Florida 2017

Ecology of coral disease

Identifying coral disease

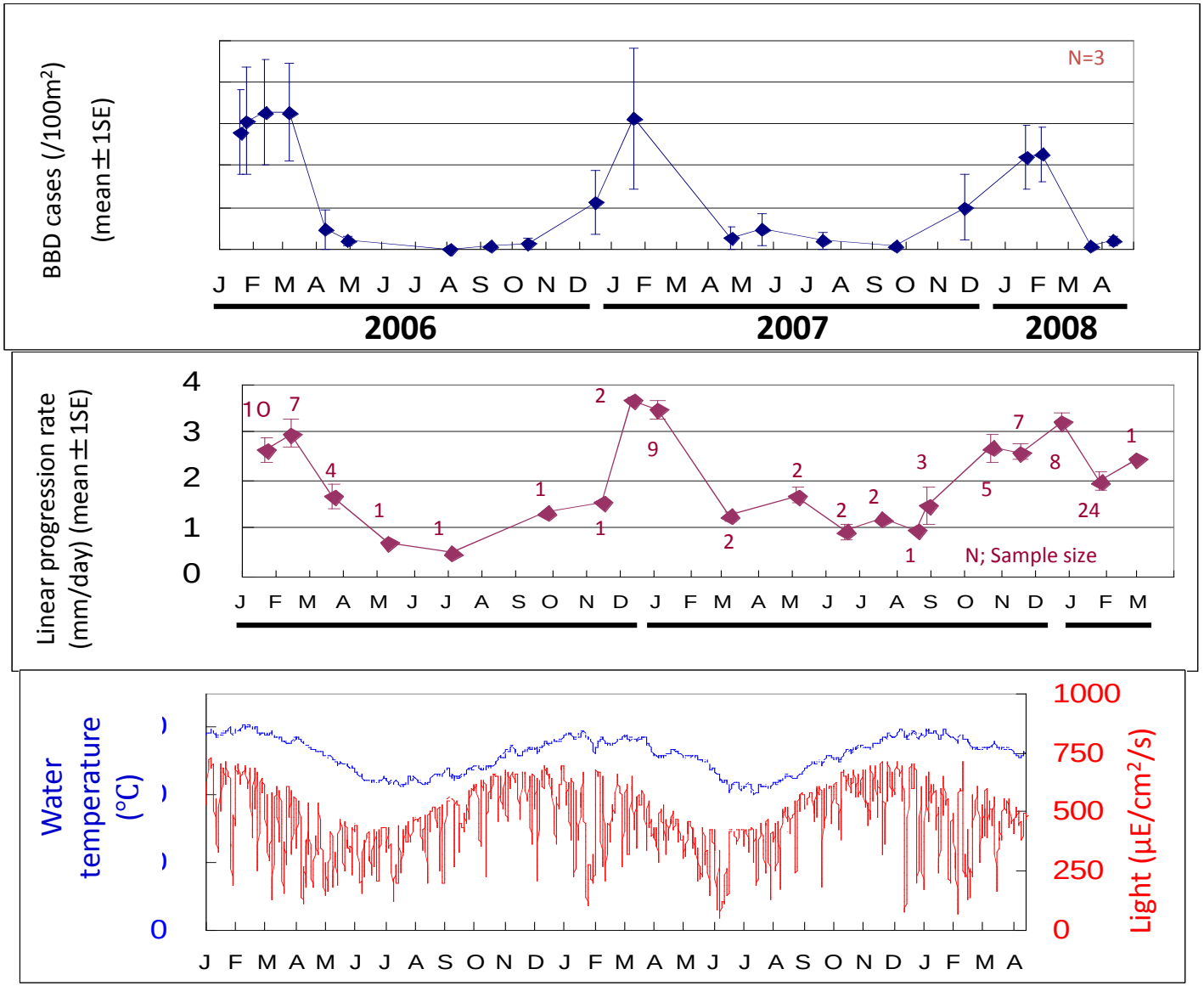
GS Aeby

Ecology of coral disease

Some diseases are seasonal

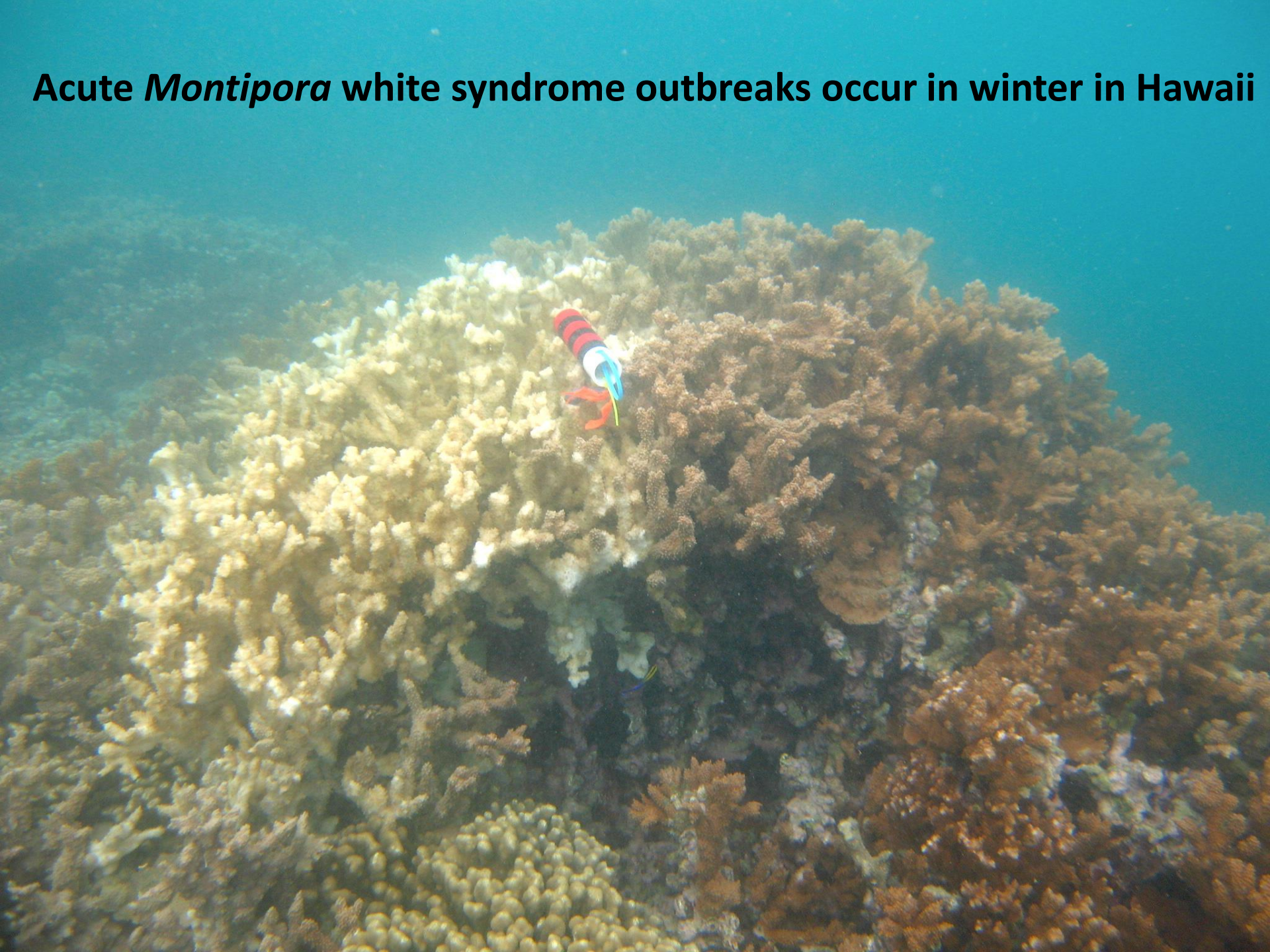
Some are not

