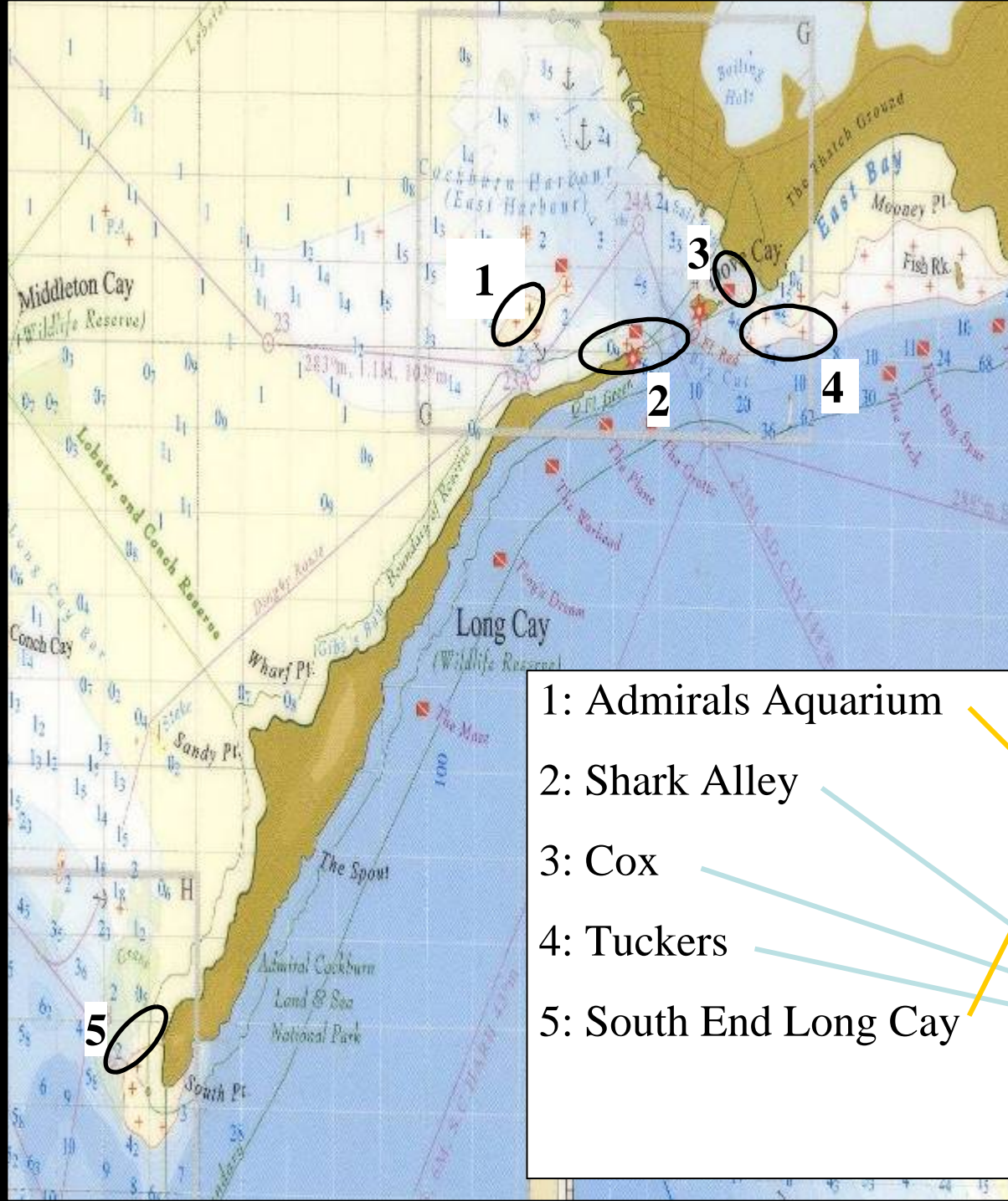




Coral Diseases

Turks Caicos Islands





- 1: Admirals Aquarium
- 2: Shark Alley
- 3: Cox
- 4: Tuckers
- 5: South End Long Cay

patch reefs

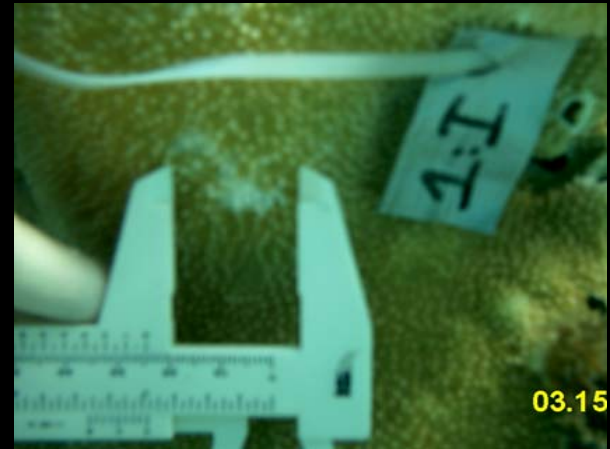
fringing reefs



How I Measured WBD & WPDa



Height

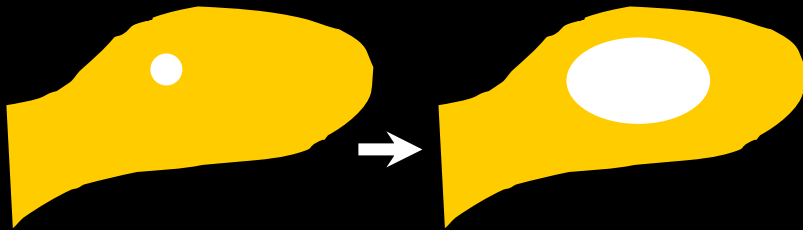


Width

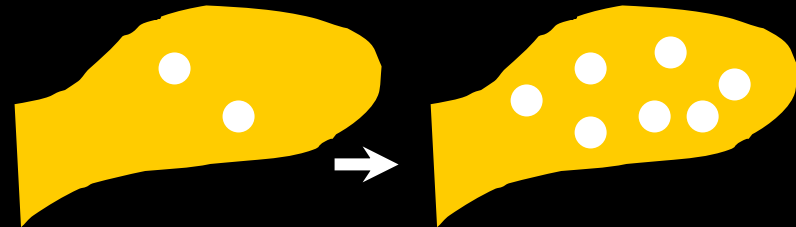
White Pox Disease

The two methods of disease spread that I found

WPDa



WPDb



Field Shots



WPDa

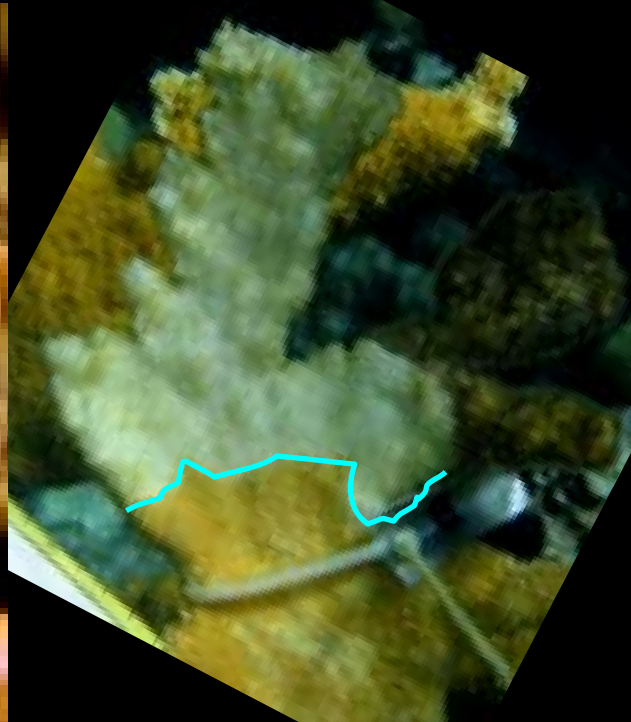


WPDb

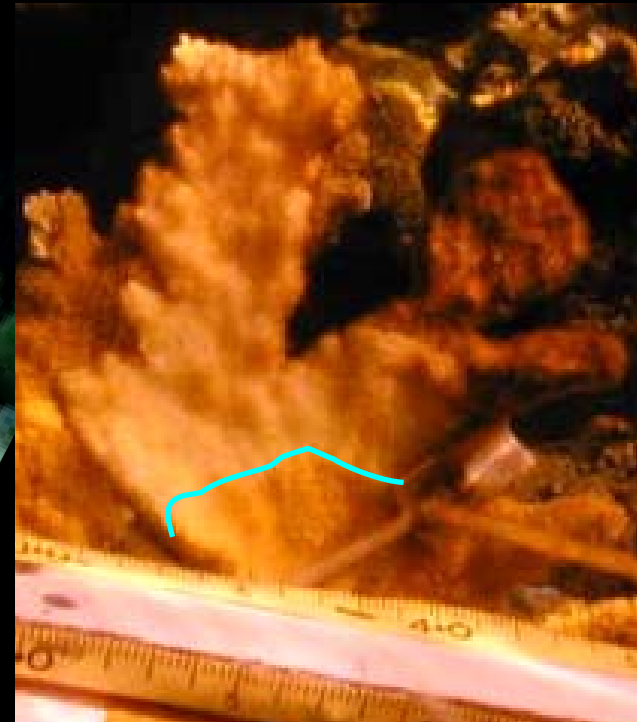
Photographic Analysis of White Pox Disease Spread



March 24th



March 30th

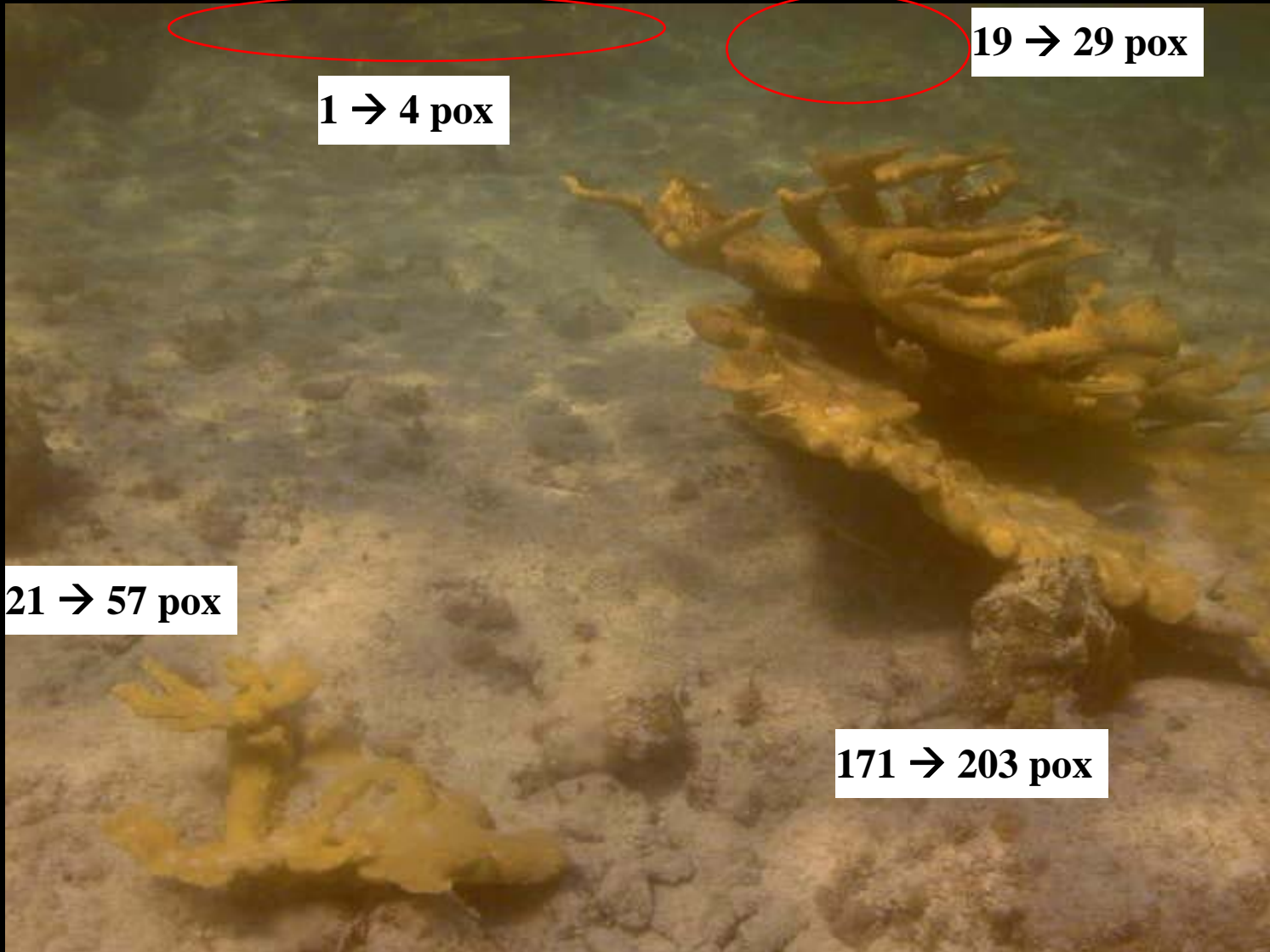


April 9th

0.21 cm²/day higher mean rate of tissue loss with photo measurements

WPDb Distribution and Spread

(March 27th & April 3rd)



1 → 4 pox

19 → 29 pox

21 → 57 pox

171 → 203 pox

Cox Development



Disease

“Disease is defined any impairment of an organism’s vital functions, systems, organs, or cells. Infectious diseases are characterized both by an identifiable group of signs and the presence of the recognized etiologic or causative agent.”

