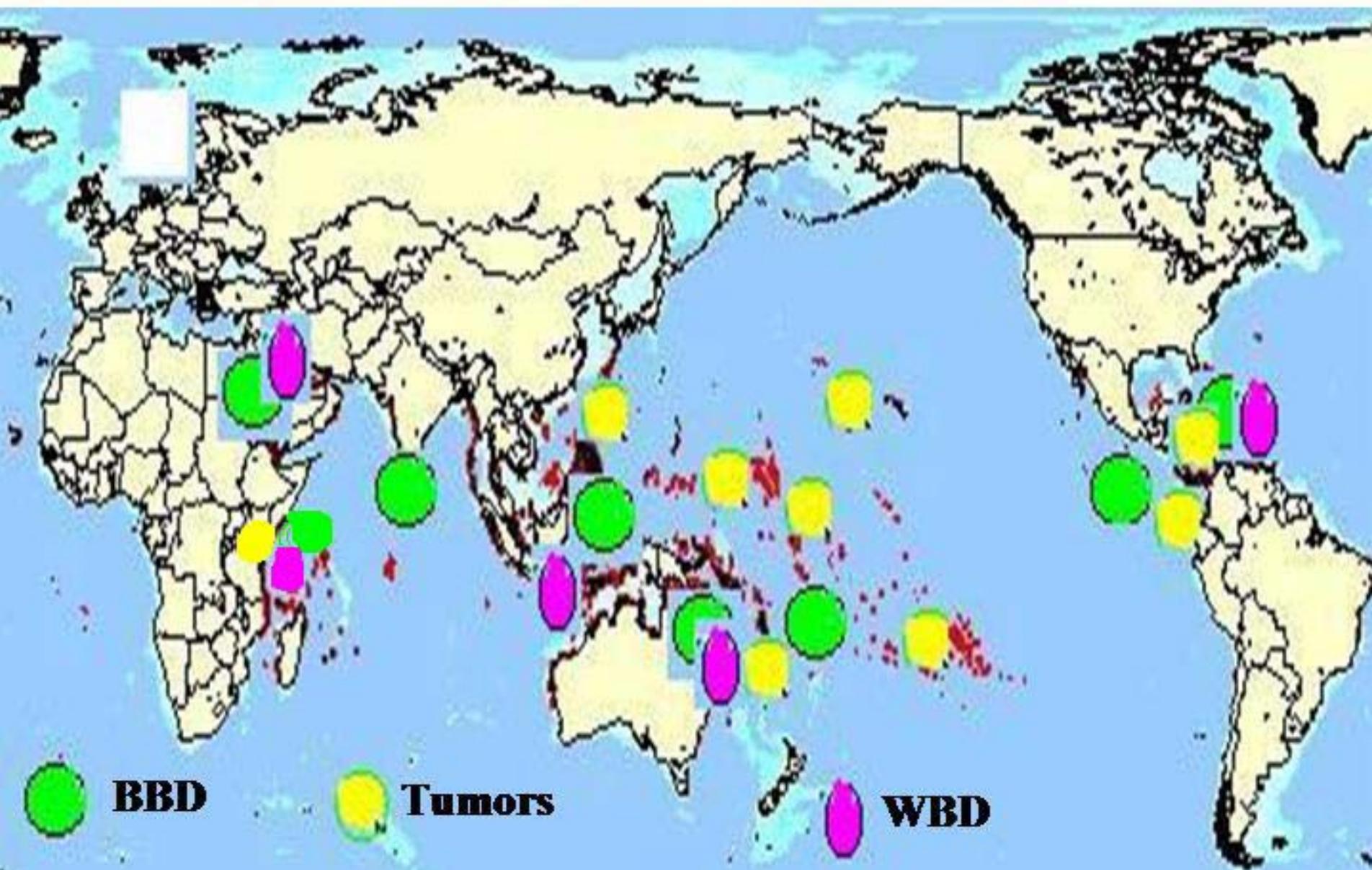




## CURRENT STATUS WORLDWIDE

- **Significant losses in coral cover, habitat and biodiversity.**
- **New syndromes are discovered every year but pathological, etiological and ecological studies are lagging.**
- **Correlations with climate change and/or human activities are not clear at this moment. Water temperature increase however, seems to be the common triggering factor.**
- **Diseases (bleaching and infectious diseases) have become one, if not the most important factor contributing to the deterioration dynamics of coral reefs.**

## Geographic distribution of BBD, WBD and abnormal growths



trematode infection



Trematode infections



Photo by

L. Preskitt

# Hawaii



Dark blotch

Porites dark blotch

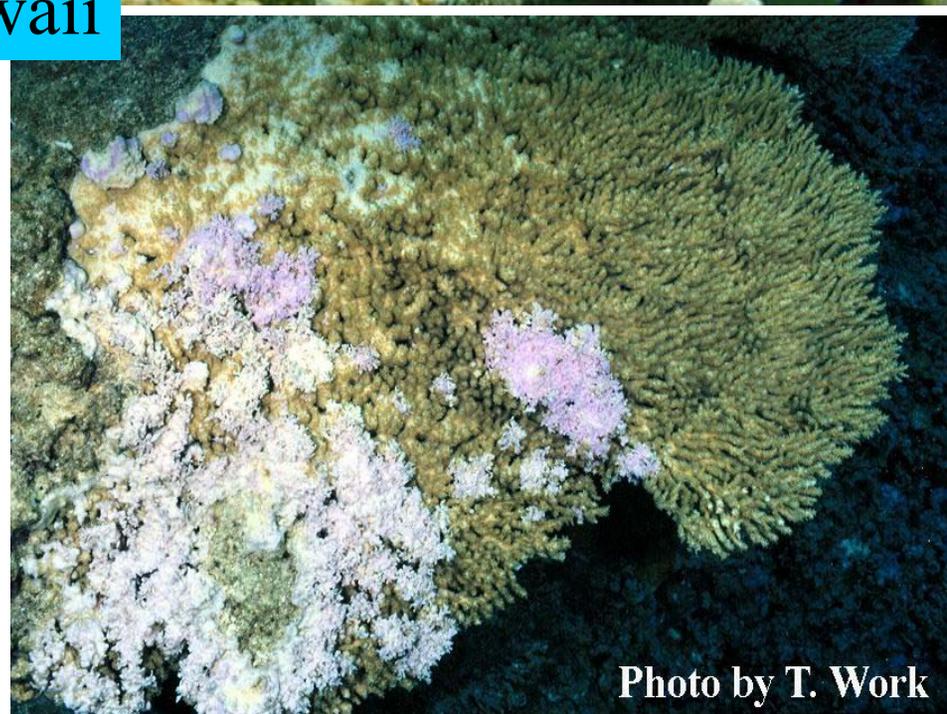
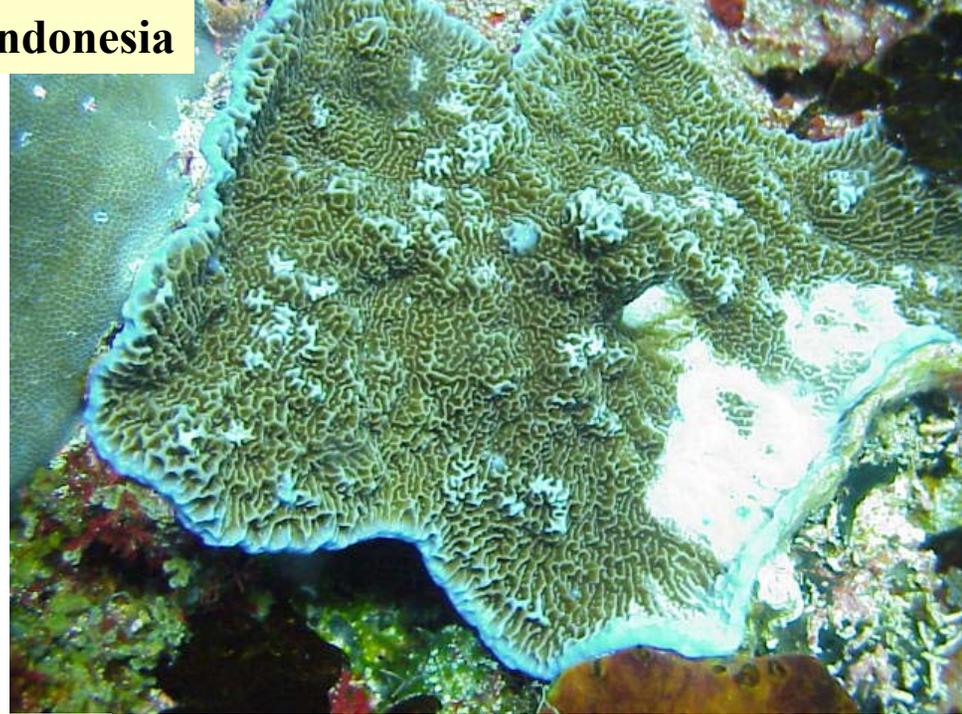
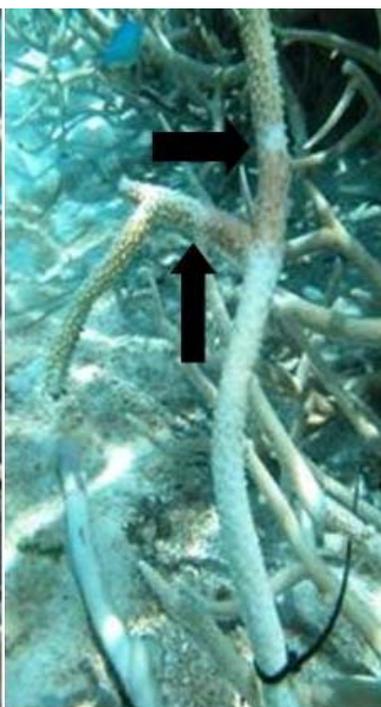