Black band disease abundance increases in summer, Palm Is 2006-07

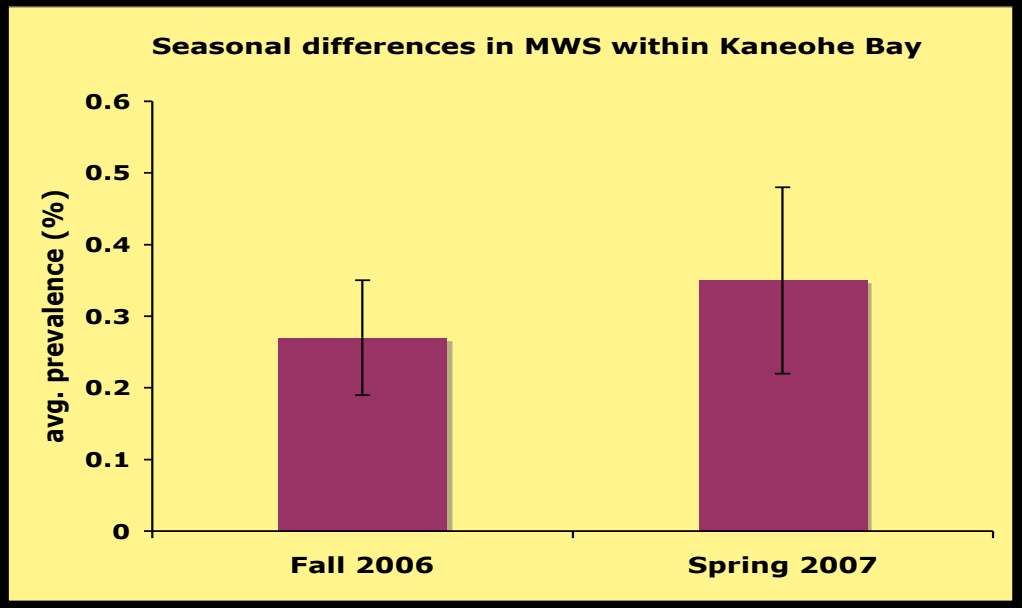


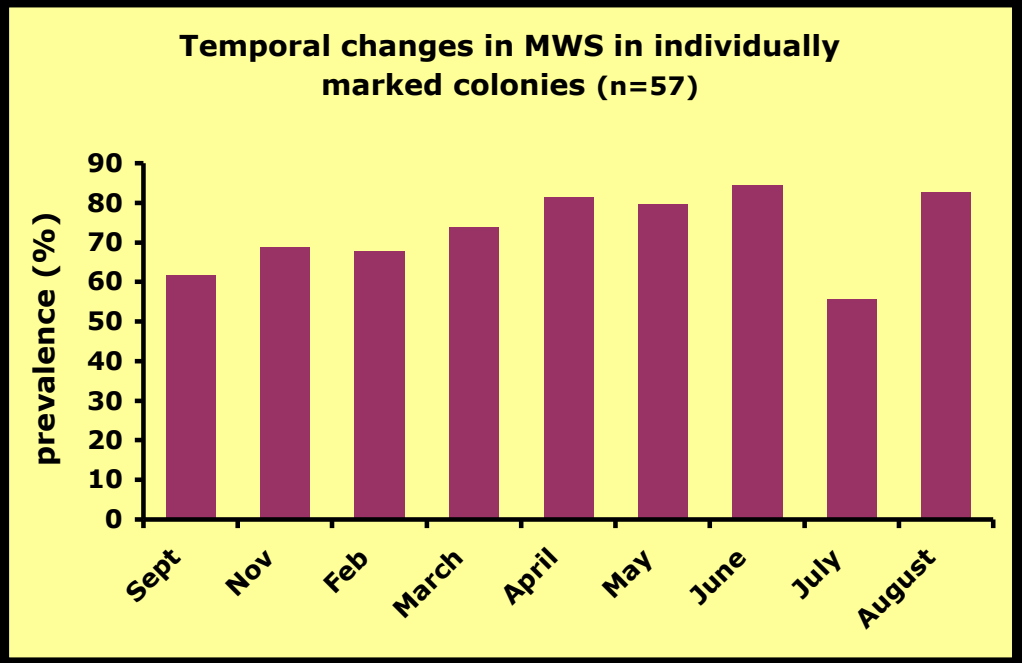
Sato et al. 2009

Acute *Montipora* white syndrome outbreaks occur in winter in Hawaii