(Ben-Hiaim and Rosenberg, 2002)

Marine Diseases

As of 2000 as many as **34 mass mortalities** had been reported in a wide variety of marine groups, each affecting more than **10%** of the infected population

(Harvell et al. 1999, Green & Bruckner 2000)

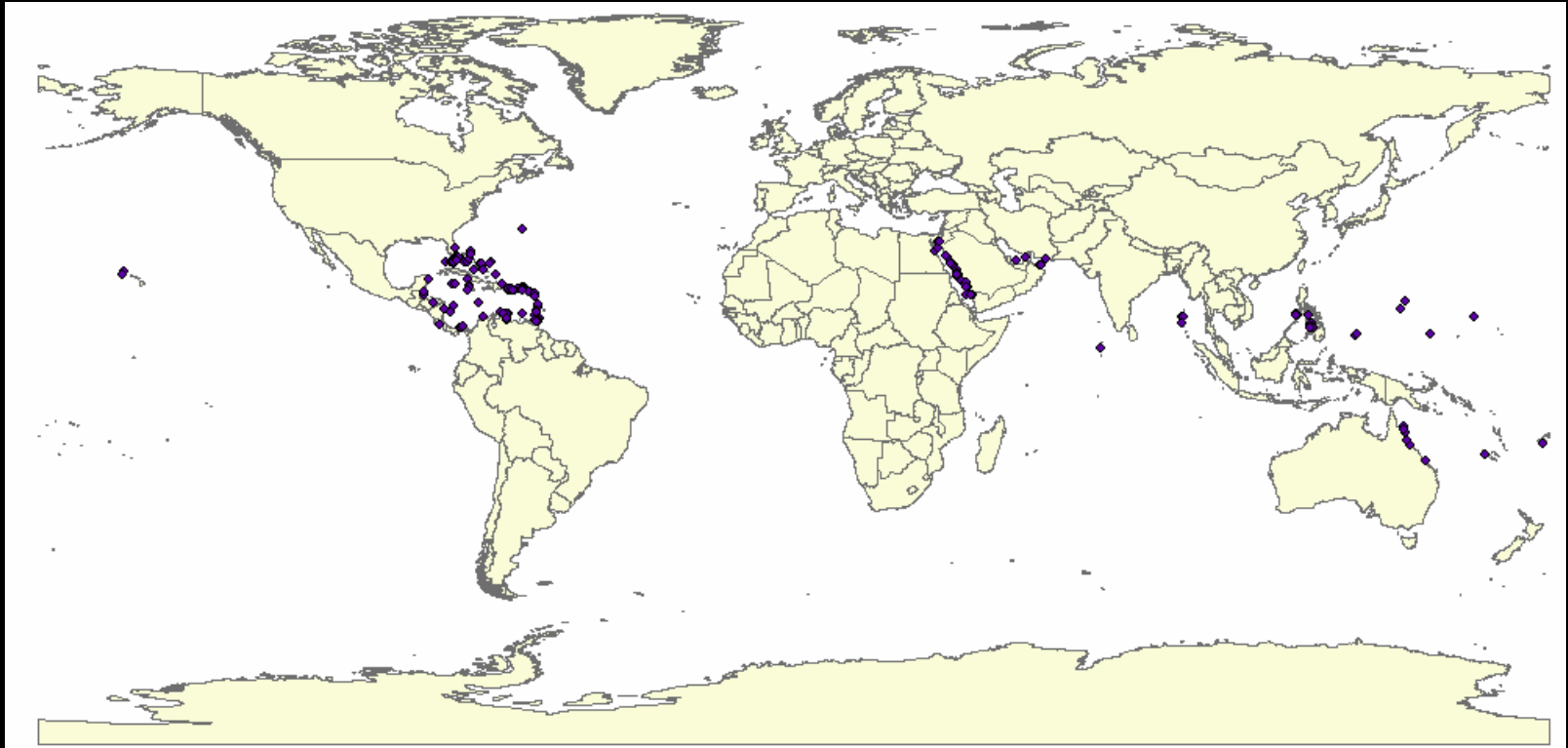


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Marine
Disease
Pathology &
Research
Consortium

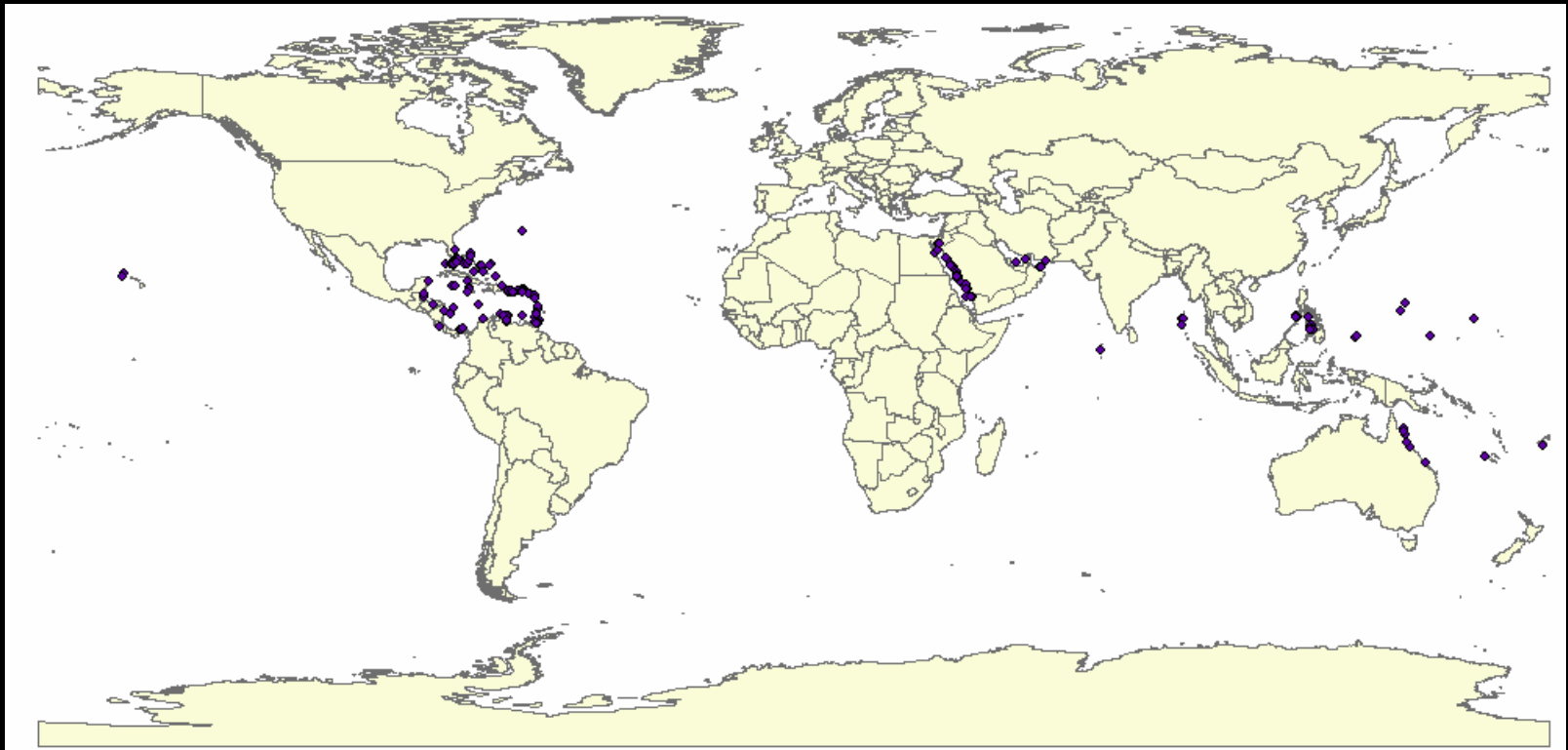
Coral Disease Distribution



“Records and sources of coral disease” (Green and Bruckner 2000)

Region	Records of Disease	Number of Sources
Wider Caribbean	1375	125
Red Sea and Gulf of Arabia	494	9
Pacific and South East Asia	174	15
Indian Ocean	24	3

Coral Disease Distribution



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Increased Incidence

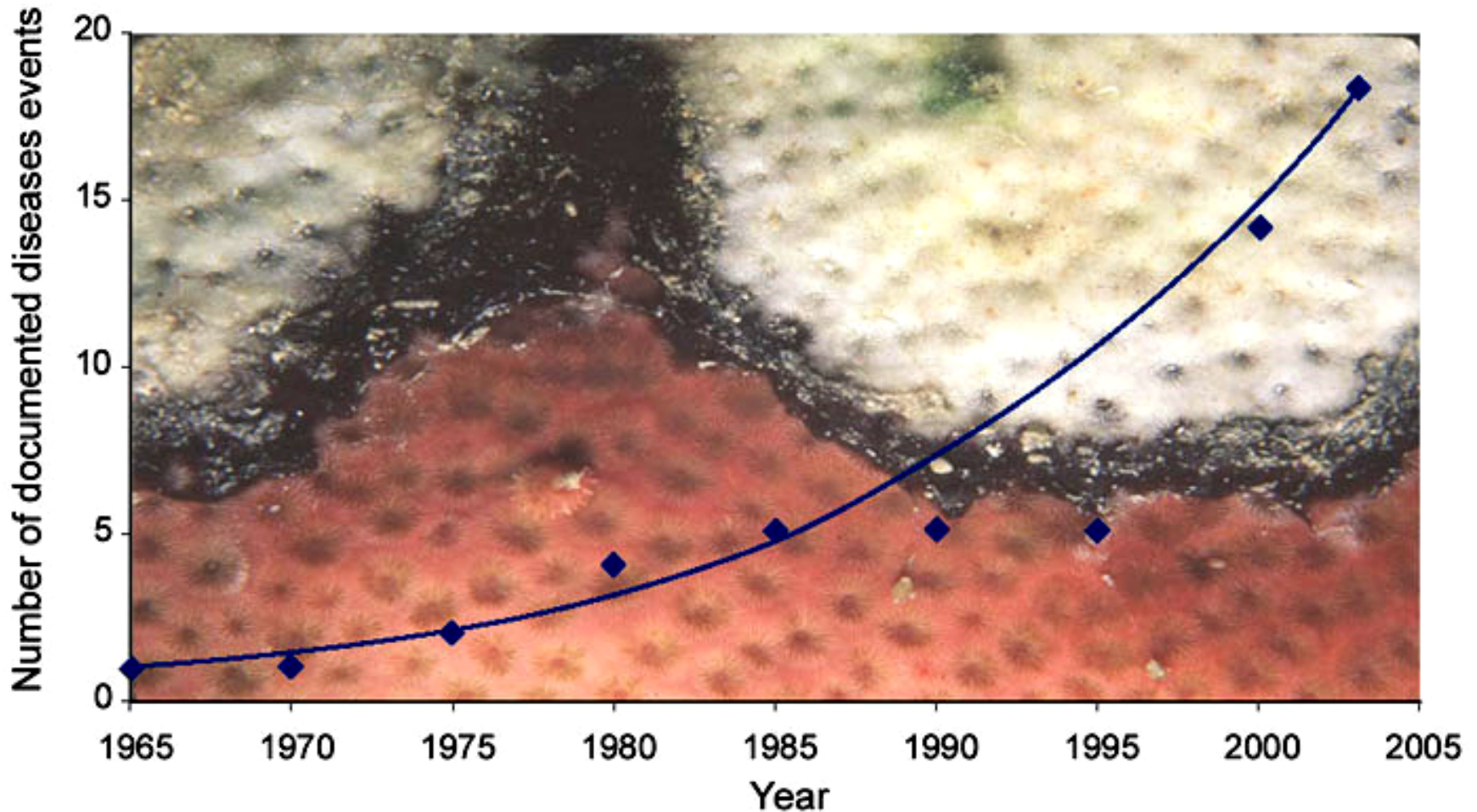


Fig 4.5: Exponential increase in the number of described coral diseases since the first report of disease in 1965.