Photo by T. Work

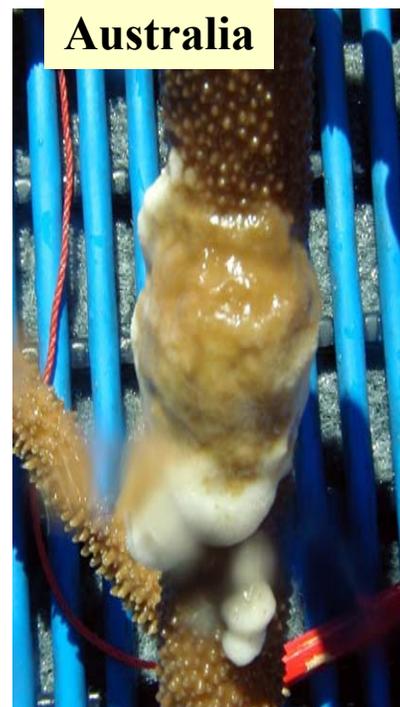
**Bali, Indonesia**



**Brown band**



**Australia**



# **Caribbean viewed as a disease “hot-spot”**

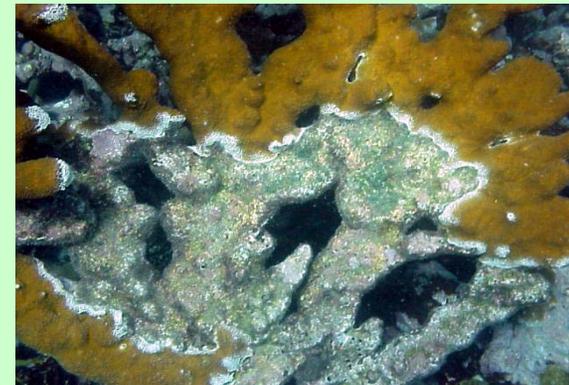
- **Emergence and virulence of high number of diseases/ syndromes in last decades.**
- **66 % of all disease reports come from 38 Caribbean nations**
- **22 (76 %) of 29 diseases/syndromes reported worldwide are in the Caribbean (Caribbean has only 8 % of coral reef area).**
- **42 zooxanthellate coral species affected (75 %)**
- **High frequency of epizootic events over the years with significant loss of coral cover.**
- **Two major epizootic events have caused significant ecological changes at local and regional scales.**

# Geographic distribution of BBD, ASP, WP-II, YBS, DSS-I in the Caribbean region

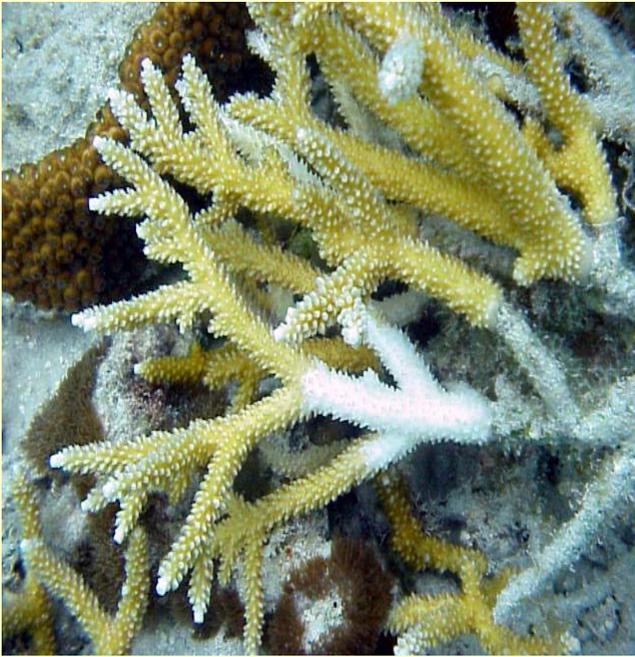


# Epizootic consequences

- **Changes in coral reef community structure/function:**
  - Shifts in species dominance and composition
  - Changes in population/species abundance and distribution
  - Significant reduction in live cover / biomass
  - Reduction in biodiversity.
  - Reduction in spatial heterogeneity / habitats
- **Reduction in productivity**
- **Reduction in reproductive output**
- **Evolutionary consequences ?**
- **Social/economic consequences ?**