No seasonality in chronic *Montipora* white syndrome



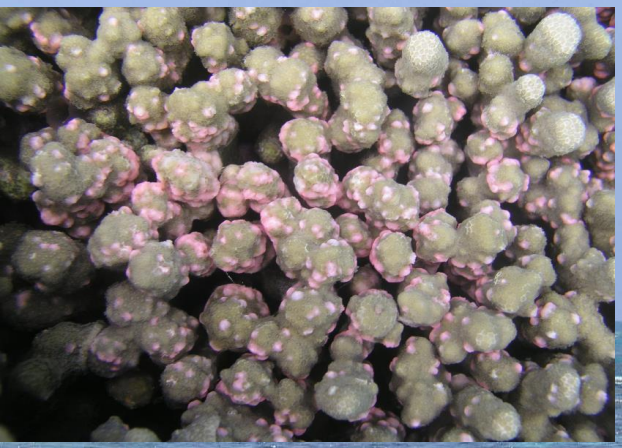


Aeby et al. 2010

Some diseases are host specific

Some are not

***Porites* trematodiasis**



Blackband disease

Porites

***Goniopora, Pachyseris, Acropora, Platygyra, Pocillopora*, etc.**

Virulence varies among coral diseases

Coral Disease

Lesion Type

- **Tissue loss**
  - Chronic
  - Sub-acute
  - Acute
- **Discoloration**
- **Growth anomaly**