adapted from Sutherland et al., 2004

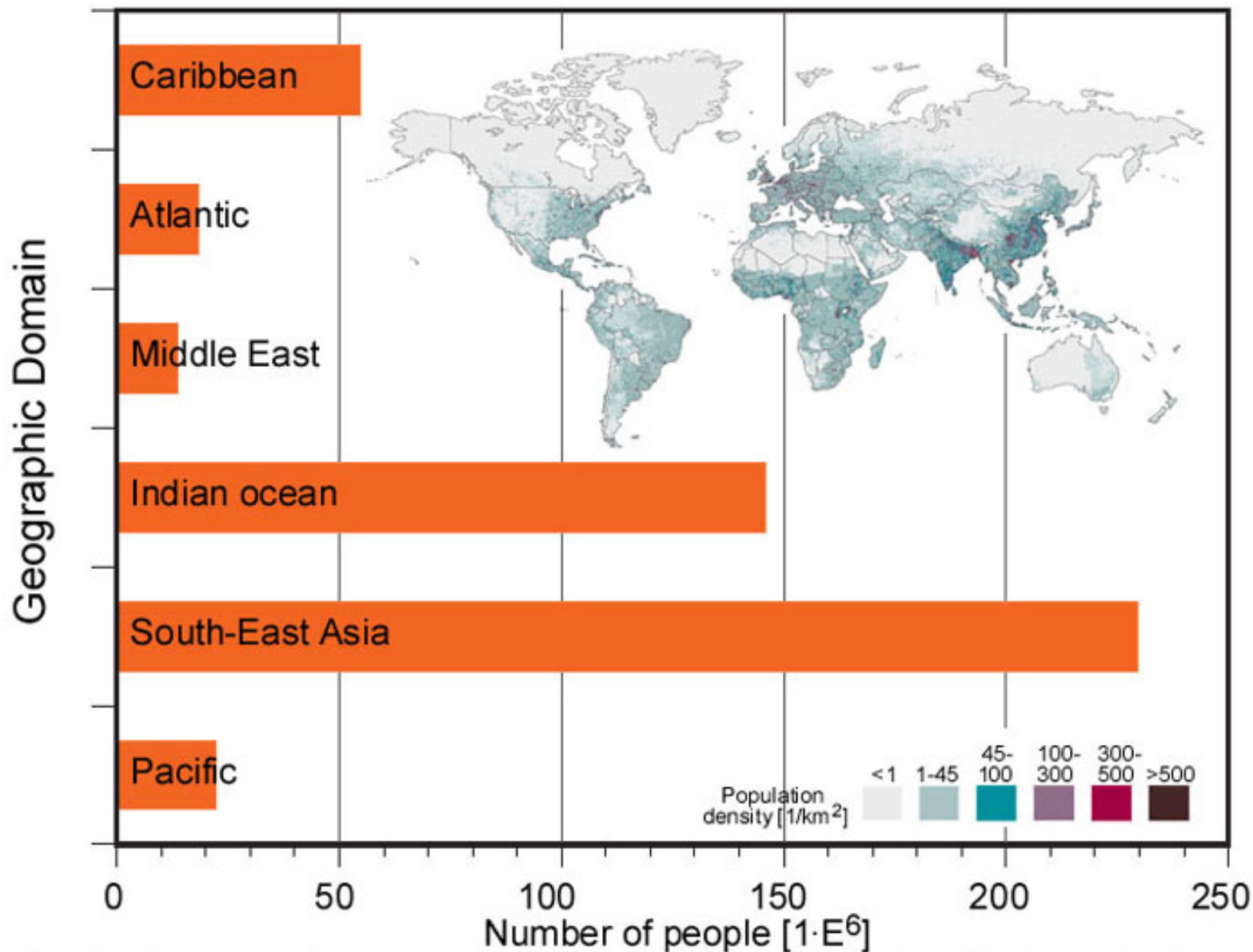


Fig. 1.0: Number of people living within 100km of a coral reef; almost half a billion people live near reefs

adapted from Bruan et al., 1998 & AAAS, 2000

A microscopic image of coral polyps, showing their characteristic wavy, ridged structure. A prominent dark, irregular line runs across the polyps, likely representing a disease lesion or a natural crevice. The overall color is a mix of light and dark green.

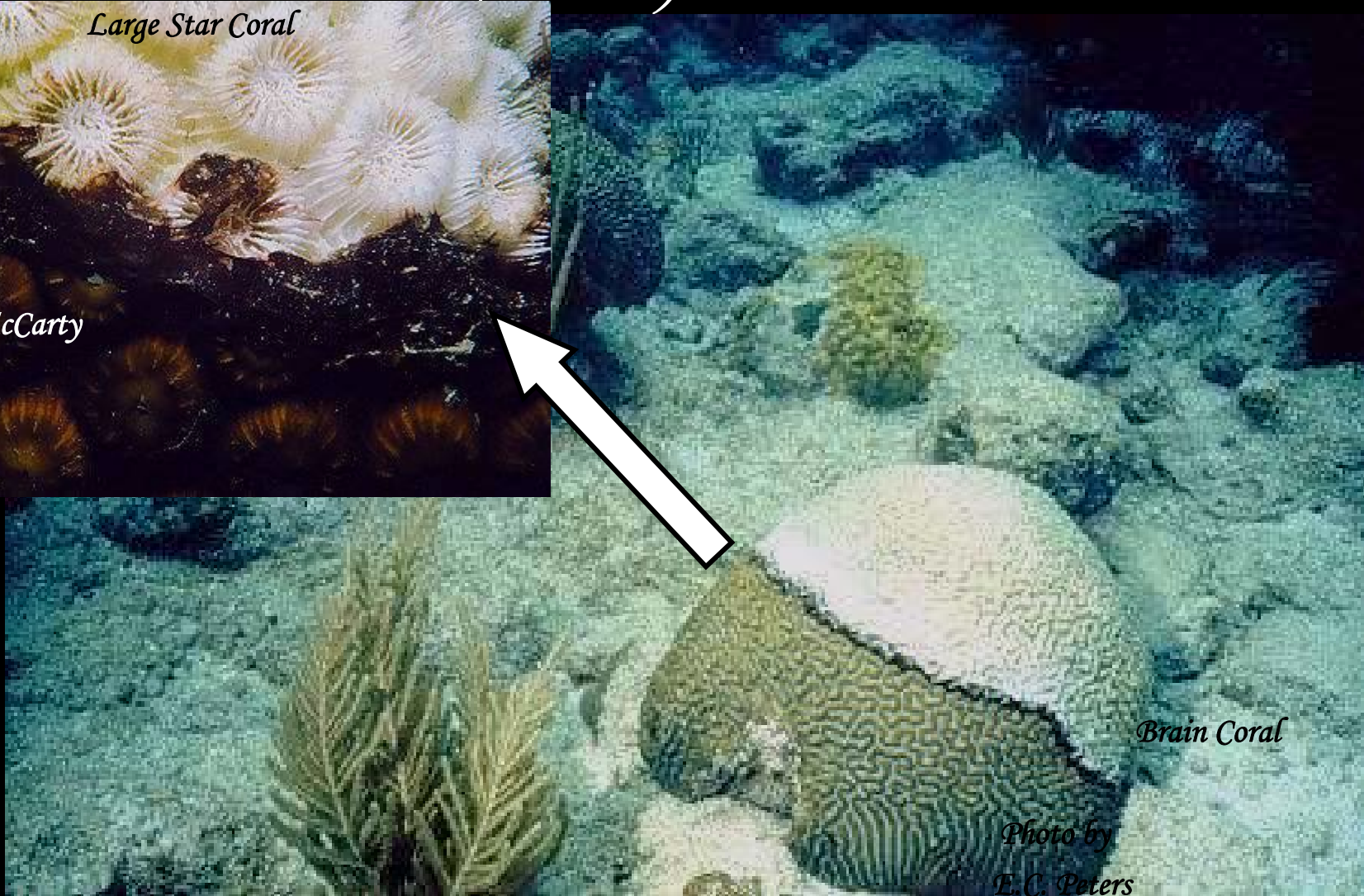
The Diseases

Black Band Disease *(BBD)*

Large Star Coral



Photo by H. McCarty



Brain Coral

*Photo by
E. C. Peters*

White Band Disease *(WBD)*

Elkhorn Corals

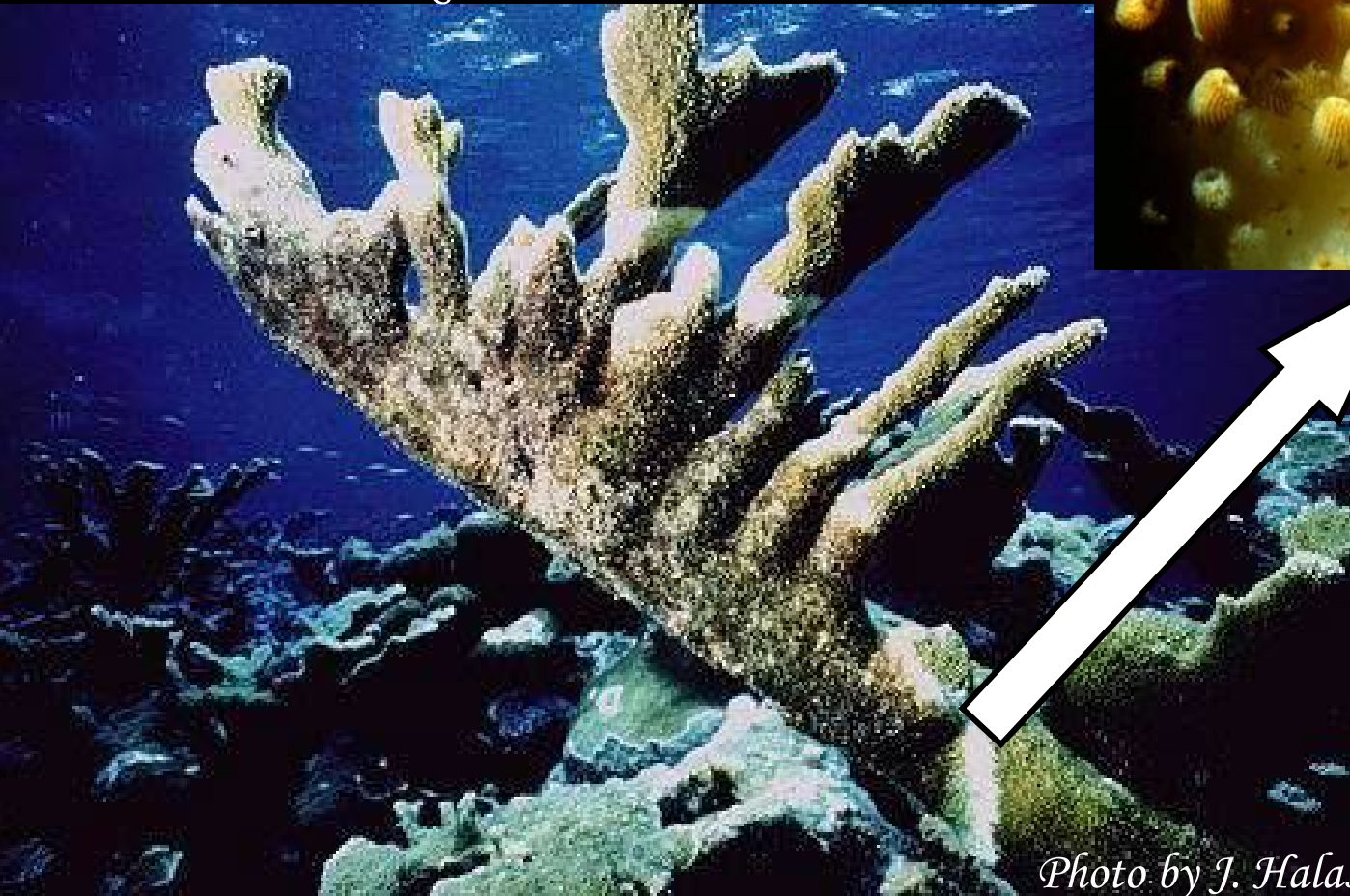
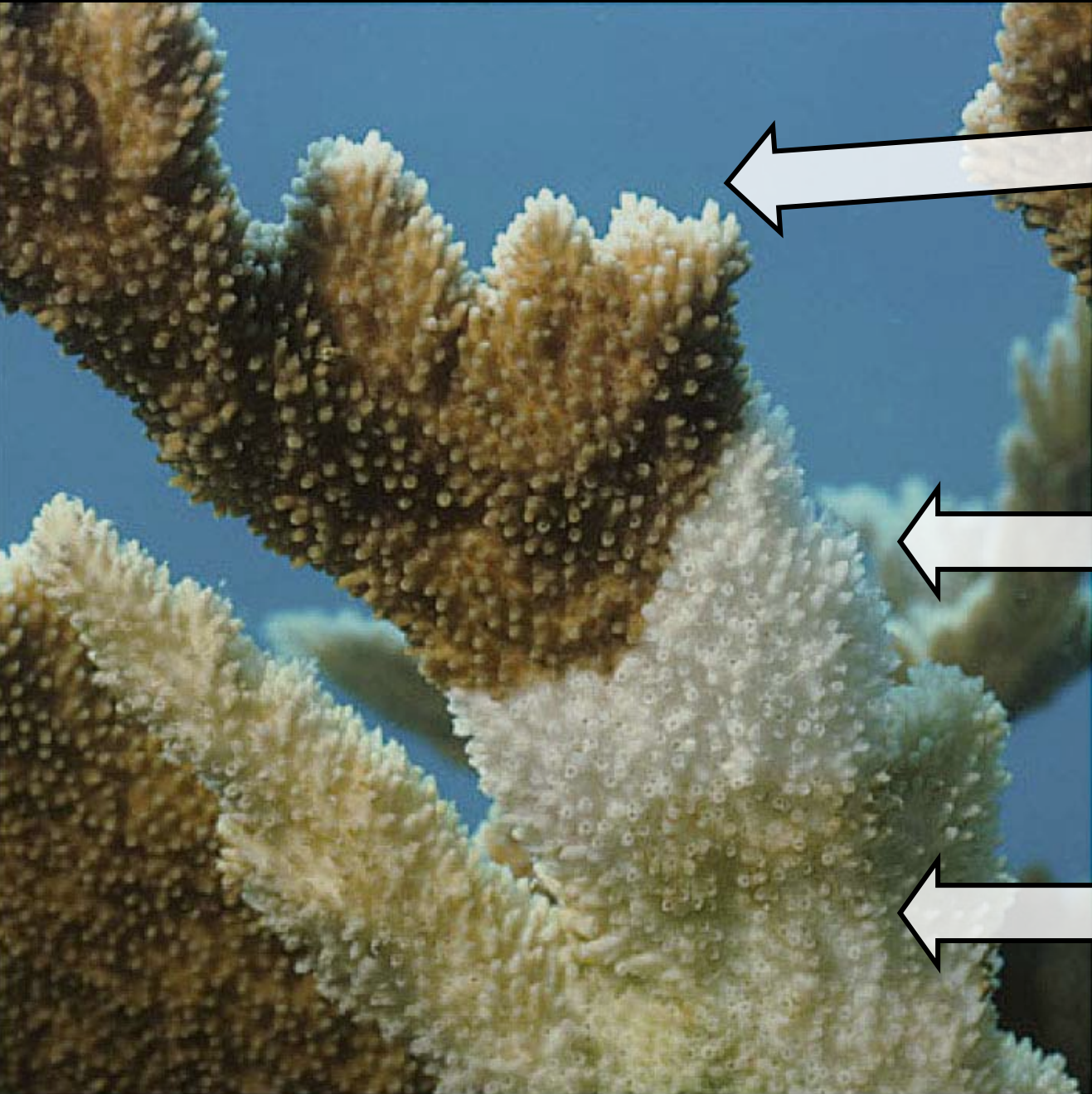