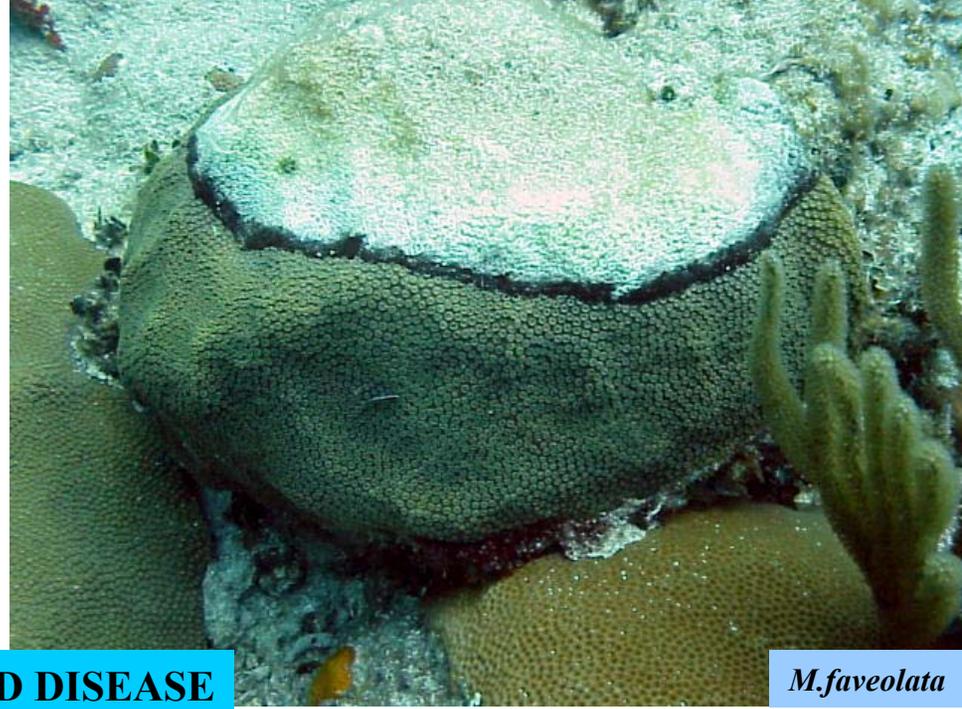


# CARIBBEAN CORAL REEF DISEASES\*



**\* Pathogens identified**

*D.strigosa*



*M.faveolata*

**BLACK BAND DISEASE**  
Bacterium consortium

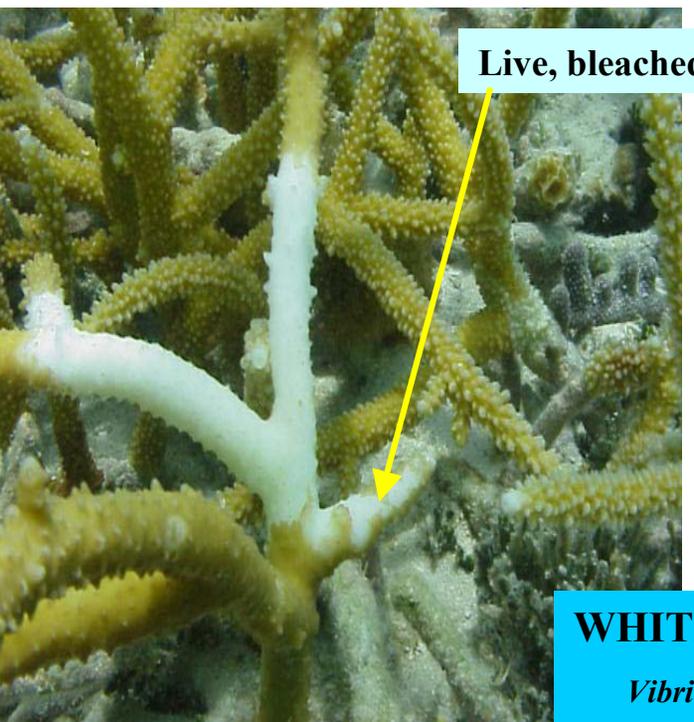


*A.cervicornis*



*D.strigosa*

**WHITE BAND-I**



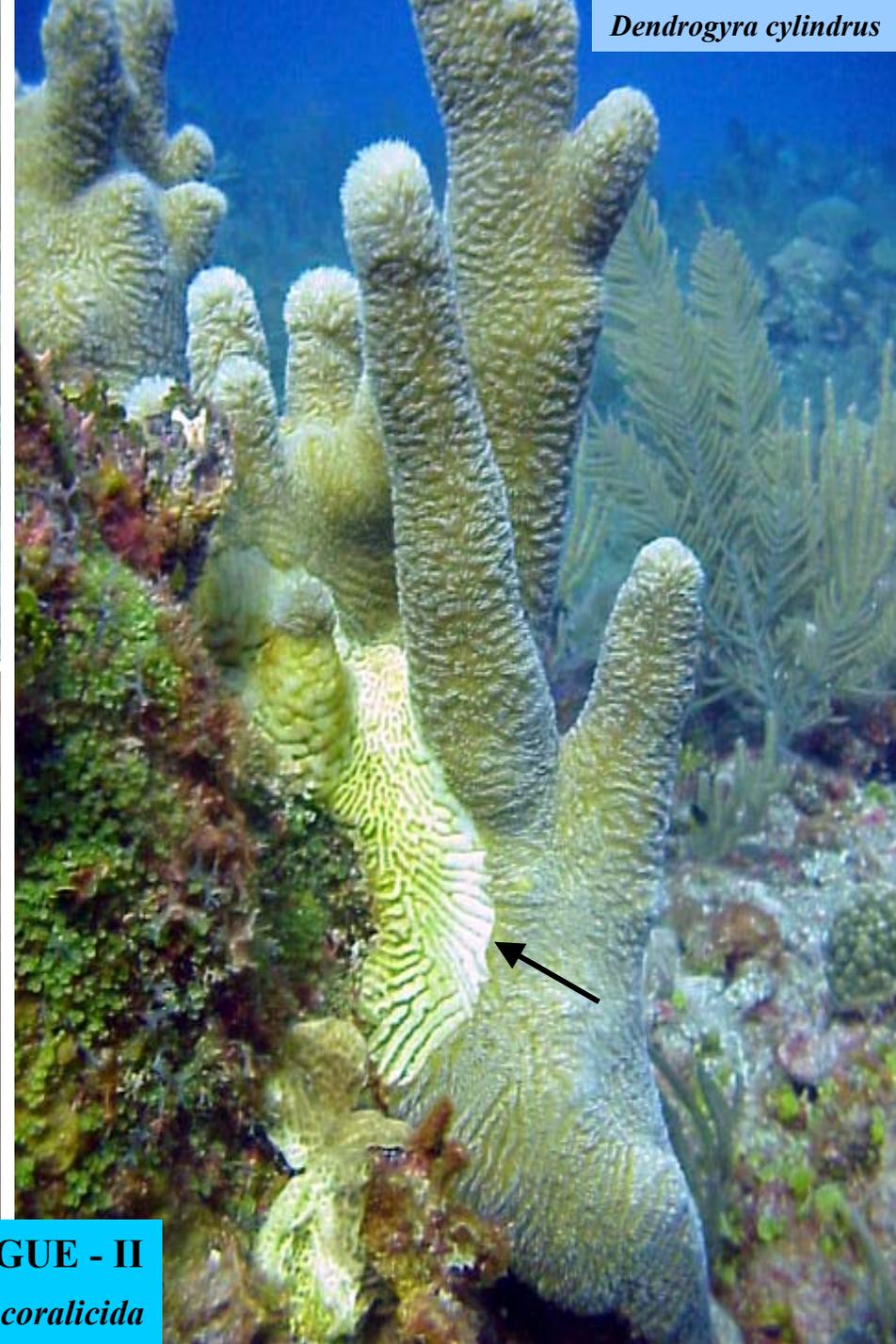
Live, bleached

**WHITE BAND-I**  
*Vibri*





*D.stockesii*



*Dendrogyra cylindrus*



*M. annularis*

**WHITE PLAGUE - II**  
*Aurantomonas coralicida*



*A. cervicornis*



**WHITE POX DISEASE**  
*Serratia marsescens*



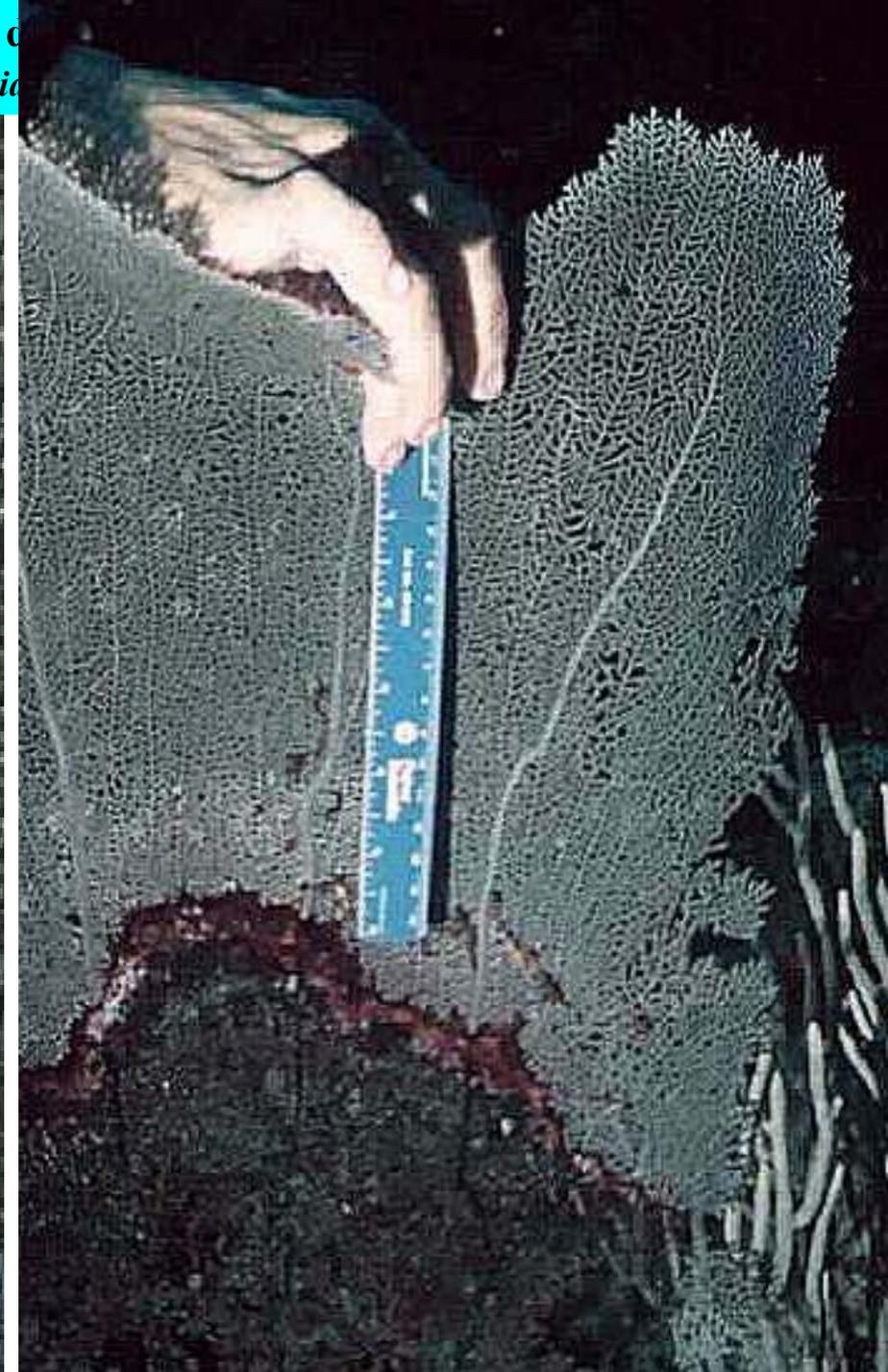
*A. palmata*