Virulence

Direct colony mortality

Reduce coral growth
Decrease reproduction

acute tissue loss
High virulence

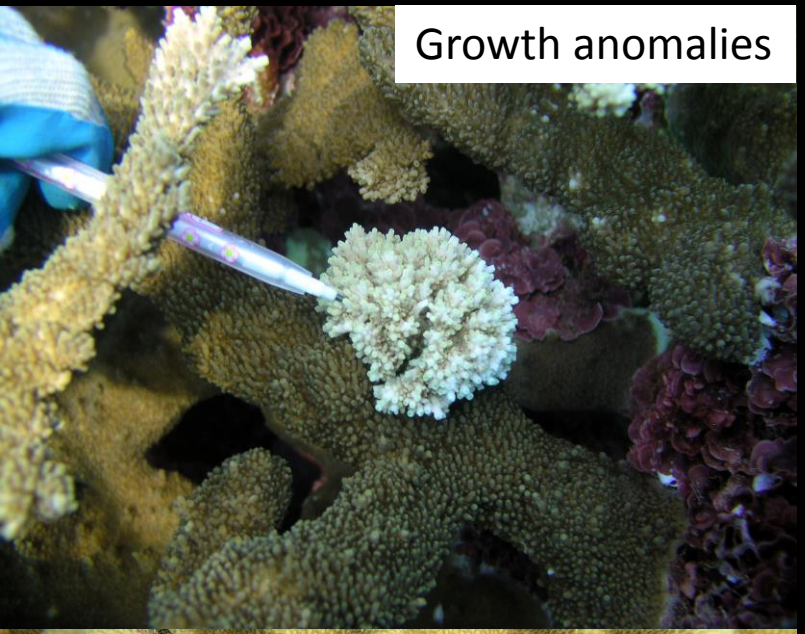
Acute *Montipora* white syndrome

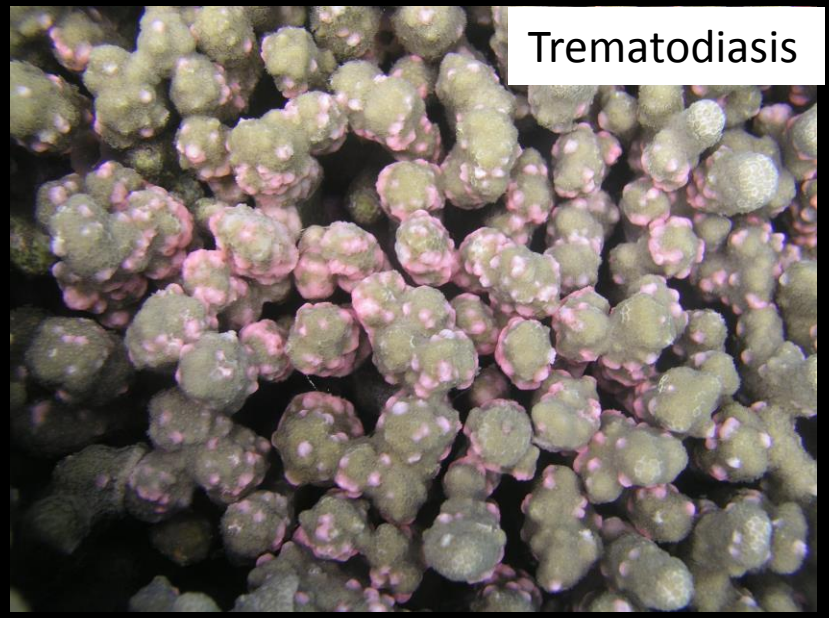
Sub-acute tissue loss
Medium virulence

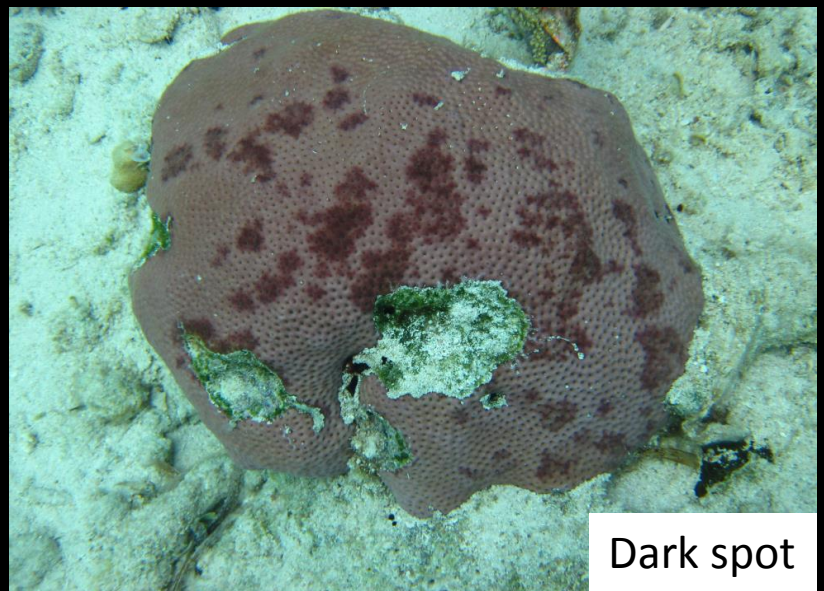
Sub-acute white syndrome

Black band disease

Low virulence


Growth anomalies


Trematodiasis


Dark spot

Disease susceptibility varies among coral genera

Study	Region	coral genera
Willis et al. 2004	GBR	Pocilloporidae, Acroporidae, Poritidae
Haapkyla et al. 2010	GBR	*Acropora, Montipora*
Dalton & Smith 2006	eastern Australia	*Acropora, Turbinaria, Pocillopora*
Aeby et al. 2008	American Samoa	*Acropora, Pavona, Porites*
Myers & Raymundo 2009	Micronesia	*Porites, Acropora, Pocillopora*
Aeby et al. 2011	MHI & NWHI	*Porites, Acropora, Montipora*
Vargas-Angel 2009	US Pacific Remote Island Areas (Johnston Atoll, Wake, Baker, Howland, Jarvis, Palmyra, Kingman)	*Montipora, Porites, Acropora*
Raymundo et al. 2005	Philippines	*Porites*
Haapkyla et al. 2009	S.E. Sulawesi, Indonesia	*Acropora, Porites, Astreopora/Anacropora*
Hobbs & Frisch 2010	Indian Ocean Cocos Islands, Christmas Island	*Acropora*
Williams et al. 2011	Palmyra	*Astreopora, Acropora, Montipora*

Differential disease susceptibility among coral genera

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Aeby et al. 2008	American Samoa	*Acropora, Pavona, Porites*