Photo by E.C. Peters

Photo by J. Halas



Healthy

WBD
moving
upwards

tissue
killed by
WBD

Fig.4.19: WBD; Caribbean *Acropora palmata* infected with WBD-I.

Sutherland et al, 2004

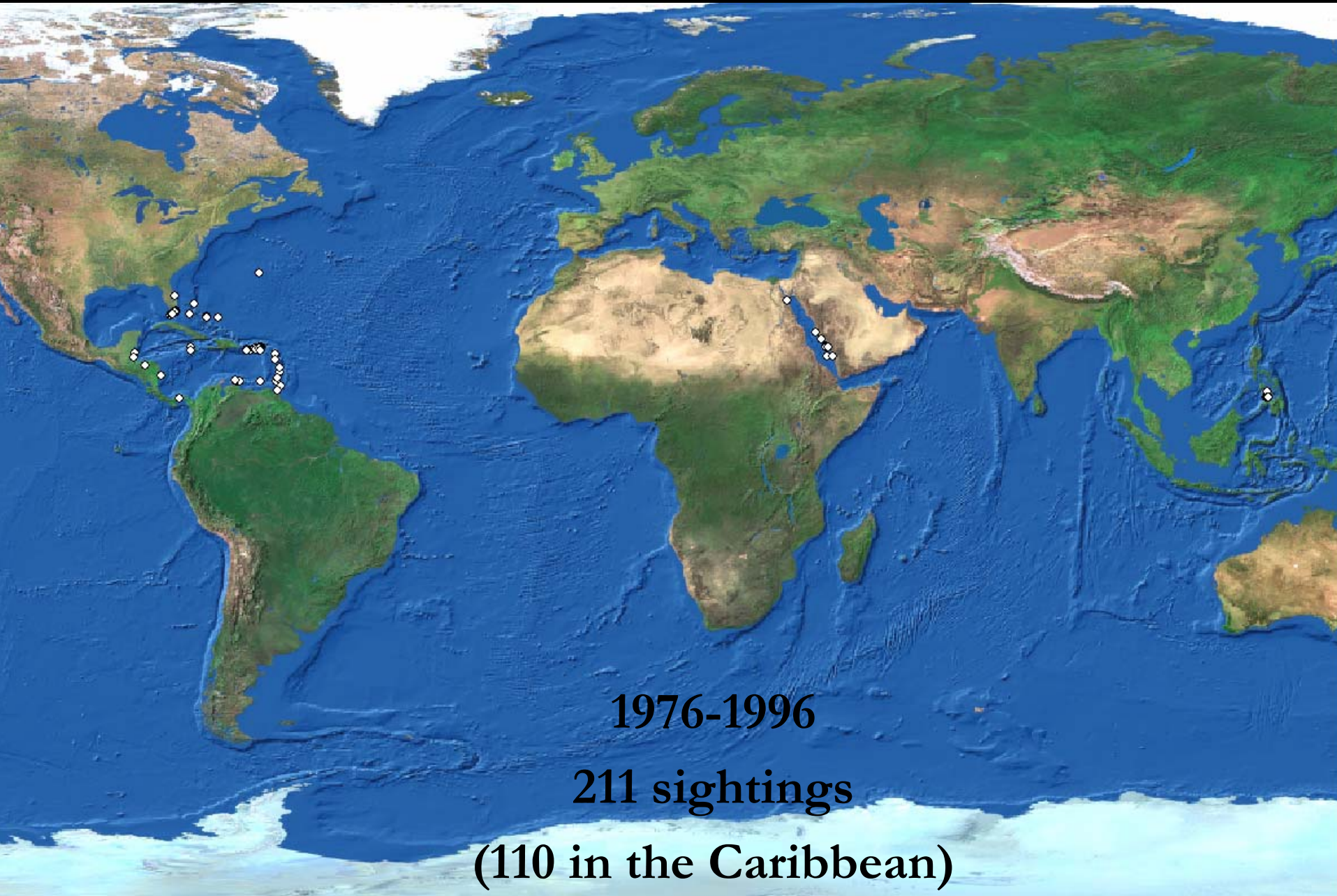
Living Coral

Recent Mortality

Old Mortality

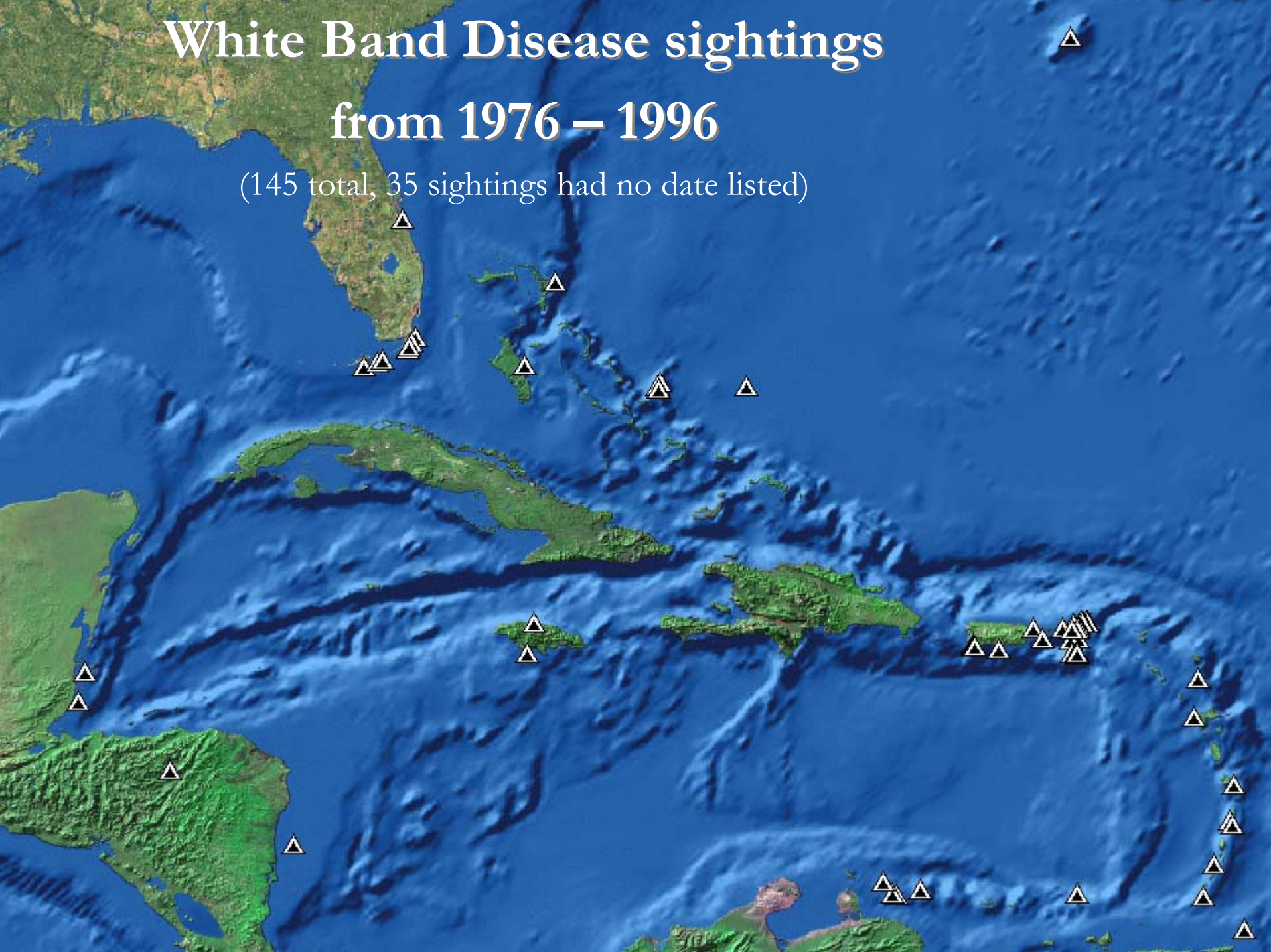


White Band Disease



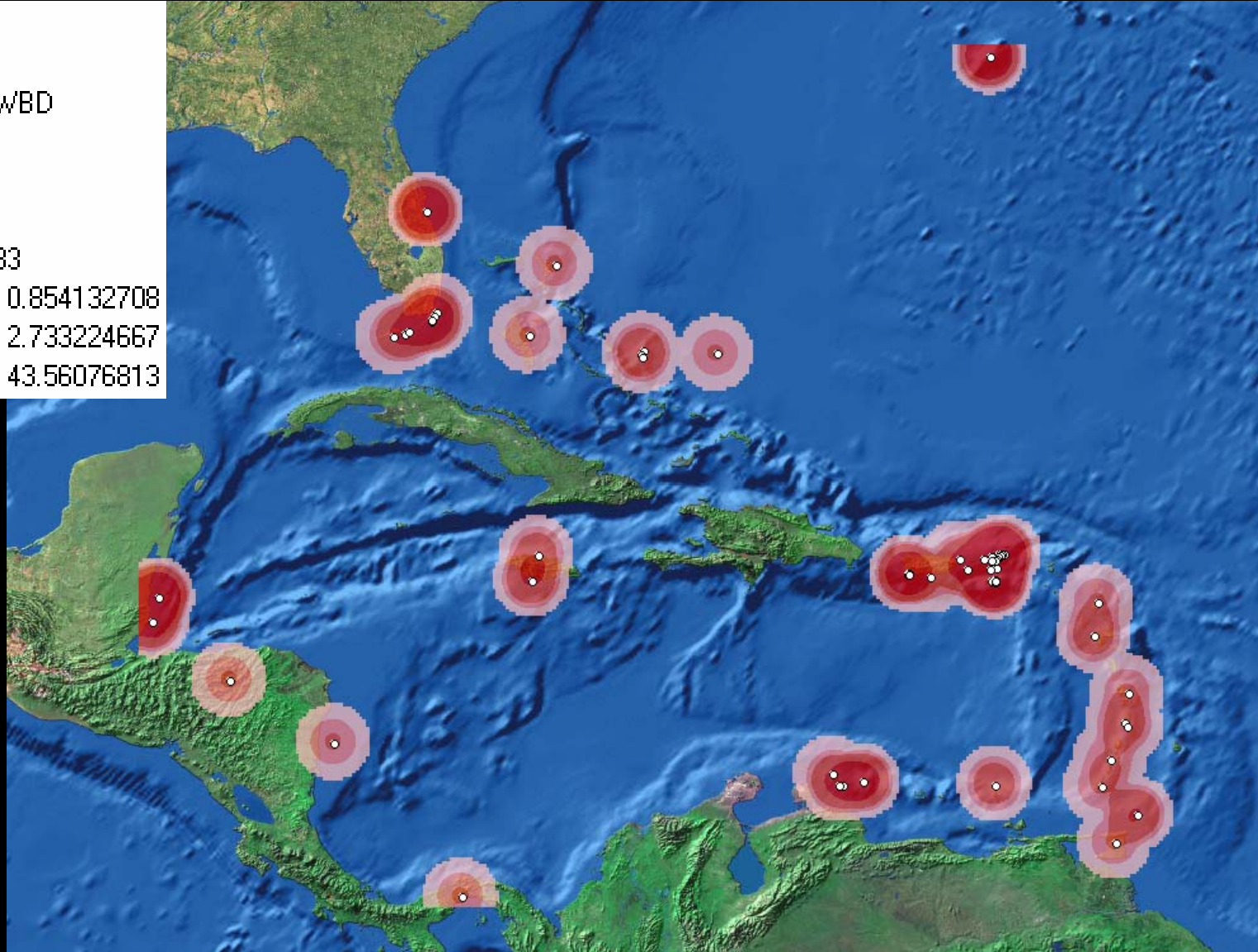
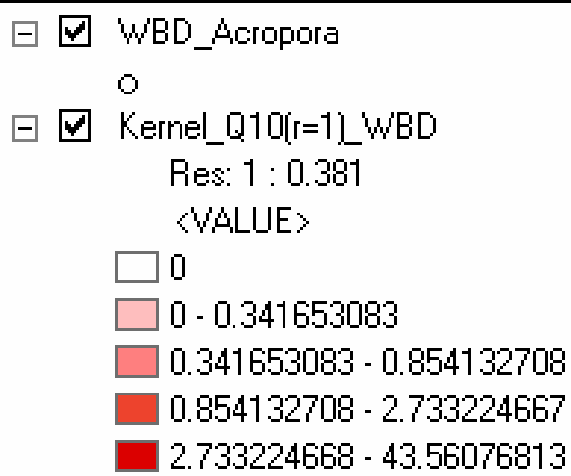
White Band Disease sightings from 1976 – 1996