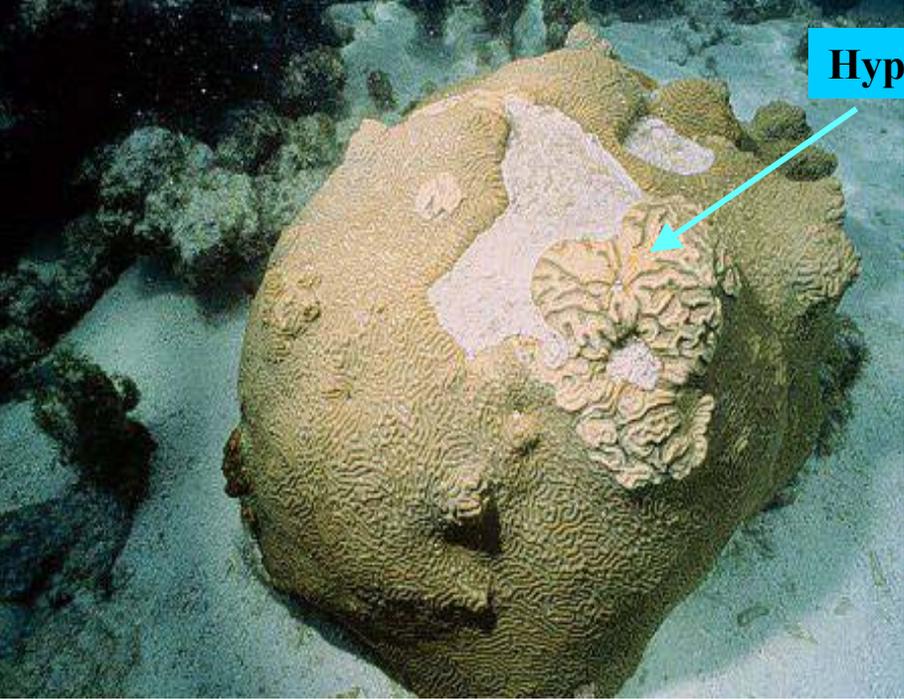
# ASPERGILLOSIS

*Aspergillus sidowii*

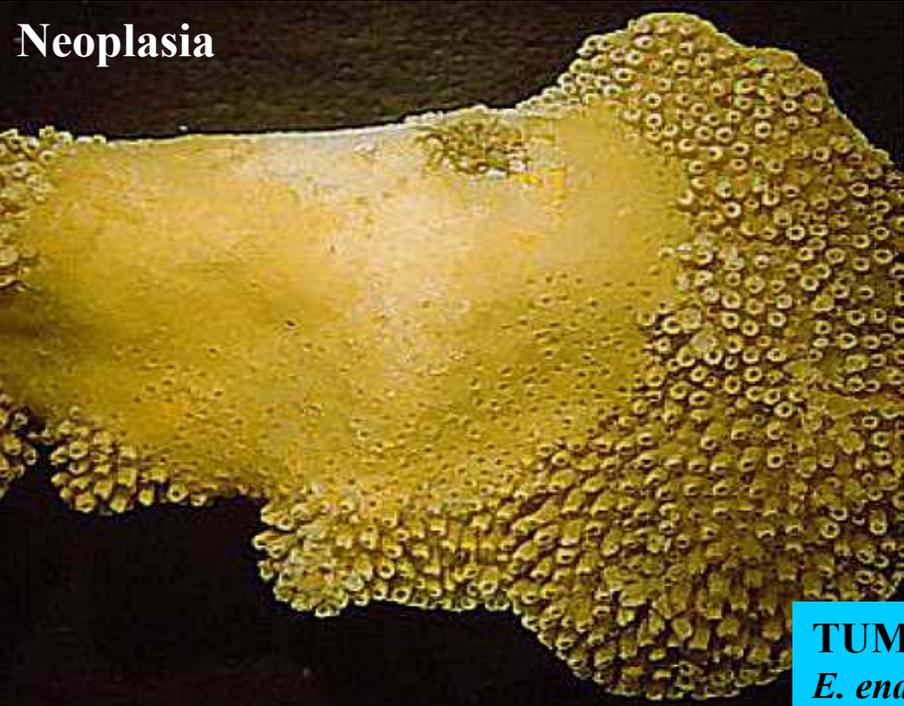


Red-band of  
*Oscillatoria*

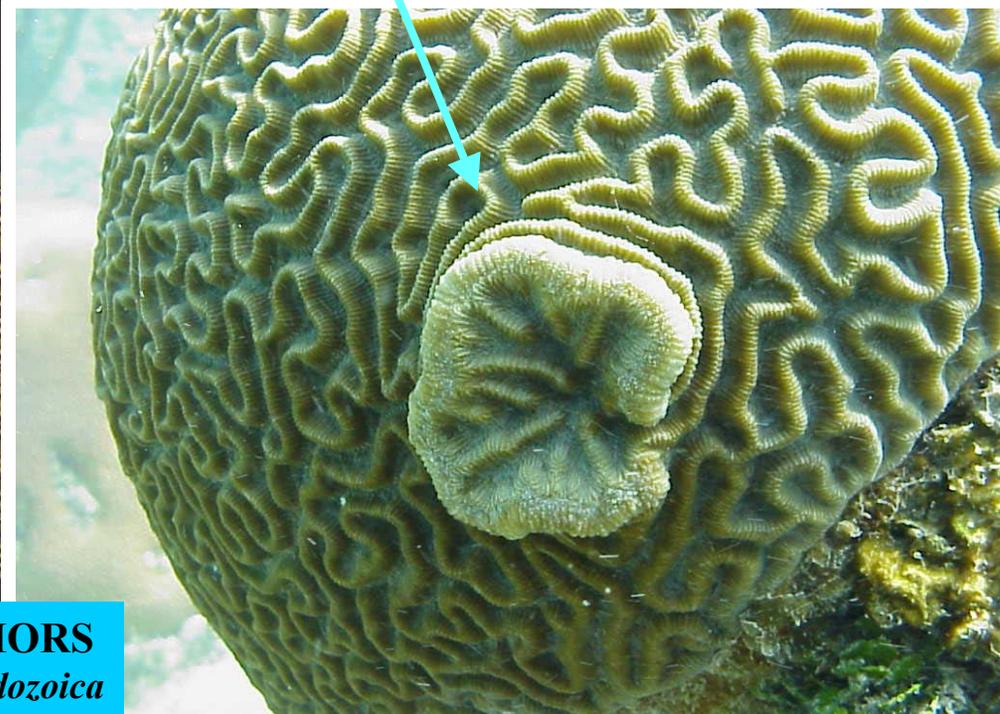




**Hyperplasia**

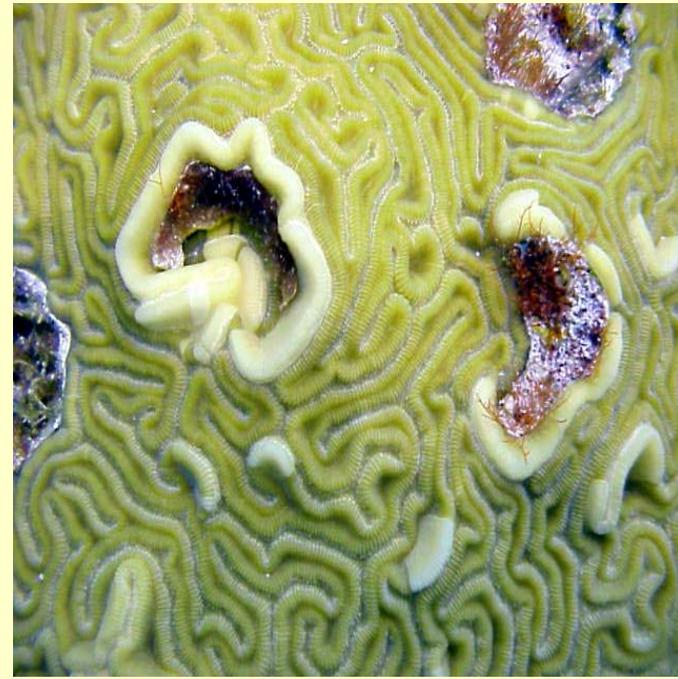


**Neoplasia**



**TUMORS**  
*E. endozoica*

# CARIBBEAN CORAL REEF SYNDROMES\*



\* Pathogens have NOT been identified

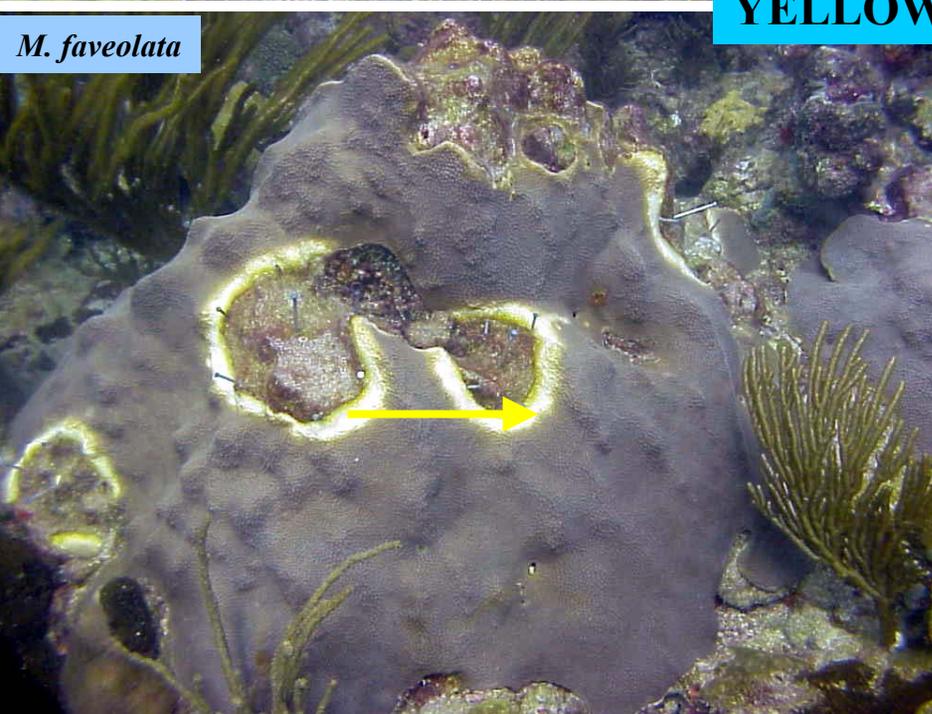
*M. annularis*



*M. franksi*



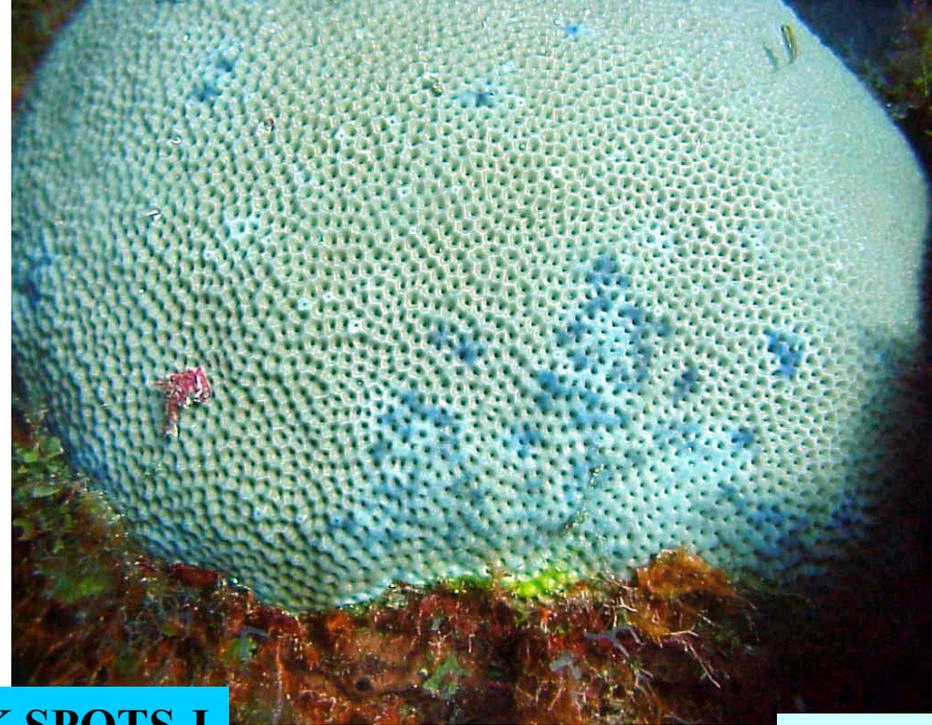
*M. faveolata*



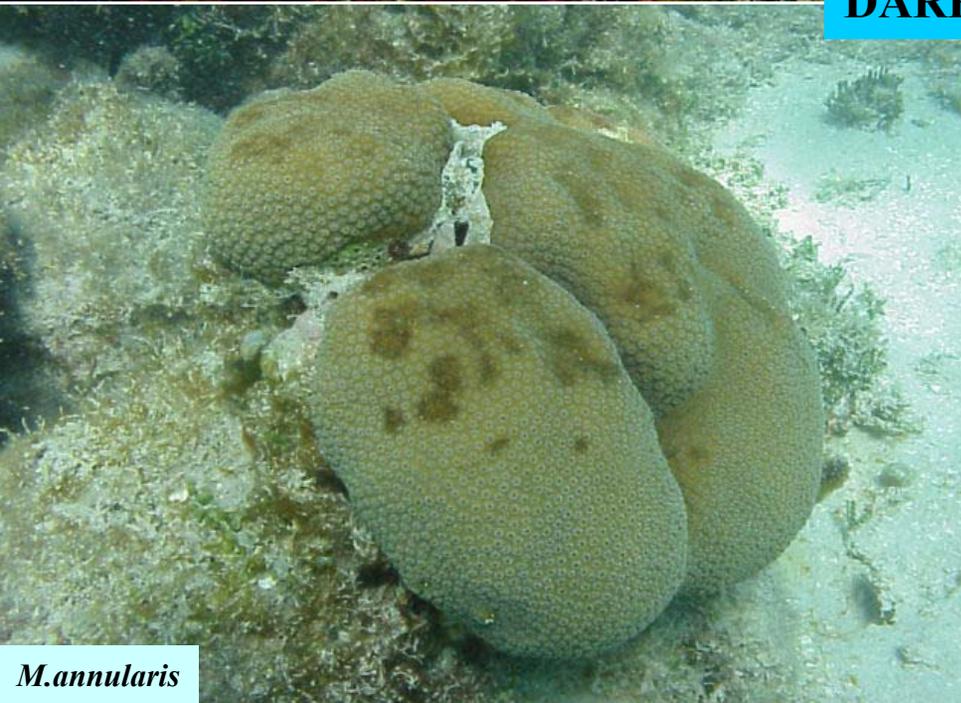
**YELLOW BAND**



**Colony mortality**



**DARK SPOTS-I**



*M.annularis*