Myers & Raymundo 2009	Micronesia	*Porites, Acropora, Pocillopora*
Aeby et al. 2011	MHI & NWHI	*Porites, Acropora, Montipora*
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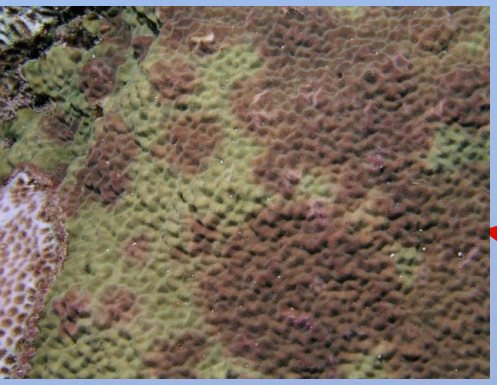
Hobbs & Frisch 2010	Indian Ocean Cocos Islands, Christmas Island	*Acropora*
Williams et al. 2011	Palmyra	*Astreopora, Acropora, Montipora*

Acropora, Montipora, Porites, Pocillopora, Astreopora, Turbinaria, Pavona

What is causing disease in corals?

Endolithic hypermycosis

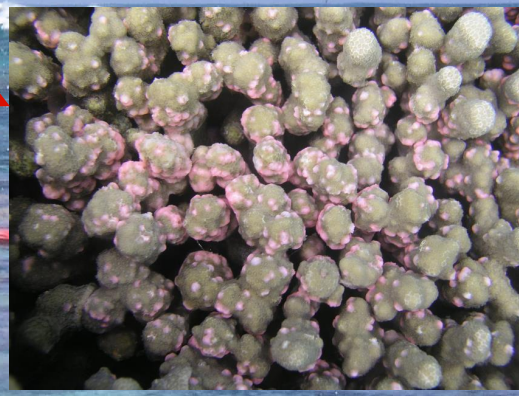


White syndrome

- virus
- bacteria
- fungus
- parasites
- protozoans
- abiotic

Brown band

Trematodiasis



Ecology of coral disease

Seasonality of disease occurrence

- Differs among disease types

Host specificity

- Host specialists and host generalists

Differential susceptibility among coral genera

- *Acropora, Montipora, Porites, Pocillopora, Turbinarea, Astreopora, Pavona*

Virulence of different diseases

- Acute, subacute, chronic tissue loss – reduced growth or reproduction

Disease etiologies

- Bacteria, fungus, parasites, protozoa

Identification of coral disease

1) Type of lesion

Tissue loss, Color change, Abnormal growths

2) Discriminate bet/ disease & other biological factors

Field investigation -> laboratory studies

3) Describe the lesion

Host affected
Acute vs. subacute vs. chronic
Focal, multi-focal, coalescing
Location on colony
Lesion margin