(145 total, 35 sightings had no date listed)



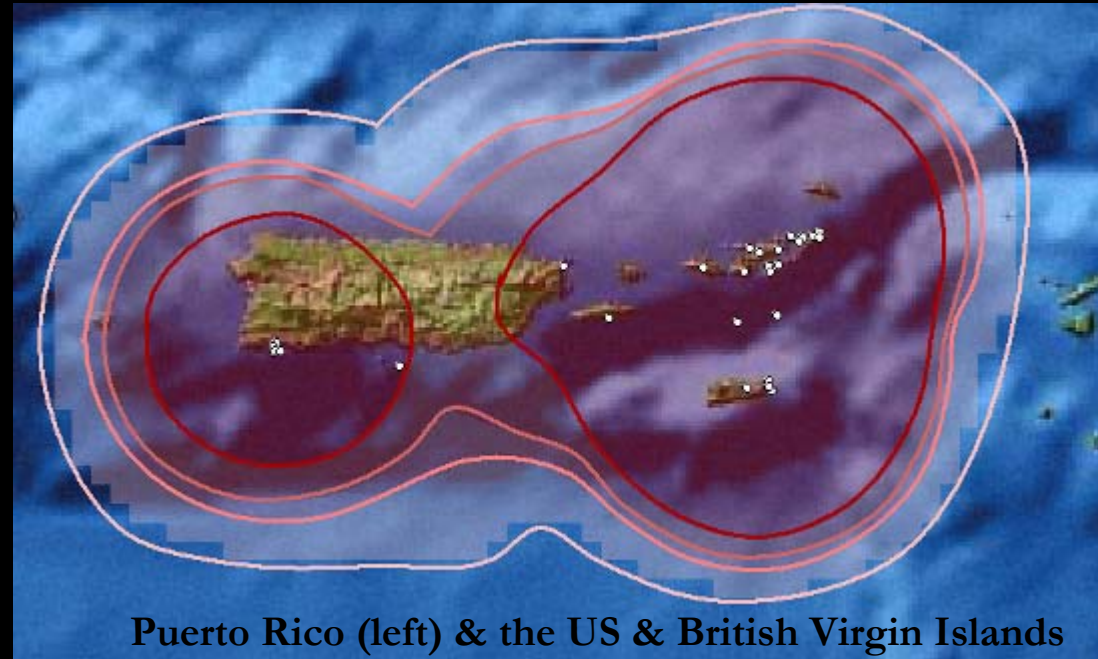
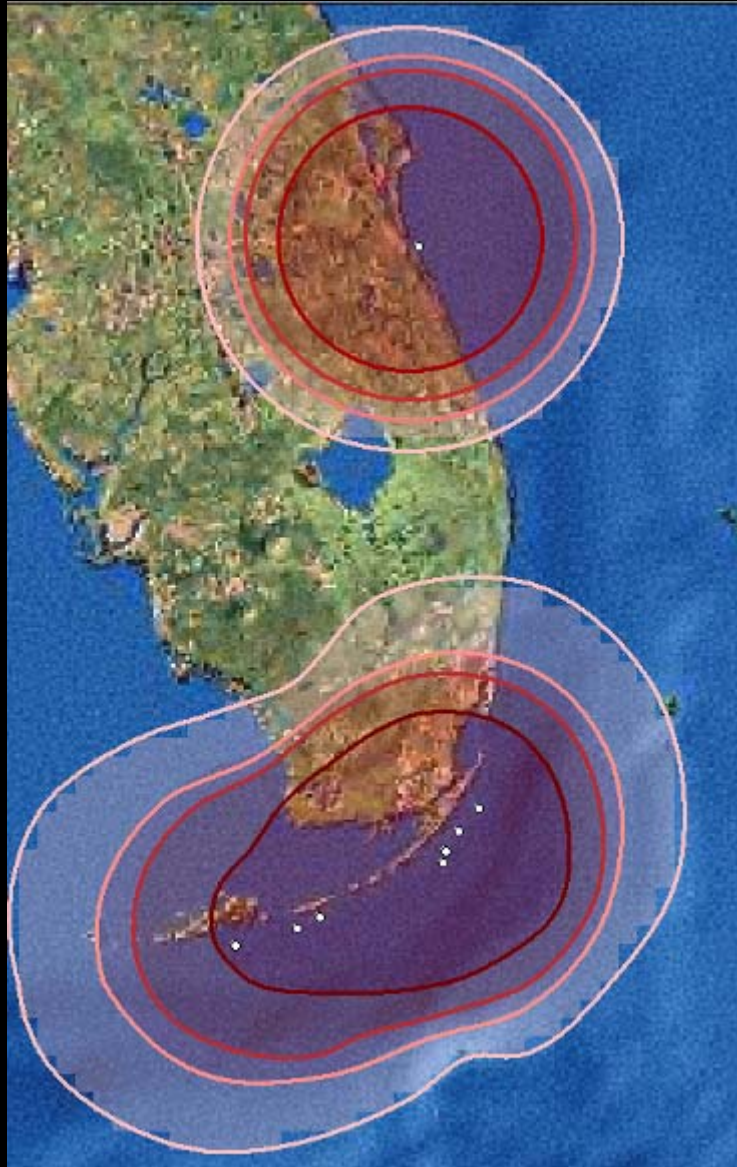
Finding WBD Hot Spots

Kernel, $r = 1$, Quartiles (5)

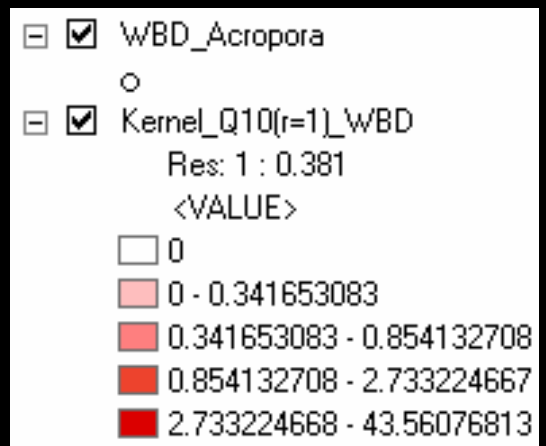


Examining WBD Hot Spots

Kernel, $r = 1$, Quartiles (10)



Puerto Rico (left) & the US & British Virgin Islands



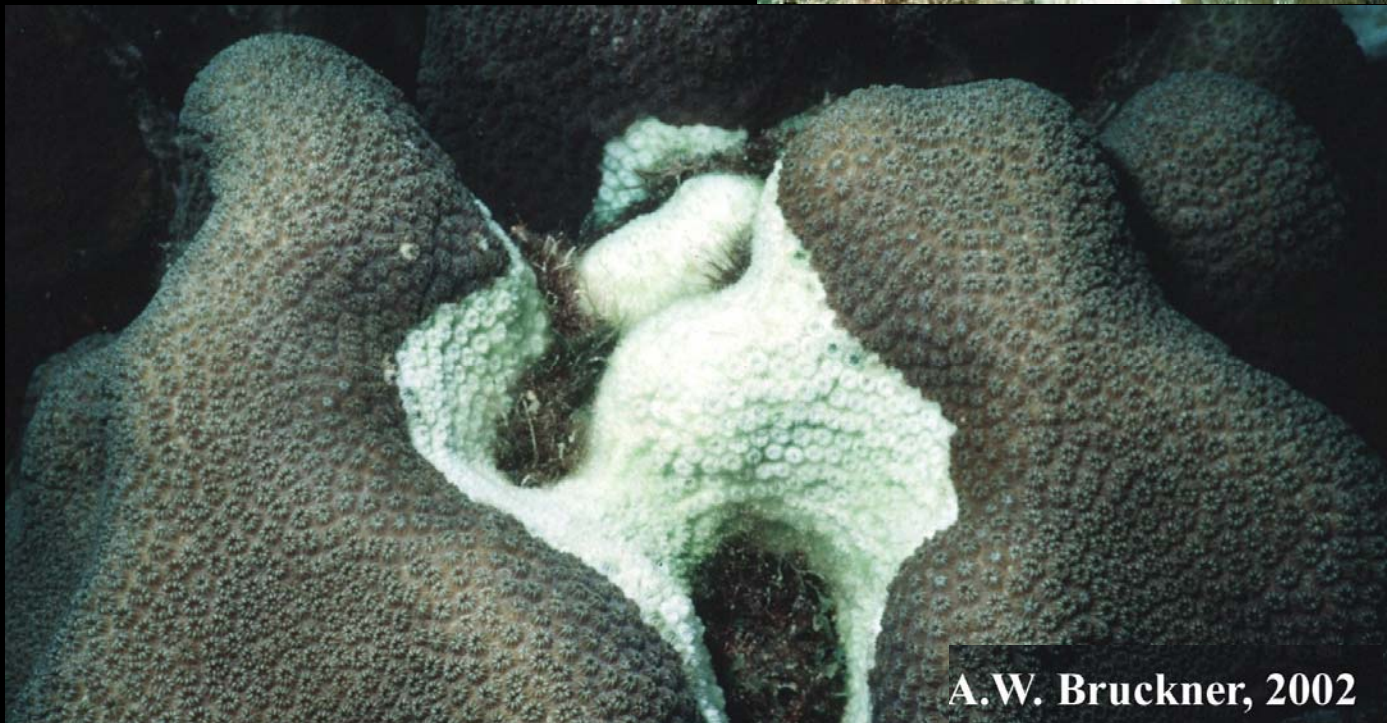
WBD forces Caribbean reef-building corals to the brink of extinction



Over the past 30 years WBD has infected moderately healthy reefs (left) killing them and leaving behind fields of rubble (right)

White Plague Disease

(WP)



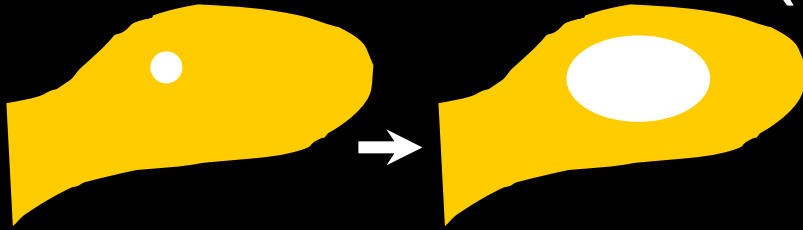
A.W. Bruckner, 2002

White Pox Disease

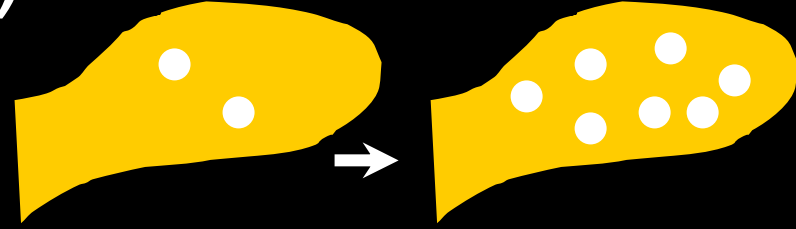
(WPD)



White Pox Disease (WPD)