*M. faveolata*



**DARK SPOTS-II**



*S.intersepta*

# Dark Spots -II ?



*Colpophyllia natans*

*Acropora palmata*



**PATCHY NECROSIS / SHUT DOWN REACTION??**





**RING SYNDROME**



*D. labyrinthiformis*

*S. siderea*



*M. faveolata*



**“WHITE SYNDROMES -BLOTCHES”**

*S. intersepta*



*S. siderea*





*M.faveolata*



*M.cavernosa*



*P.astreoides*

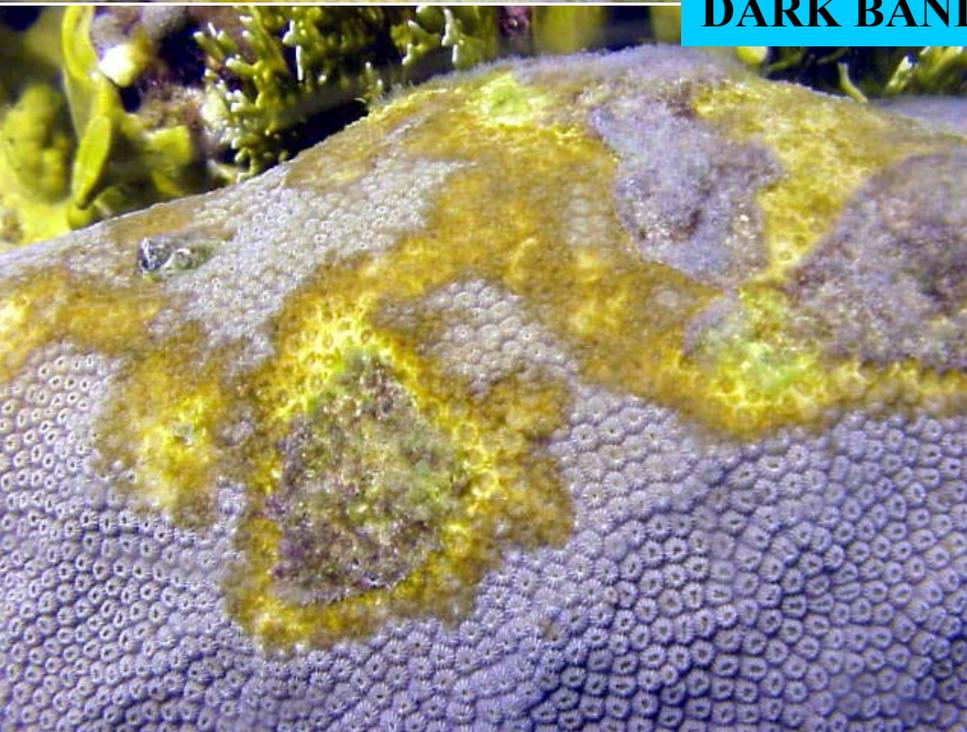
**WHITE SYNDROMES**

*M.annularis*



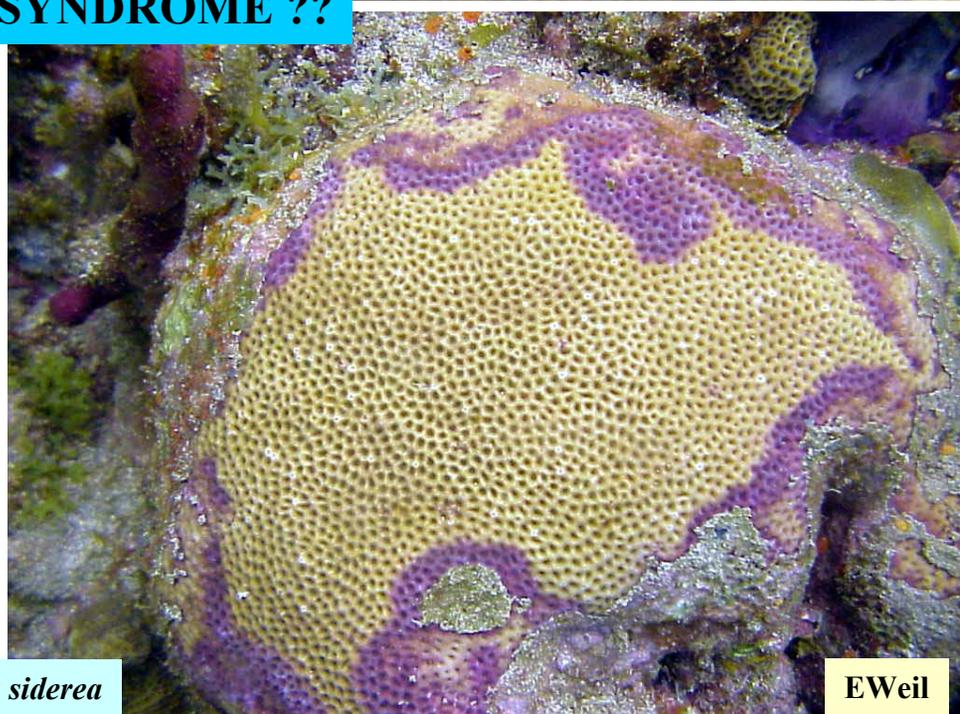
**DARK BAND SYNDROME**

*M.faveolata*

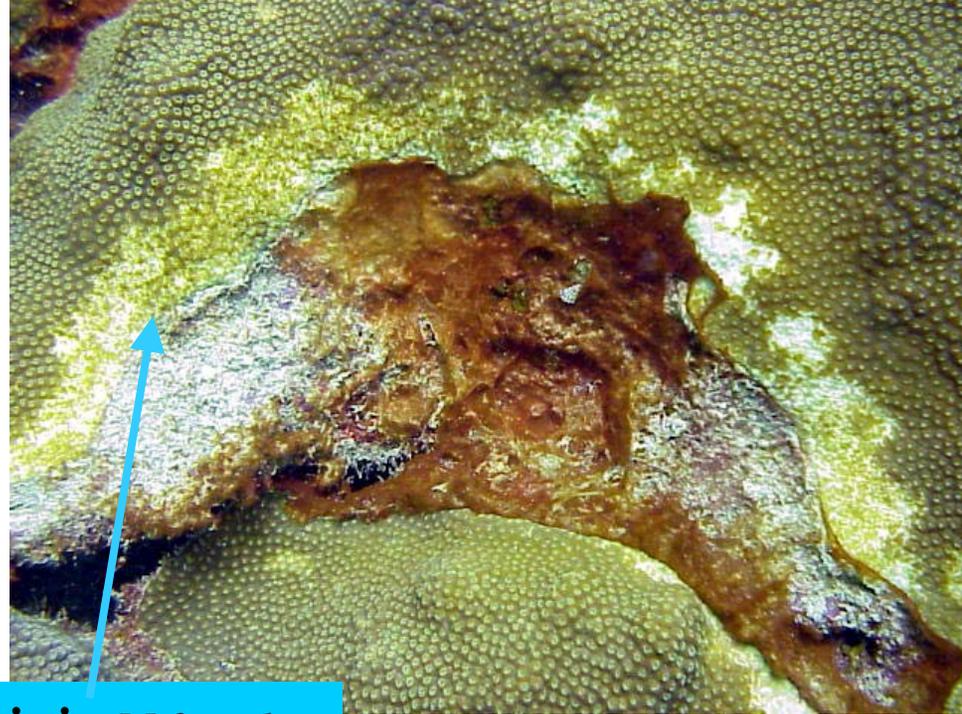




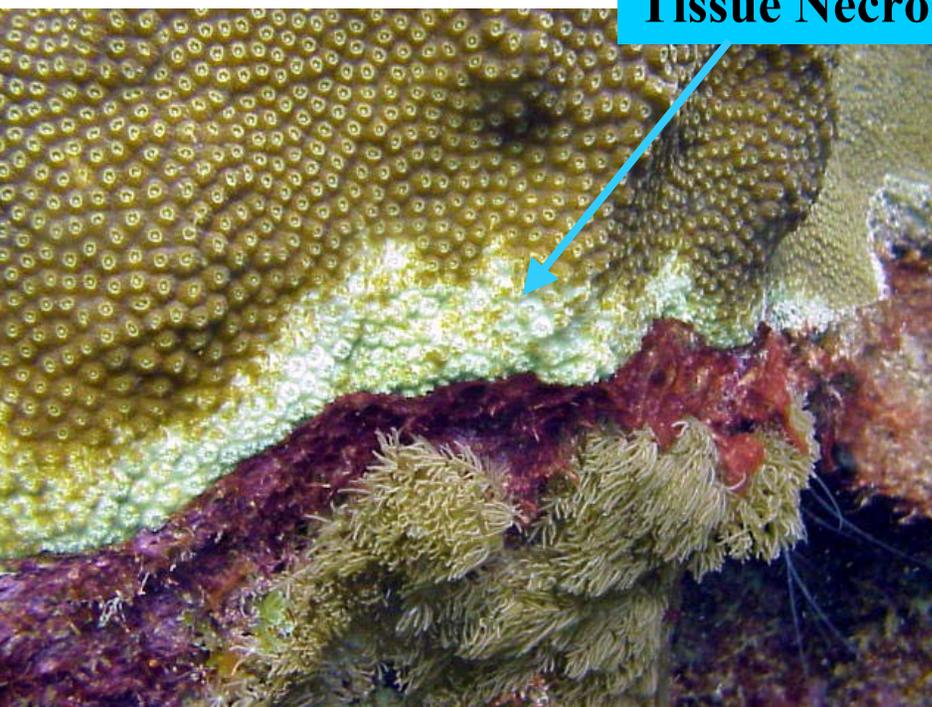