4) Disease nomenclature

Host affected
Lesion type

3 types of lesions

- **Tissue loss**

- **Discoloration**

- **Growth anomaly**

Identification of coral disease

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Lesion margin

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Host affected

Lesion type

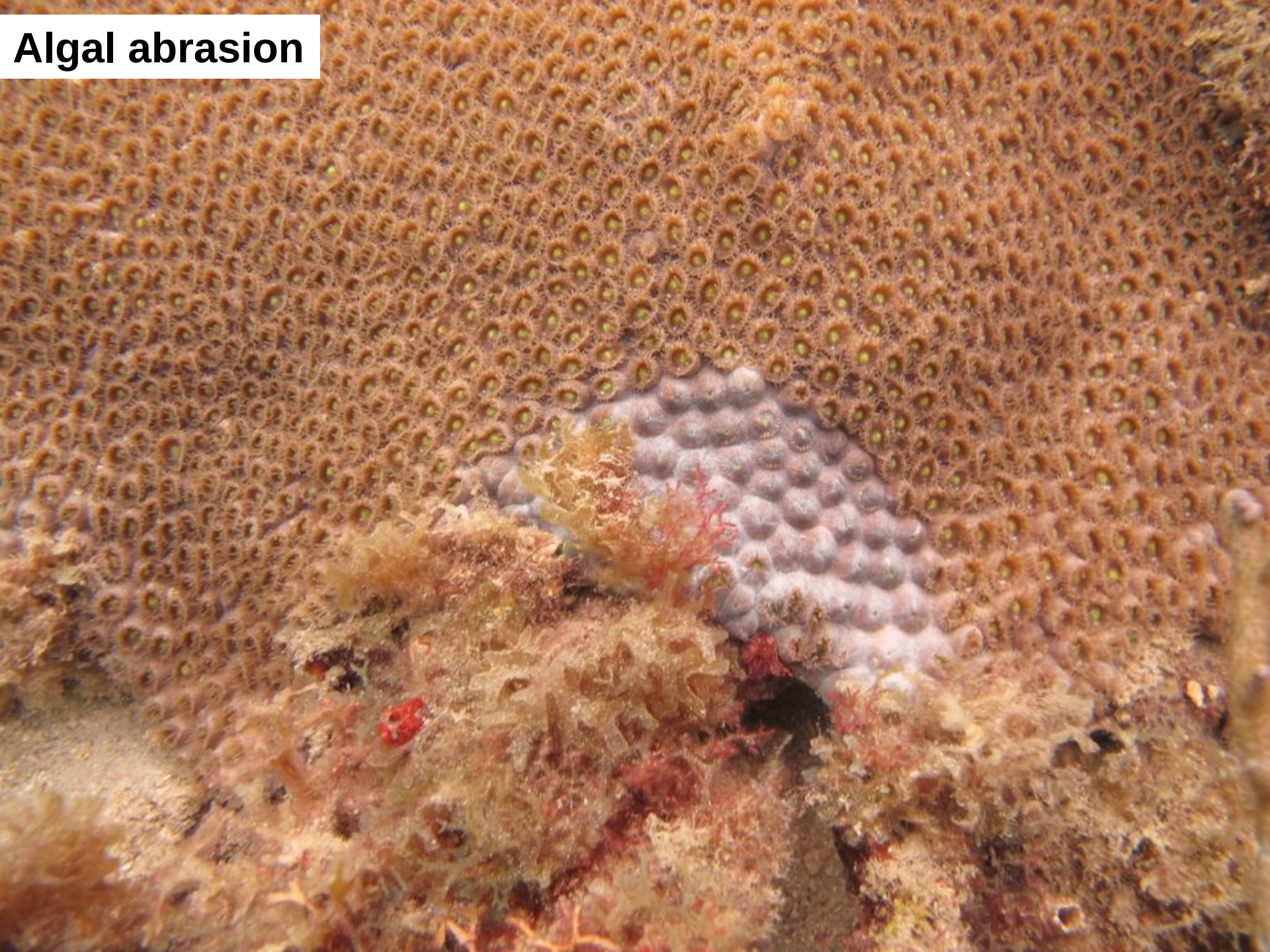
Discriminate between disease & other biological factors