WPD a



WPD b



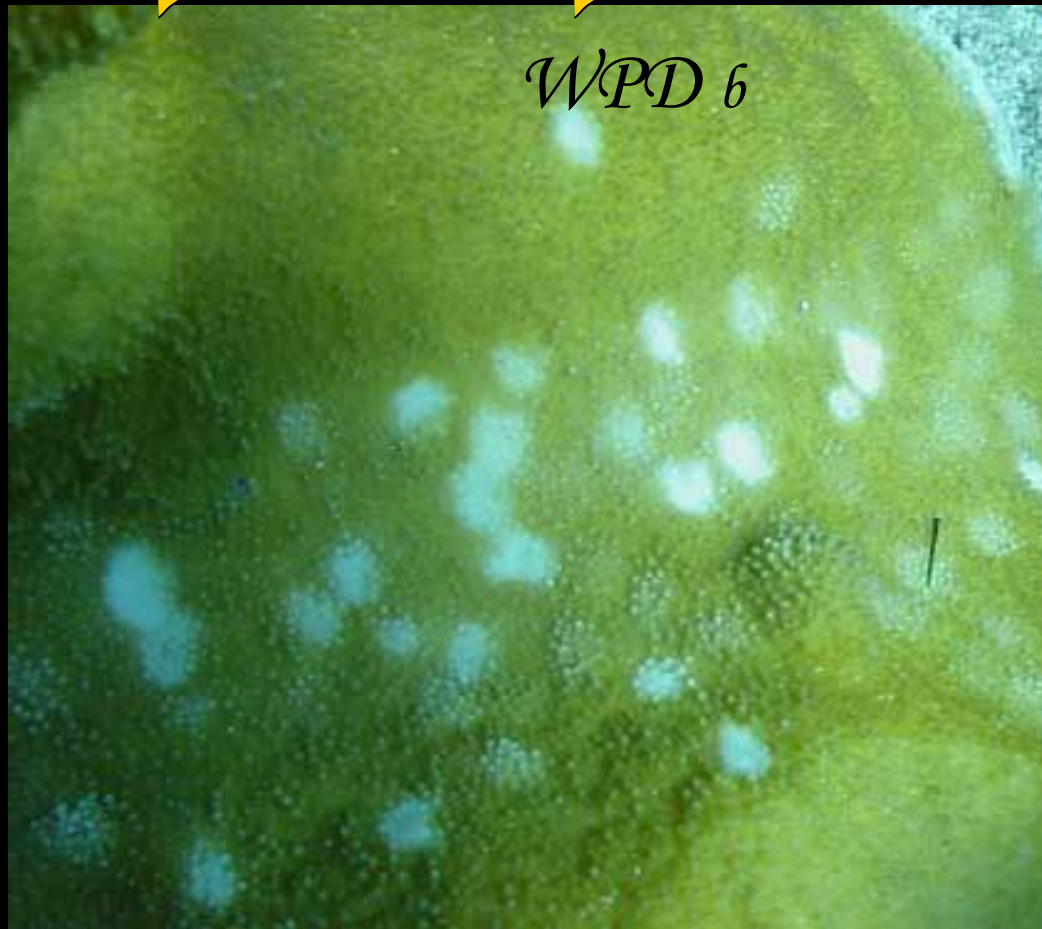
White Pox Disease (WPD)



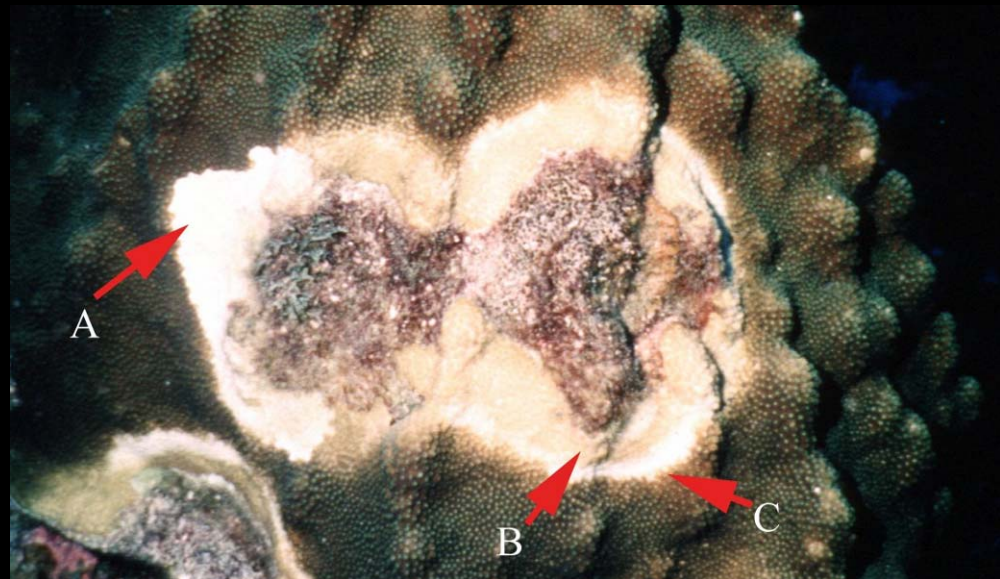
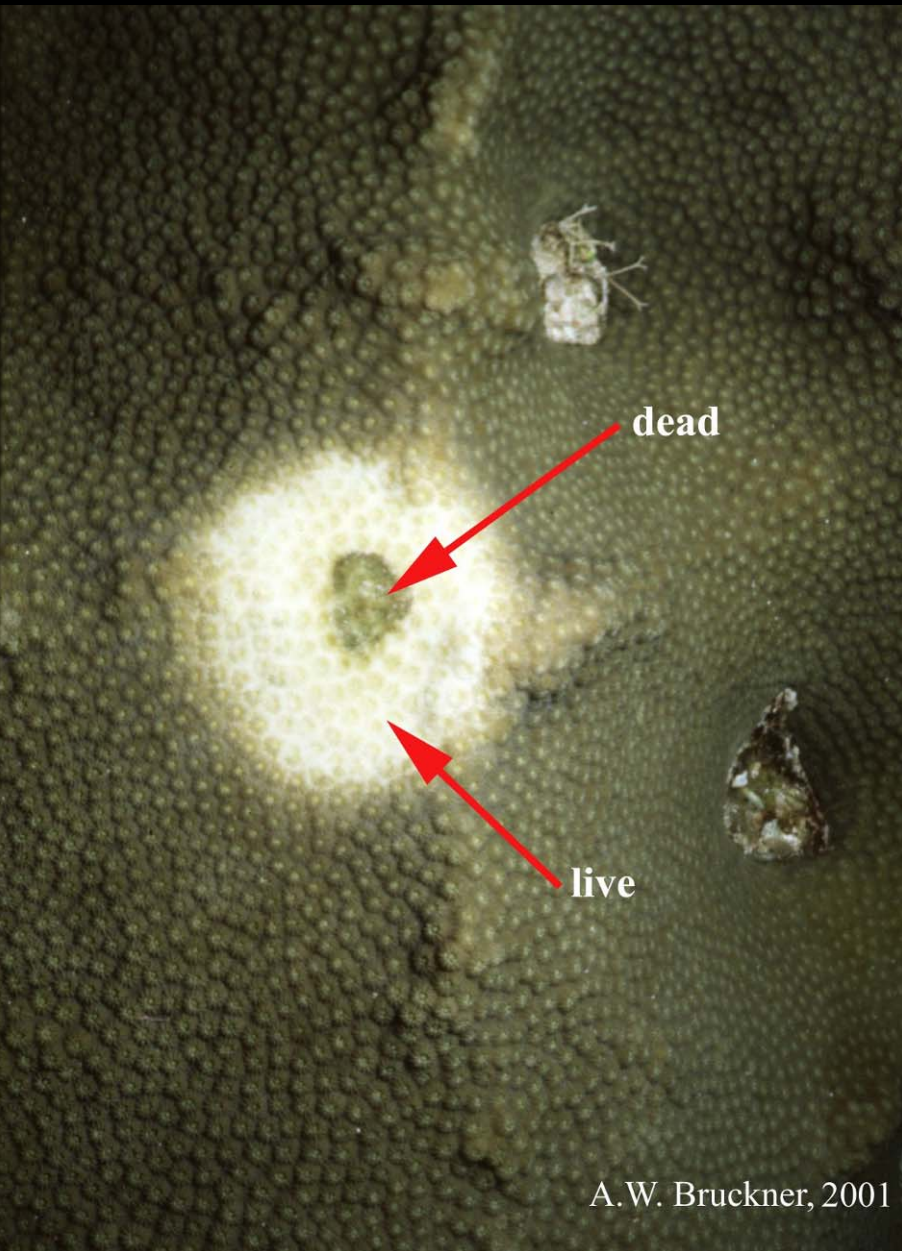
WPD a



WPD b



Yellow Blotch Disease



Colony of *M. faveolata* with a rapidly advancing YBD. The affected areas include tissue that has recently died (A), diseased tissue that has become a dark yellow color (B) and a rapidly advancing disease front that is very light yellow in color (C).”



Dark Spots Disease (DSD)



A.W. Bruckner, 1998



Rapid Wasting Disease

Lobed Star Coral

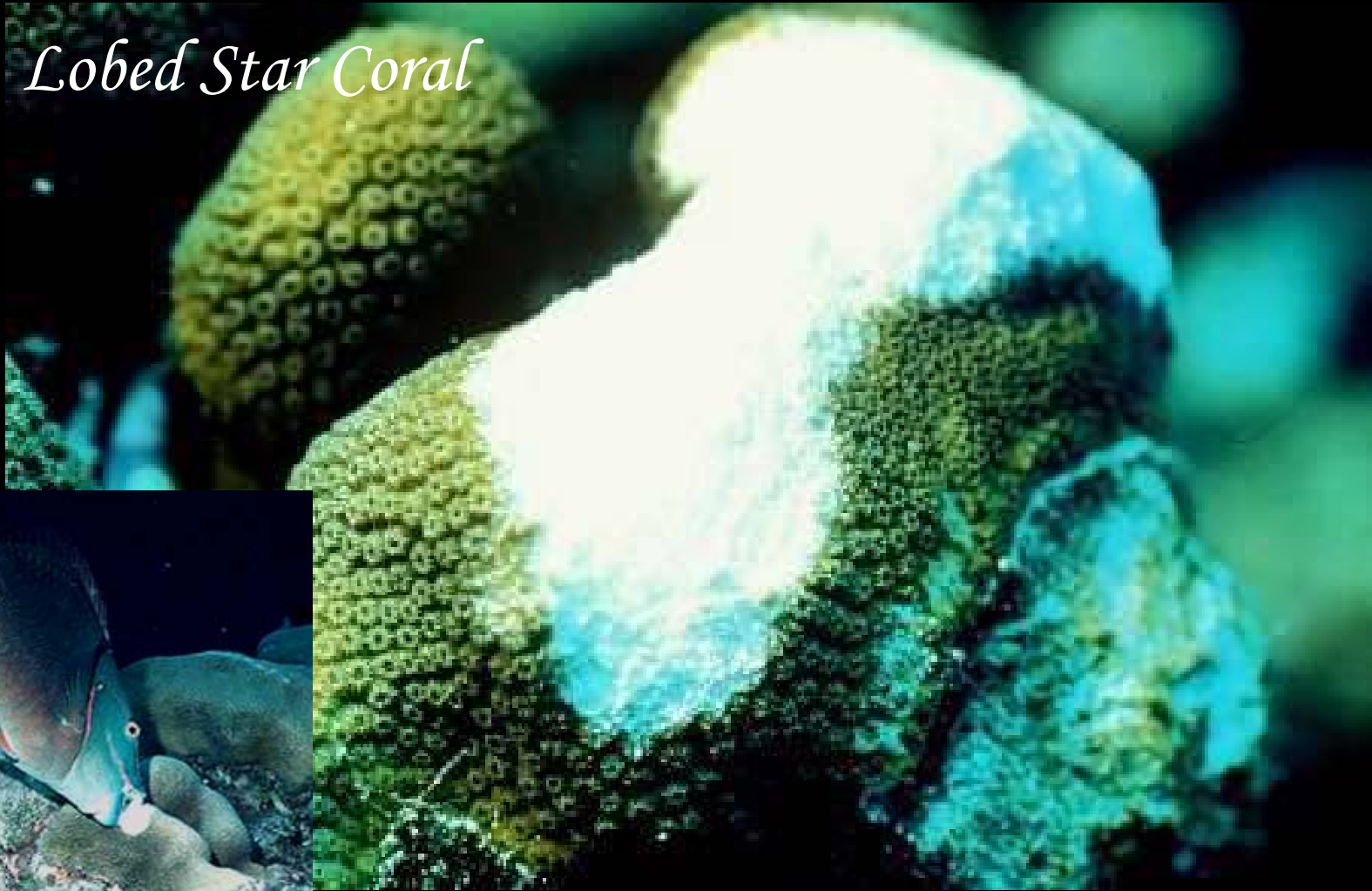


Photo by J. Cervino

Photo by A. Bruckner



Sea Fan Diseases

Photo by A. Bruckner 2001

Black Band Disease (*BBD*)