**PURPLE BAND SYNDROME ??**



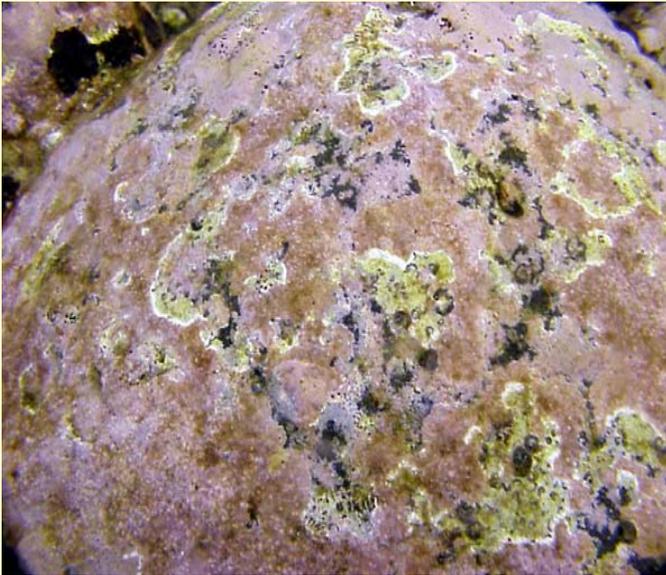
*Siderastrea siderea*



**Tissue Necrosis in *M.faveolata***



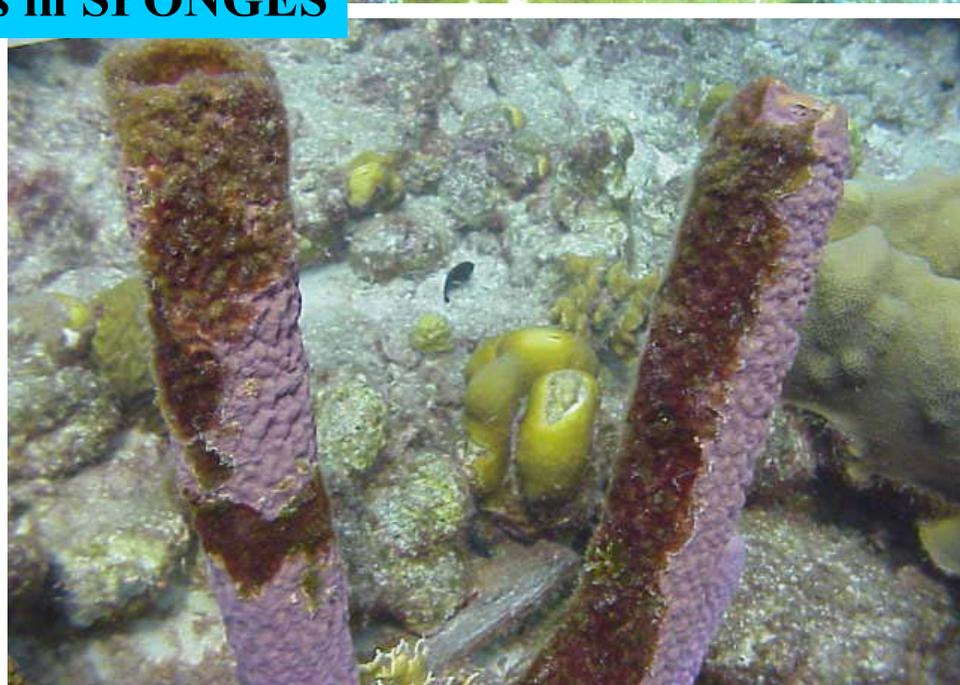
## OTHER IMPORTANT REEF ORGANISMS AFFECTED BY DISEASES / SYNDROMES \*



\* Pathogens have NOT been identified



**Tissue Necrosis in SPONGES**



# OCTOCORALS

Band syndrome

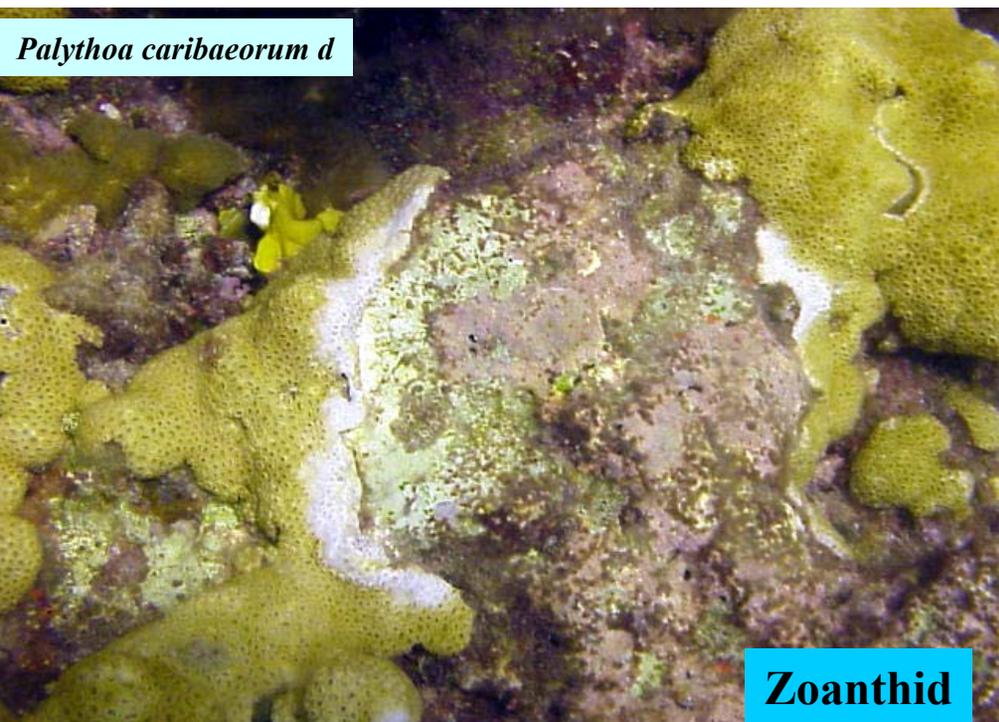
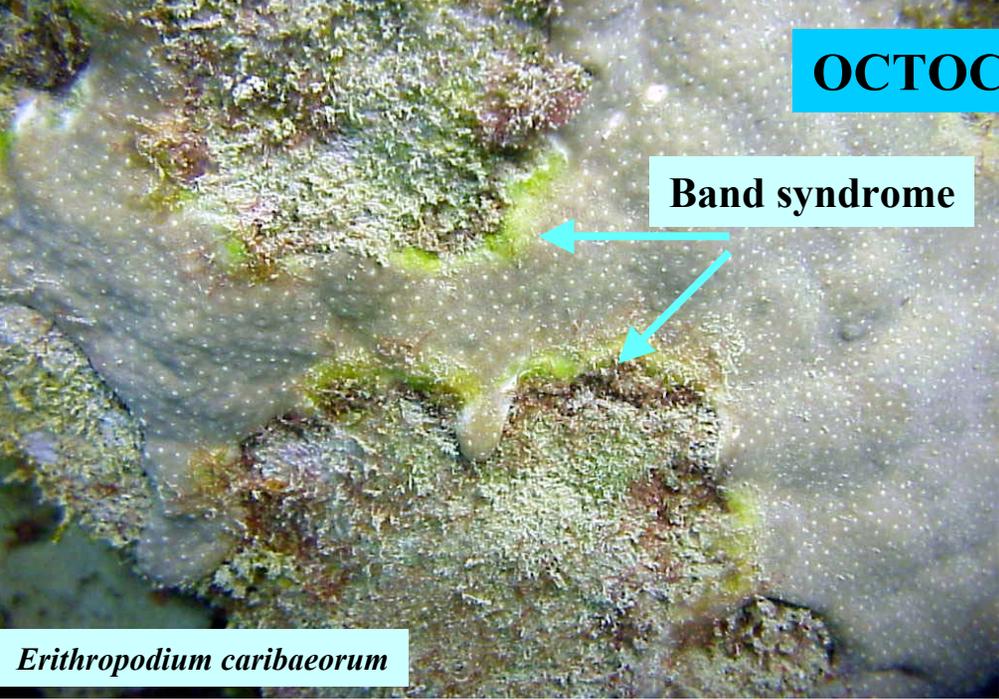


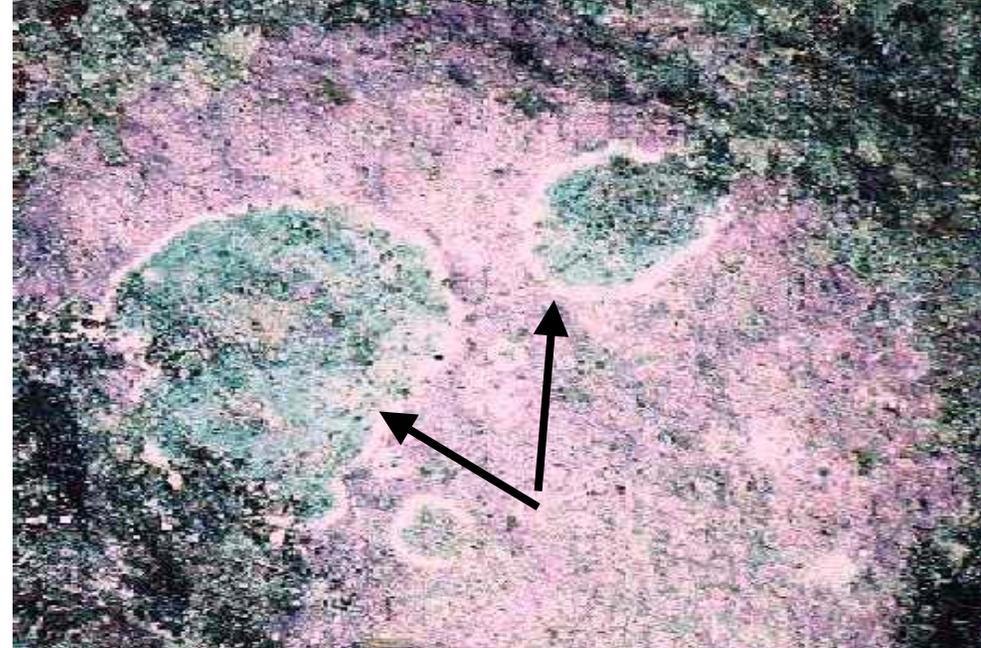
*Erithropodium caribaeorum*

*Palythoa caribaeorum d*

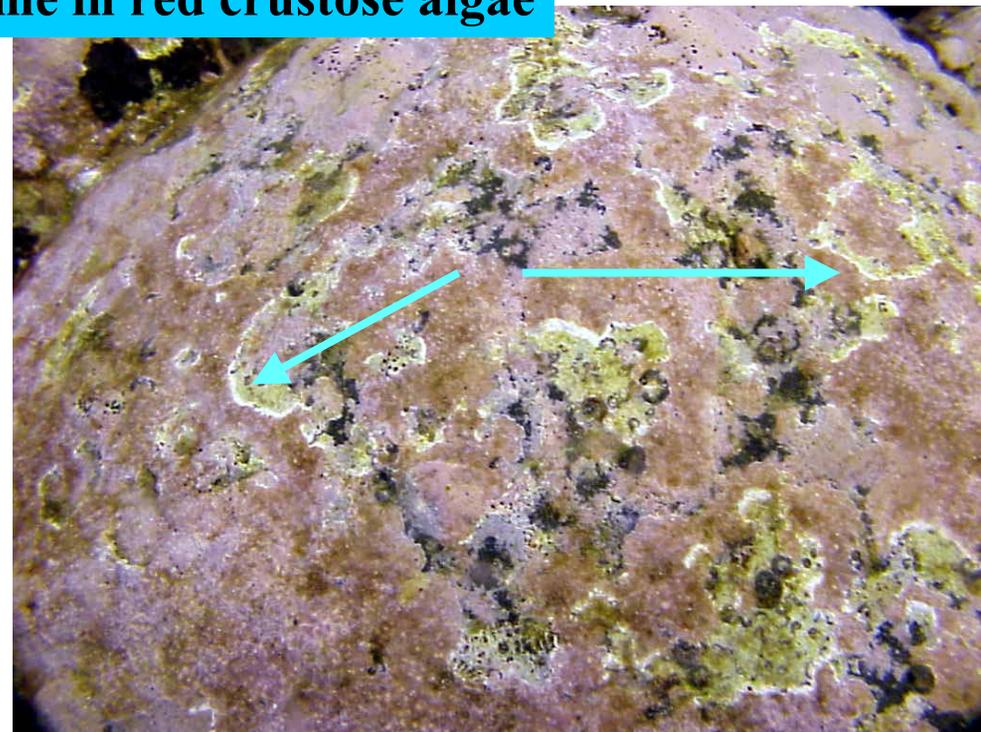
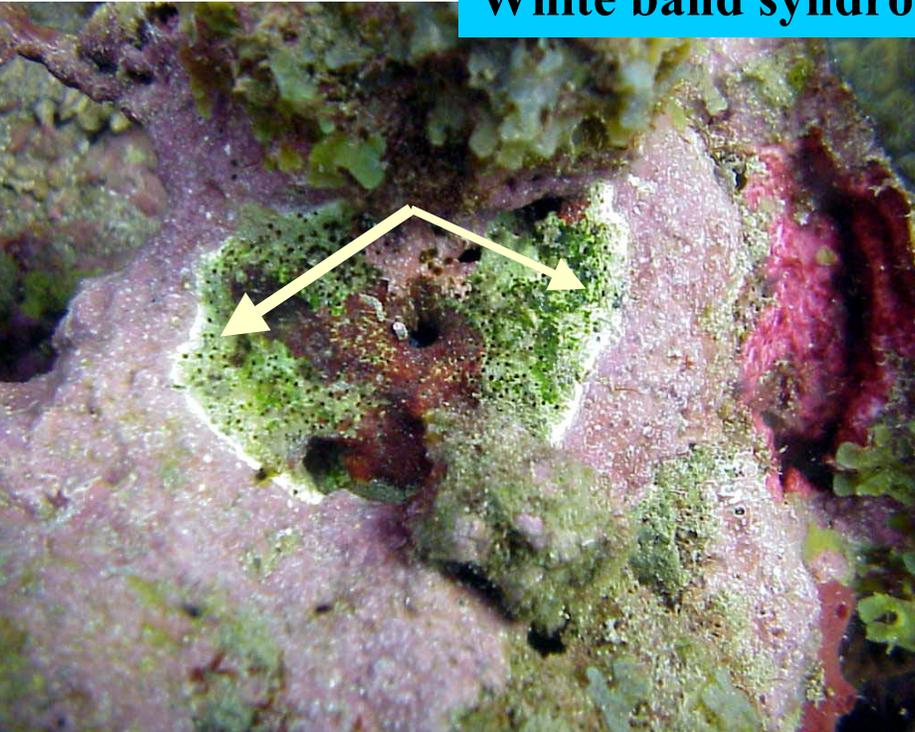
Zoanthid

Dead tissue

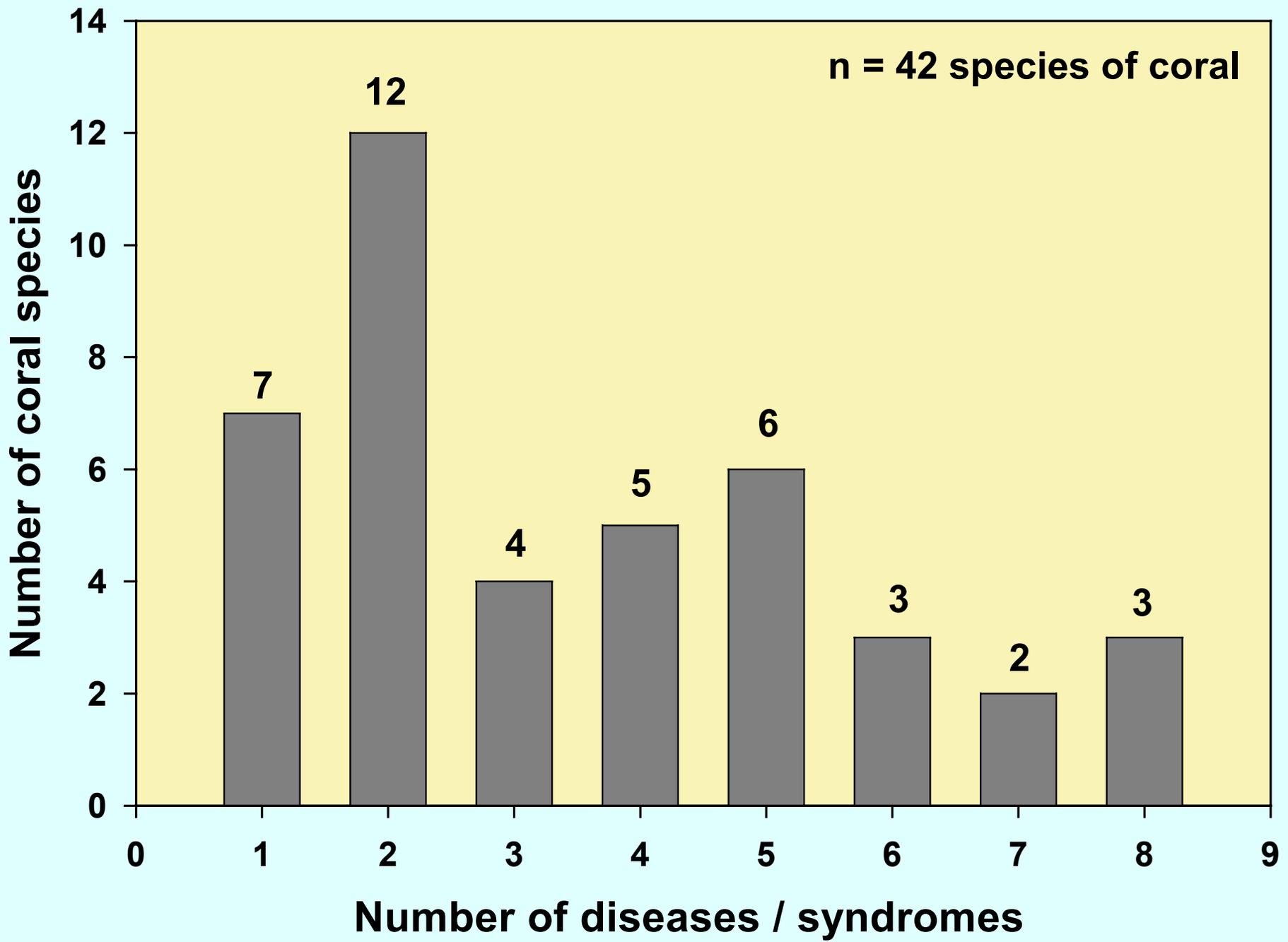


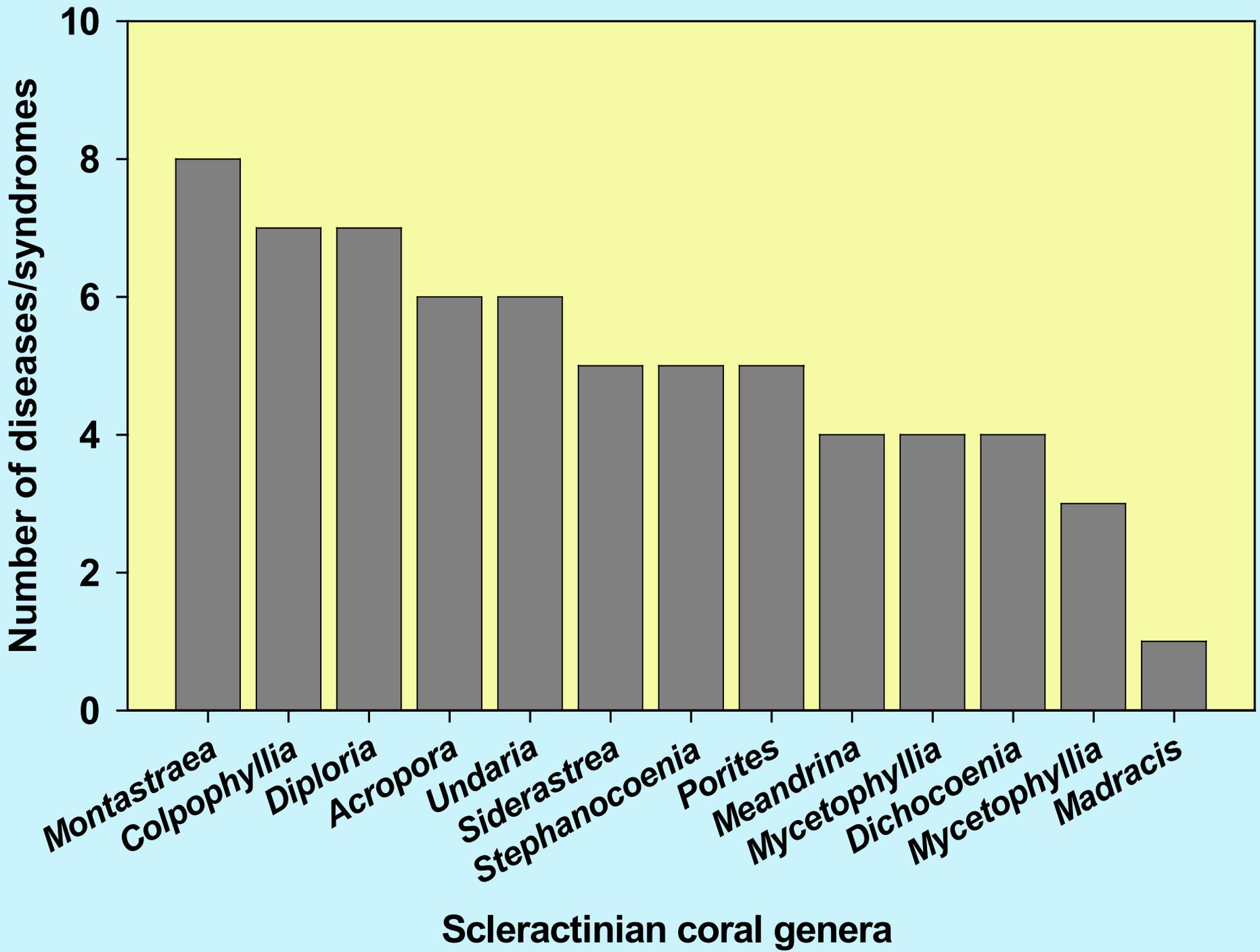


**White band syndrome in red crustose algae**

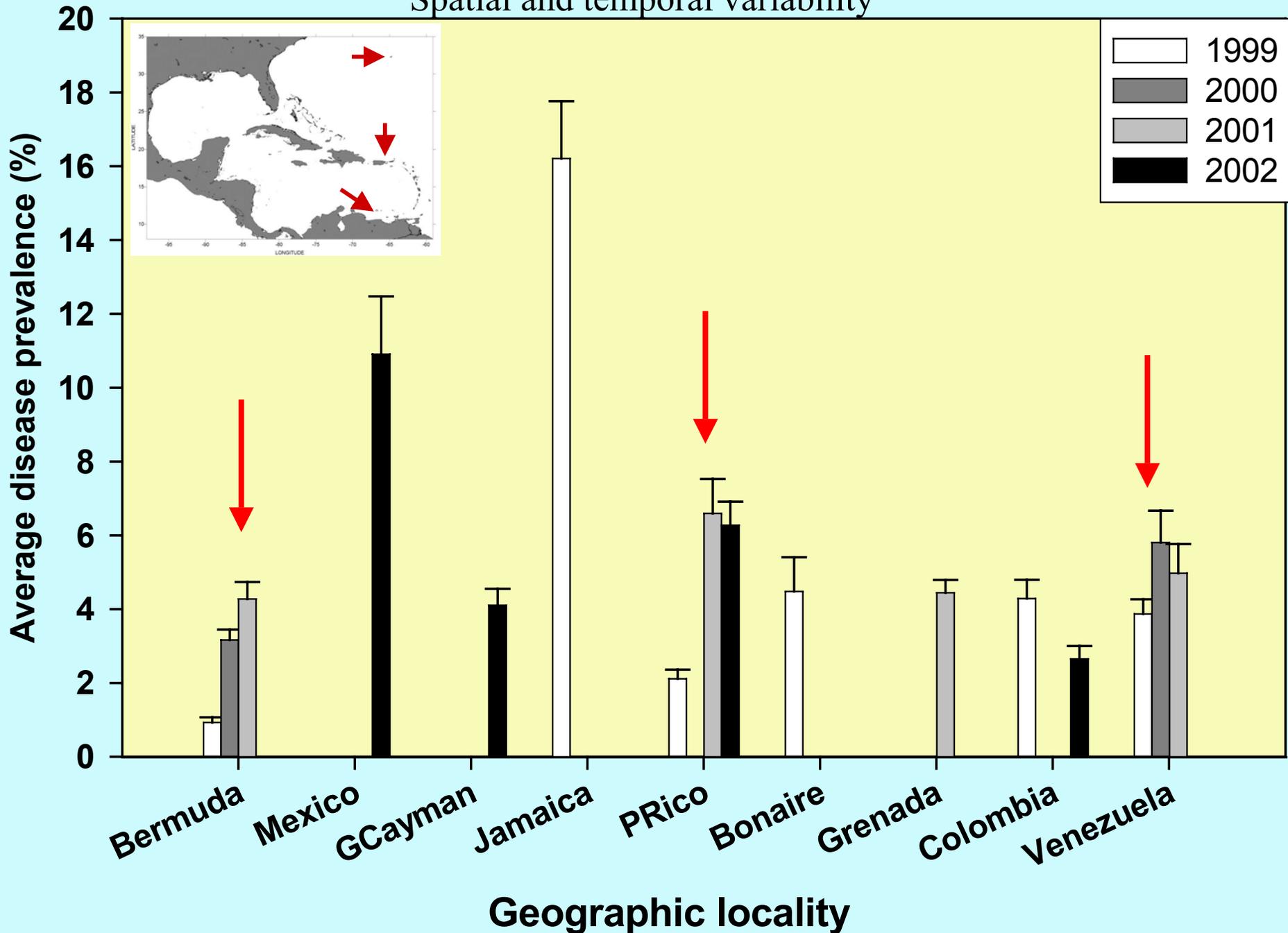


# Number of affected coral species by different diseases / syndromes





# Spatial and temporal variability



# Causes and sources of the fast emergence of new and old diseases?

- **Indirect human activities - Global Warming**

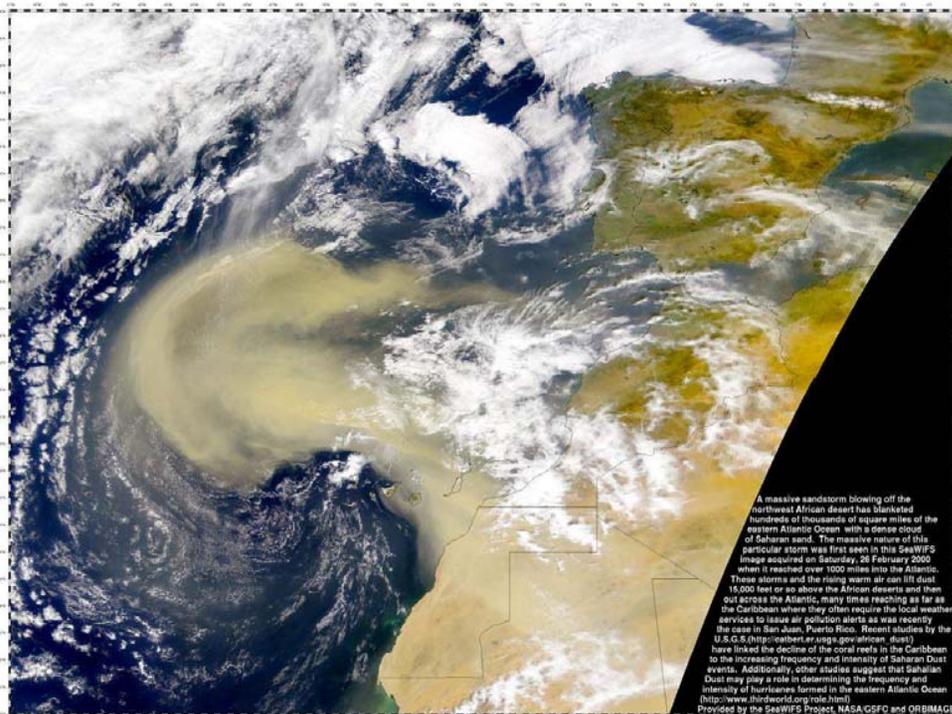
- Modification to basic biological properties - limits of tolerance - increase susceptibility.
- Increase prevalence and virulence of existing pathogens.

- **Direct human activities**

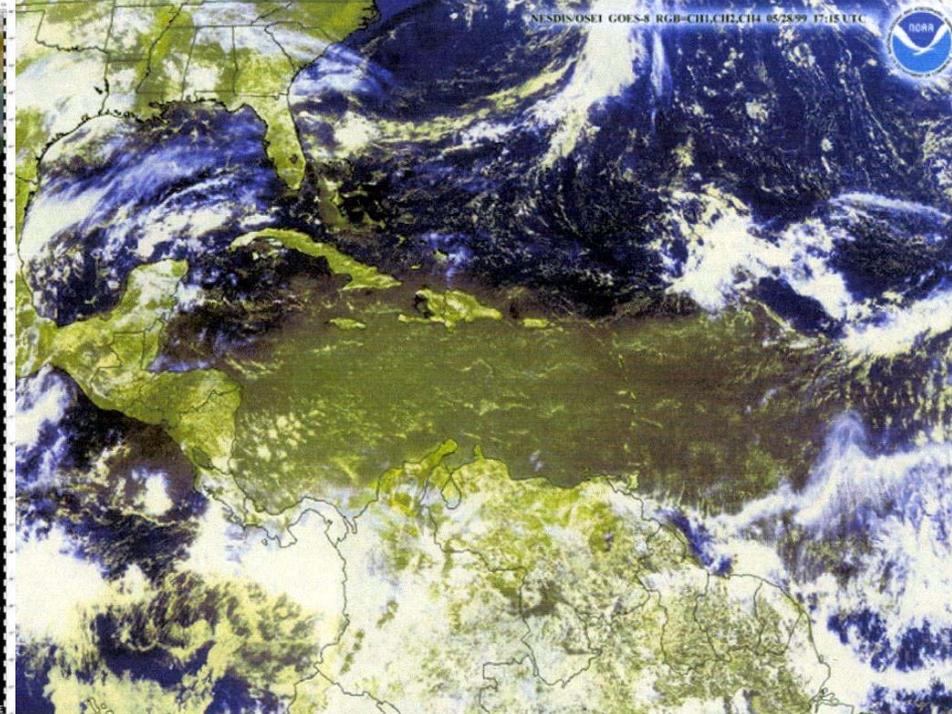
- Facilitation of movement of new pathogens
- Habitat deterioration – over-fishing - sedimentation

- **Sources**

- Local sources (virus – bacteria- other potential pathogens)
- Outside sources – African dust – land sediments – human waste



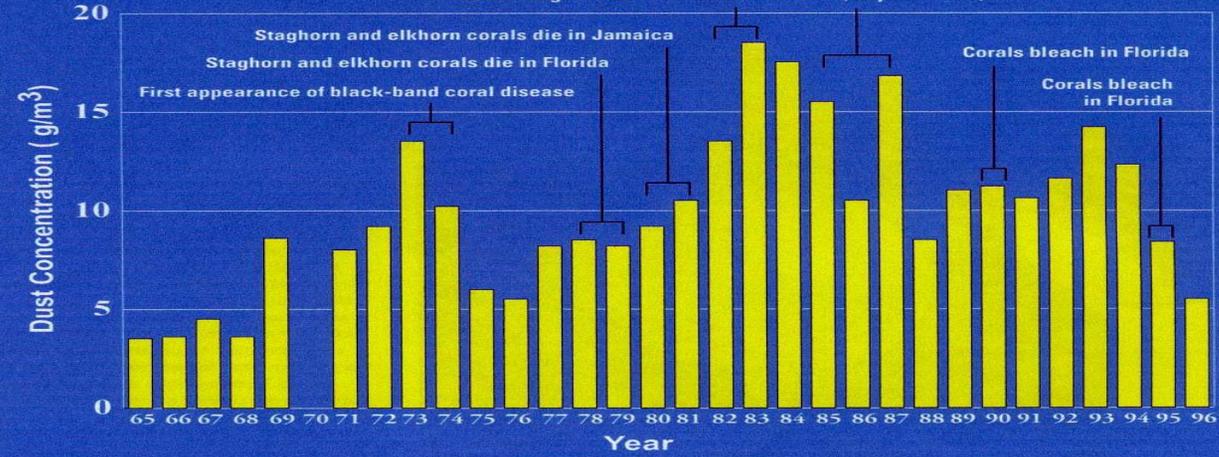
A massive sandstorm blowing off the northwest African desert has blanketed hundreds of thousands of square miles of the western Atlantic Ocean with a dense cloud of Saharan sand. The massive nature of this particular storm was first seen in this SeaWiFS image acquired on Saturday, 26 February 2000 when it reached over 1000 miles into the Atlantic. These storms and the rising warm air can lift dust 15,000 feet or so above the African deserts and then get across the Atlantic, many times reaching as far as the Caribbean where they often require the local weather services to issue air pollution alerts as was recently the case in San Juan, Puerto Rico. Recent studies by the U.S.G.S. (<http://nahrtr.er.usgs.gov/air/dust/>) have linked the decline of the coral reefs in the Caribbean to the increasing frequency and intensity of Saharan Dust events. Additionally, other studies suggest that Saharan Dust may play a role in determining the frequency and intensity of hurricanes formed in the eastern Atlantic Ocean (<http://www.jamhond.org/role.htm>). Provided by the SeaWiFS Project, NASA/GSFC and ORBIMAGE



## Barbados Mineral Dust (Annual Average: 1965-1996) and Benchmark Caribbean Events

Staghorn and elkhorn corals die throughout the Caribbean (major El Niño)  
Sea urchin *Diadema antillarum*, a key reef herbivore, dies throughout the Caribbean