R. Bruckner, 1997

Aspergillosis



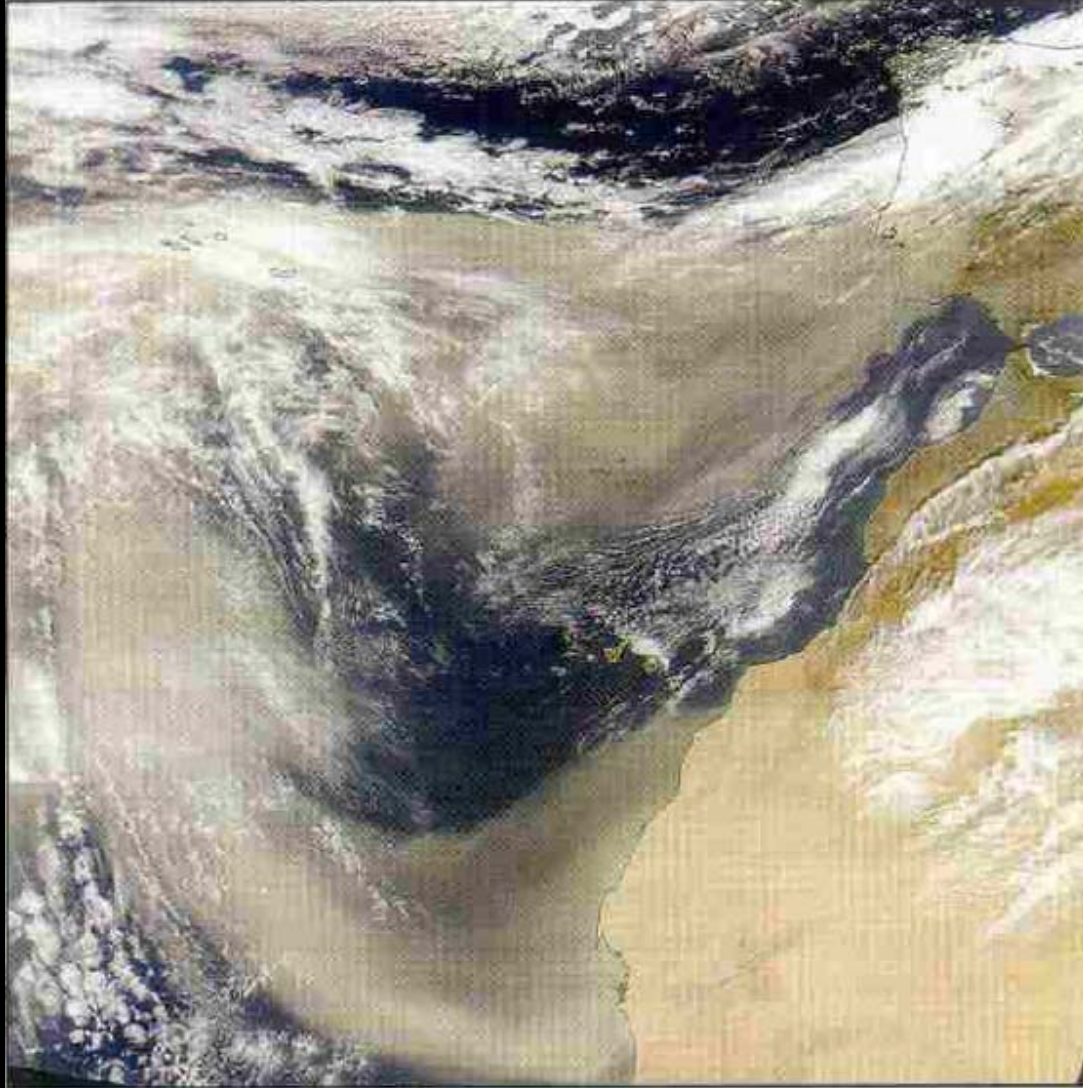


Figure 1. National Aeronautics and Space Administration (NASA) satellite image of dust cloud from Africa crossing the Atlantic Ocean. Photograph: SeaWiFS (Sea-viewing Wide Field-of-view Sensor) Project, NASA/Goddard Space Flight Center, and ORBIMAGE. (Enhanced true color.)

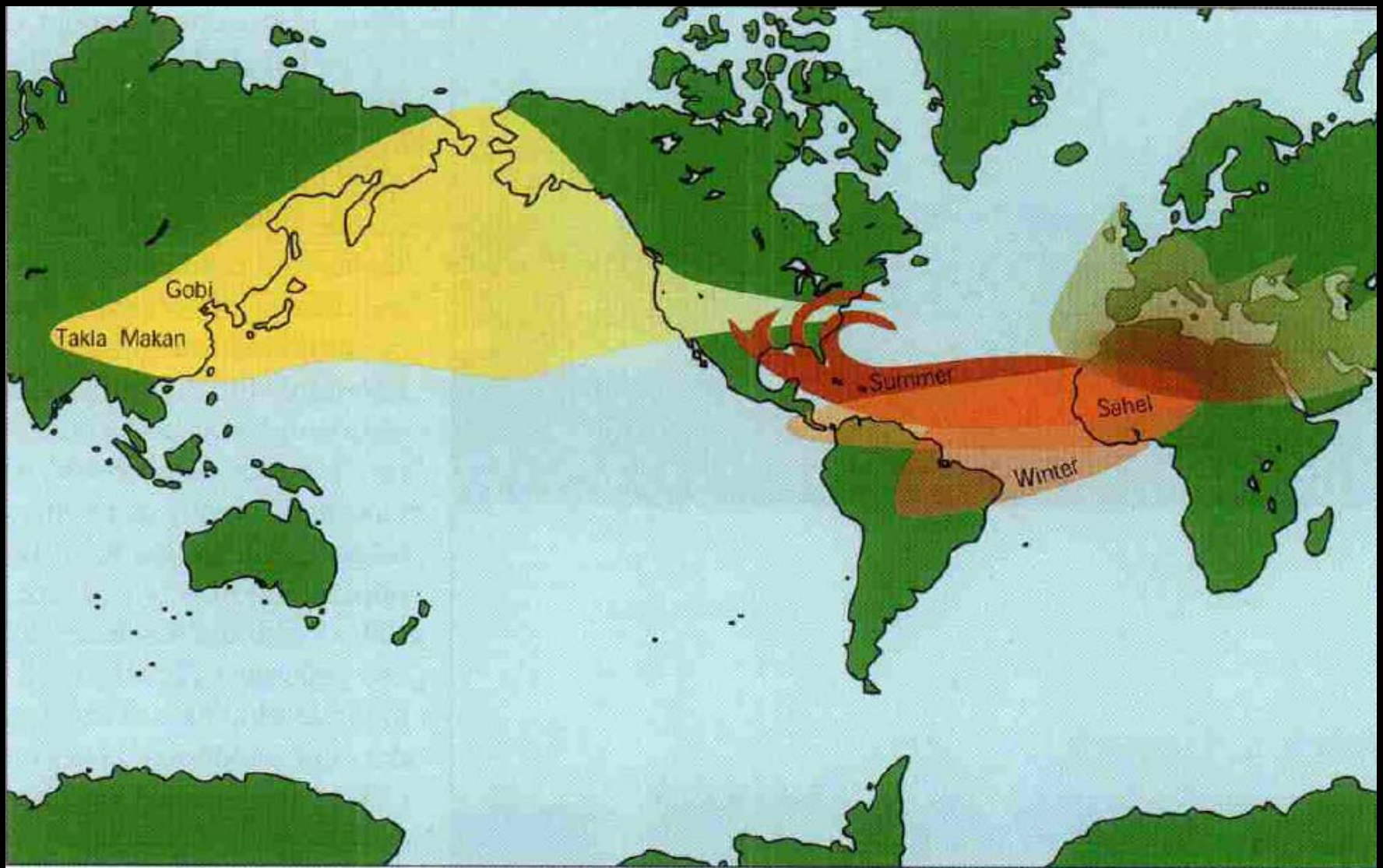
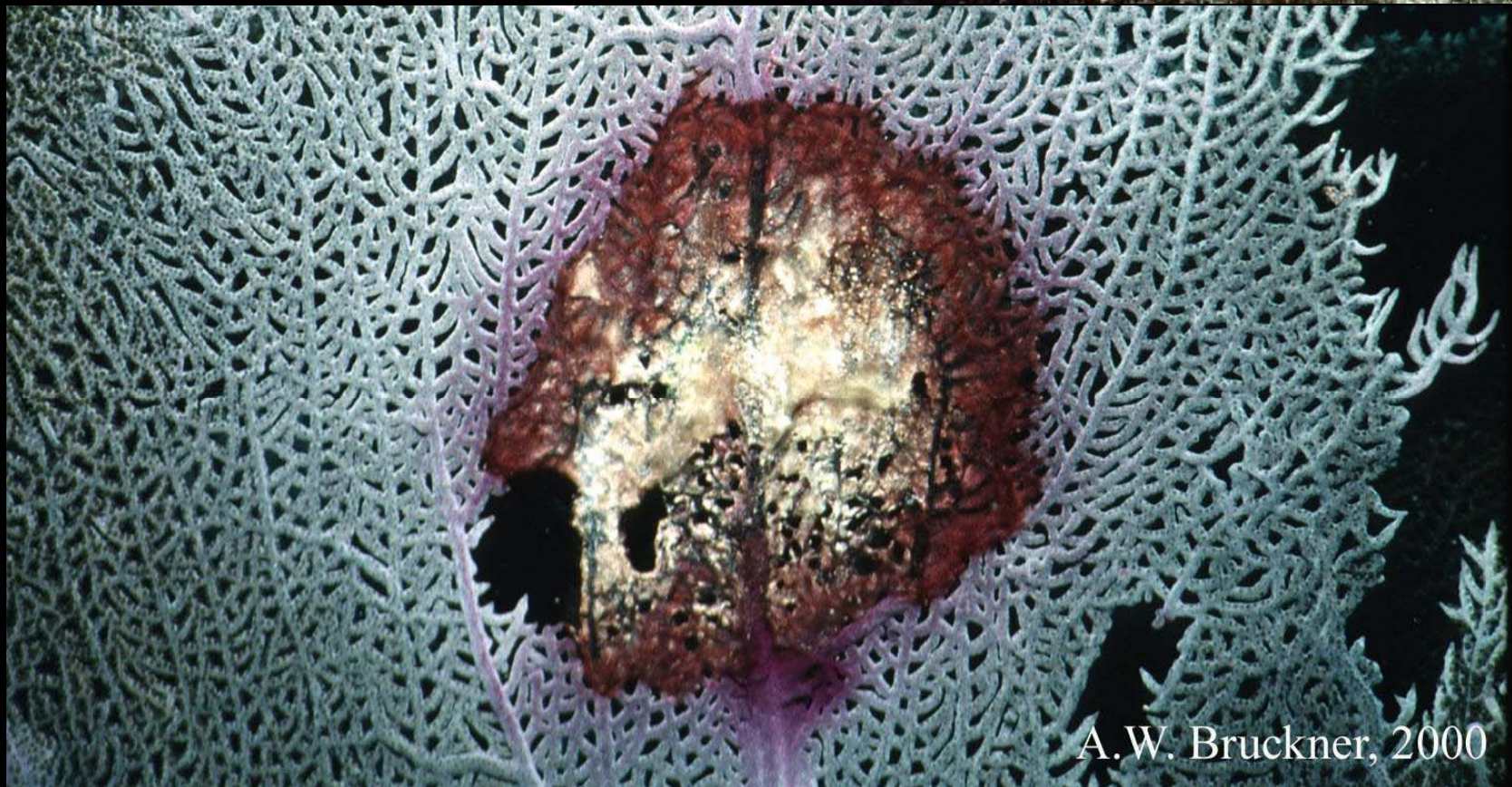