Black-band disease rampant in Florida; Corals bleach throughout the Caribbean and sea grasses die in Florida (major El Niño)



This graph, courtesy of Dr. Joe Prospero, University of Miami, shows the overall increase in African dust reaching the island of Barbados since 1965. Barbados is situated in the Windward Islands, which are hidden beneath the cloud of dust shown in the satellite image on the second page. Notice that peak years for dust deposition were 1983 and 1987. These were also the years of extensive environmental change on Caribbean coral reefs.

# Managers perspective

- **How to protect coral reefs and marine habitats - MPAs would not protect coral reef organisms from local-regional scale, water-borne pathogens.**
- **Development of remediation/restoration protocols**
- **Development of early warning system and a rapid response team**
- **Development of disease probes – improve field identification**
- **Control of pathogens movement by human activities**
- **Concerted effort between governments, researchers and managers to restore and maintain high quality water conditions.**

# RESEARCH NEEDS

- **Pathology and Etiology**

- Identify pathogens - comply with Koch's postulates
- Identify mechanism (s) causing tissue mortality.
- Better etiological characterizations - standardization
- Develop specific diagnostic methods for epidemiological studies
- Variability in space and time

- **Epizootiology (epidemiology - ecology)**

- Distribution, abundance and incidence of diseases and syndromes at local and regional scales. Assess spatial - temporal variability
- Determine host ranges –natural reservoirs and vectors.
- Assess real impact - specific mortality rates (partial/total) associated with each disease.
- Establish relationship of diseases with habitat deterioration / local environmental changes and climatic change (global warming).
- Develop epidemiological models.

## **A more holistic approach?**

**Concerted effort of all stakeholders to control habitat deterioration and environmental change and to better understand the dynamics of the disease problem.**

- **FUNDING**
- **TIME**
- **SUPPORT**



## Acknowledgements

- The Organizing committee for their kind invitation
- CARICOMP and the UNESCO Diversitas Program
- Bette Willis, Greta Smith Aeby and Cindy Hunter provided information and photographs of diseases from Australia and Hawaii

**THANK YOU**