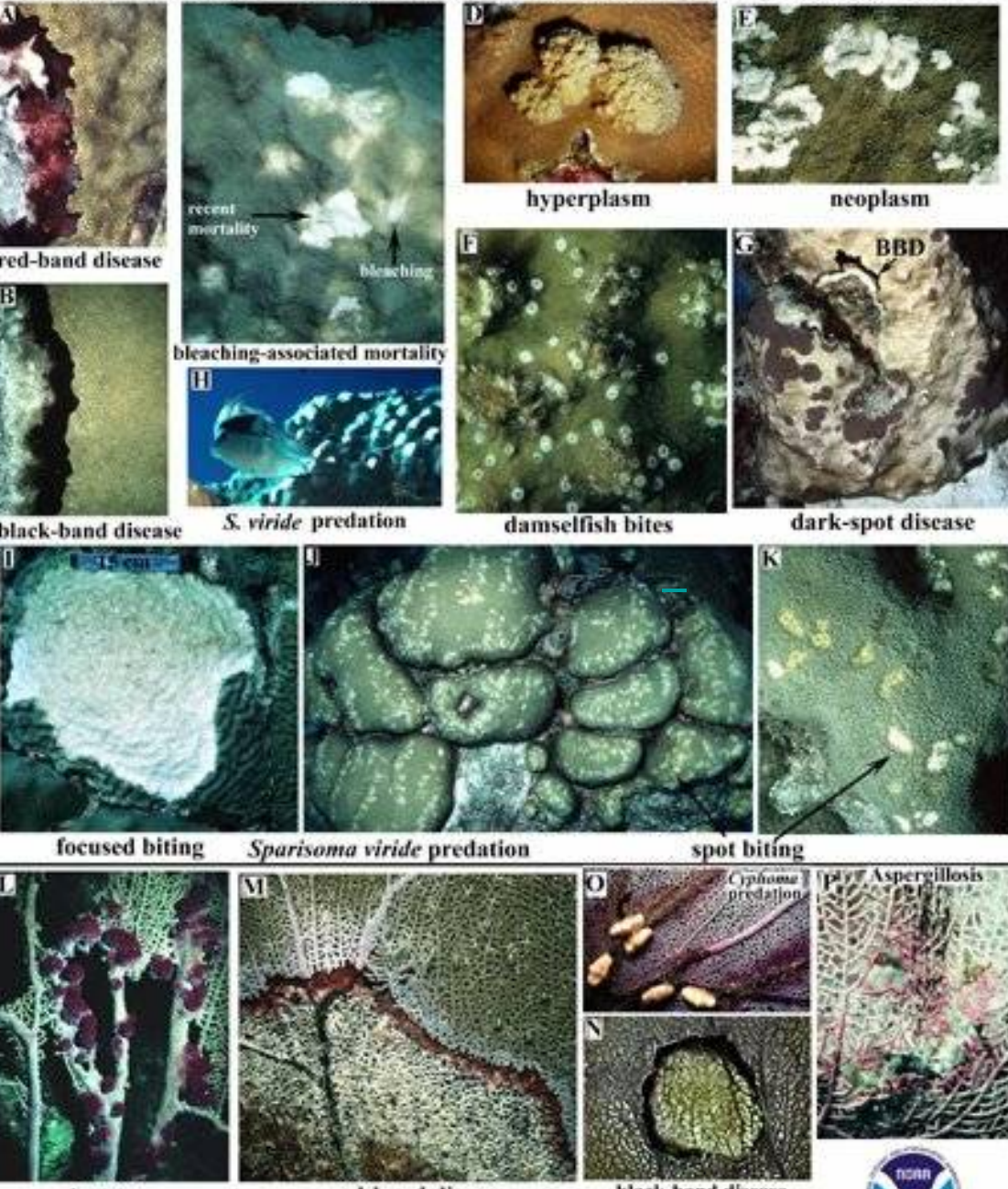
Figure 2. Dust is transported in two major global dust transport systems: (1) from the Sahara and Sahel of Africa to the Americas, Europe, and Near East; and (2) from the Takla Makan and Gobi deserts of China, across China, Korea, Japan, and the northern Pacific to North America, sometimes exiting over the Atlantic Ocean. Illustration: Betsy Boynton.

Red Band Disease
(RBD)



A.W. Bruckner, 2000


Disease, Predation and Tissue Anomalies affecting Stony and Soft Coral



tumors red-band disease black-band disease *Cyphoma* predation *Aspergillus*

Andrew Bruckner and Robin Bruckner arbruckner@hotmail.com 1999



A diver in a blue wetsuit and mask is shown underwater, examining a coral reef. The diver is positioned in the upper center of the frame, looking down at a large, light-colored coral structure in the foreground. The background shows a vast expanse of blue water and a distant horizon. The text "Flaws in modern coral pathology" is overlaid in the center of the image.

Flaws in modern coral pathology

Too Vague

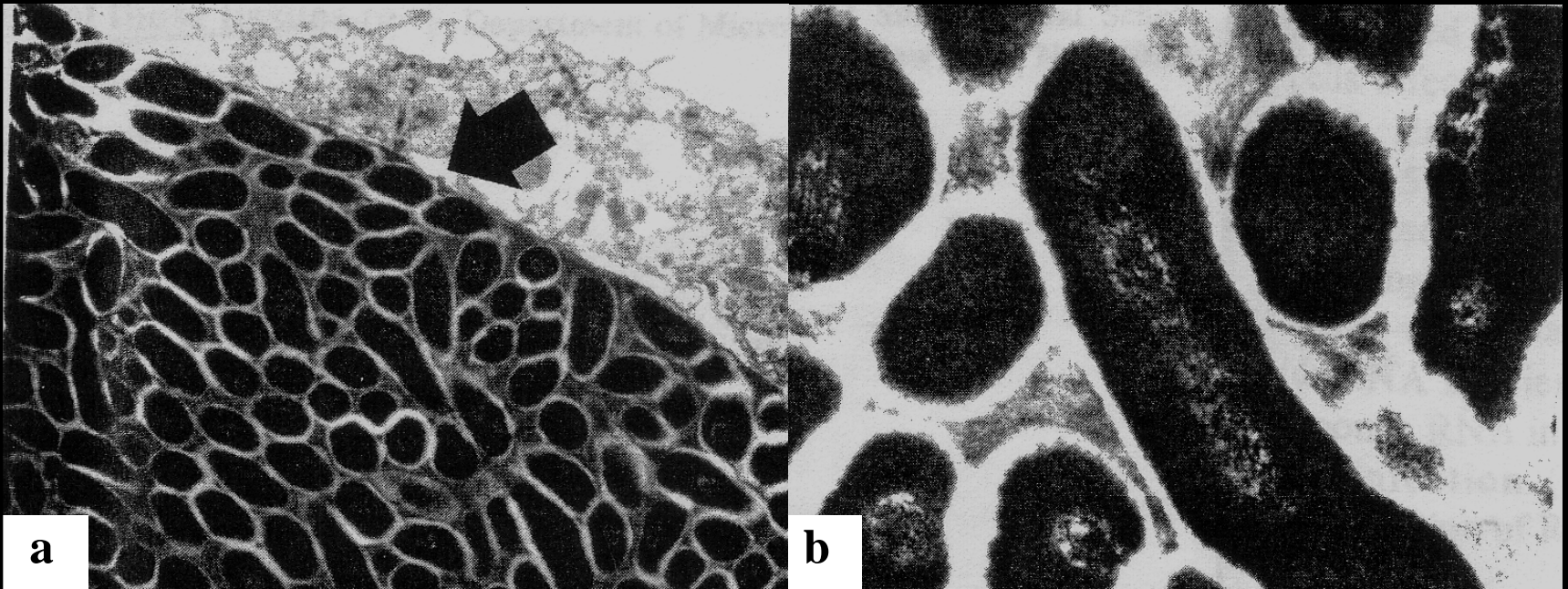


**Brain Coral (*Platygyra daedalea*)
dying from White Band Disease**



**Elkhorn Coral (*Acropora palmata*)
dying from White Band Disease**

Traditional culturing techniques Don't Work



(a) “Electron micrograph of portion of a body showing rod-shaped bacteria forming a colony. Note distinct separation of this colony from coral cell walls. $\times 5000$;

(b) “Bacteria from colony in diseased *A. palmata*. $\times 20,000$.” (Peters et al. 1983).

Koch's Postulate: as defined by Burnet & White 1972; Balter 1998; & Bhopal 2002

In order to definitively state the cause of a disease as a specific microbe, the following rules must be adhered to:

- 1) The microbe must be present in all known cases of the disease, but not present in healthy (non-diseased) organisms
 - 2) The microbe must be able to be isolated from the diseased organism and grown in pure culture in the lab
 - 3) Experimental Infection: This lab grown microbe must cause the same disease when instilled in a healthy organism
 - 4) The microbe must then be able to be isolated from the disease organism and grown in pure culture from the experimental infection in the lab
-





Acropora:
**The Indicator Genus for
Coral Epidemics and General
Marine Degradation**

My Thesis



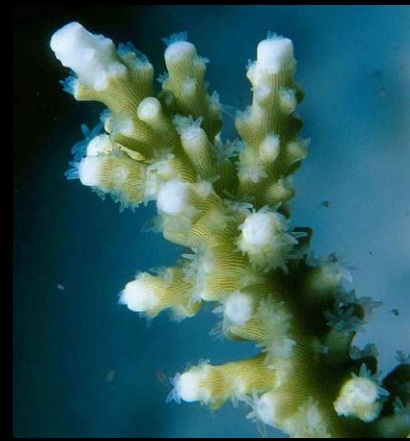
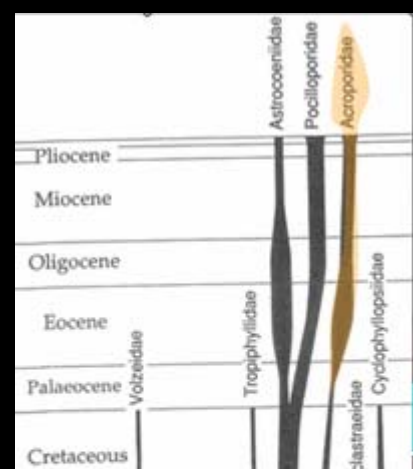
The Coral Genus

Acropora

Acropora

The most important reef-building coral in the world

As well as being one of the most specious, diverse, having a global distribution, many diverse morphologies, & more

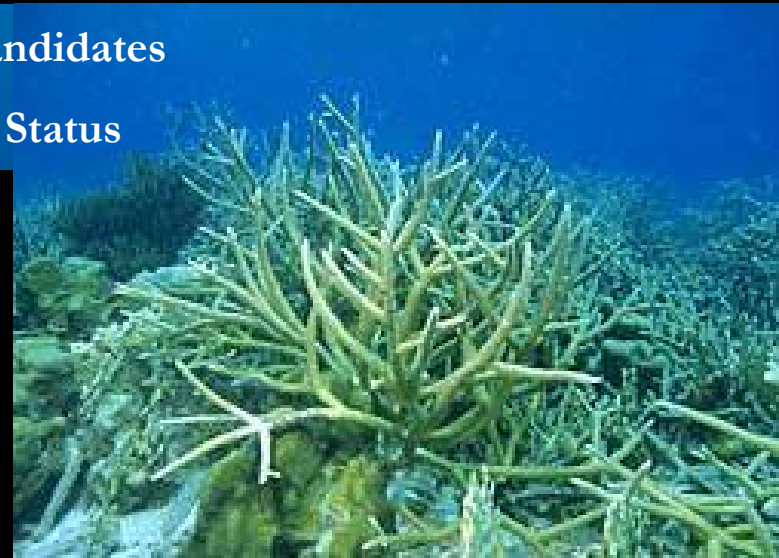


Caribbean *Acropora* are candidates
for Endangered Species Status



← *A. palmata*

A. cervicornis →



The background of the slide is a grayscale micrograph of coral polyps. The polyps are arranged in a regular, grid-like pattern. A prominent feature is a dark, horizontal band of tissue that runs across the middle of the image, representing a disease lesion. The text is overlaid on this image.

Diseases known to affect *Acropora*

P. corallyticum (Black Band Disease)

**Black Band Disease
(BBD)**



(Andreas et al. 1999)

**White Band Disease
(WBD)**



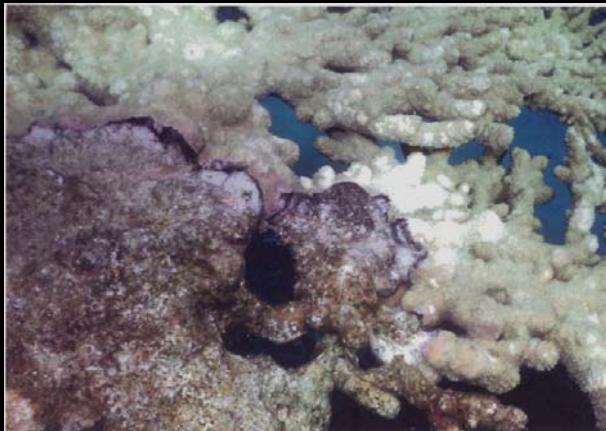
(Sutherland et al. 2004)

**White Pox Disease
(WPD)**



(Rogers et al. 2005)

**Skeleton Eroding Band
(SEB)**



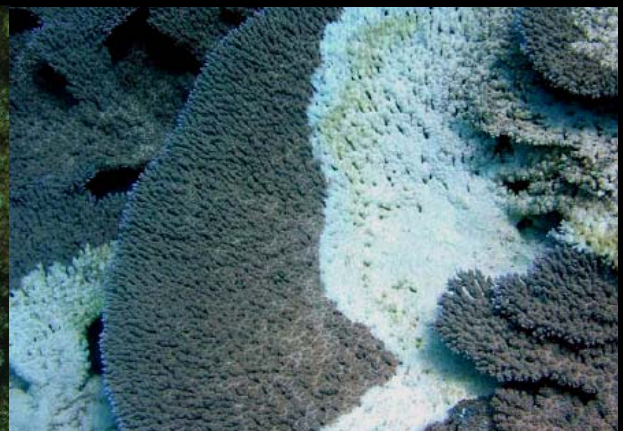
(Antonius 2000)

**Yellow Band Disease
(YBD)**



(Riegl 1996 in press)

**White Syndrome
(WS)**



(Aeby 2005)

Unresolved questions that my thesis will focus on

- Focus exclusively on diseases affecting what I believe is the indicator coral genus, *Acropora*
- Compare coral disease distribution to the overall *Acropora* distribution to see where there are corals which are not being affected
- Use GIS to look for possible spatial, temporal, or statistical correlations between diseases and anthropogenic stressors
- Essentially I'm hoping that by doing a META Analysis of the studies done to date, that I may be able to find disease trends that have been missed by only treated coral pathology on the local level