Color change

disease

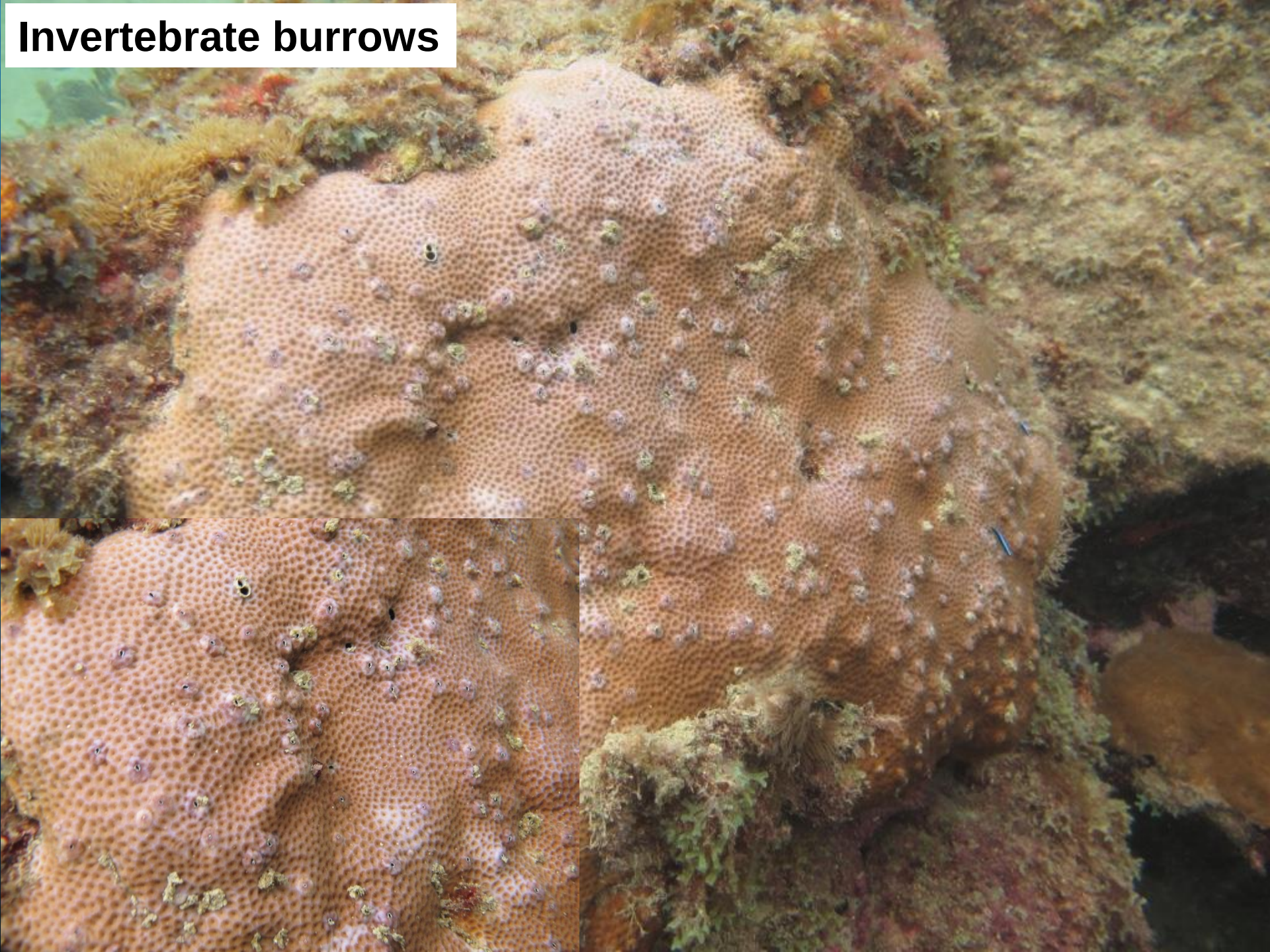
competition
abrasion
invertebrate burrows

Algal abrasion




Competition among corals

Invertebrate burrows

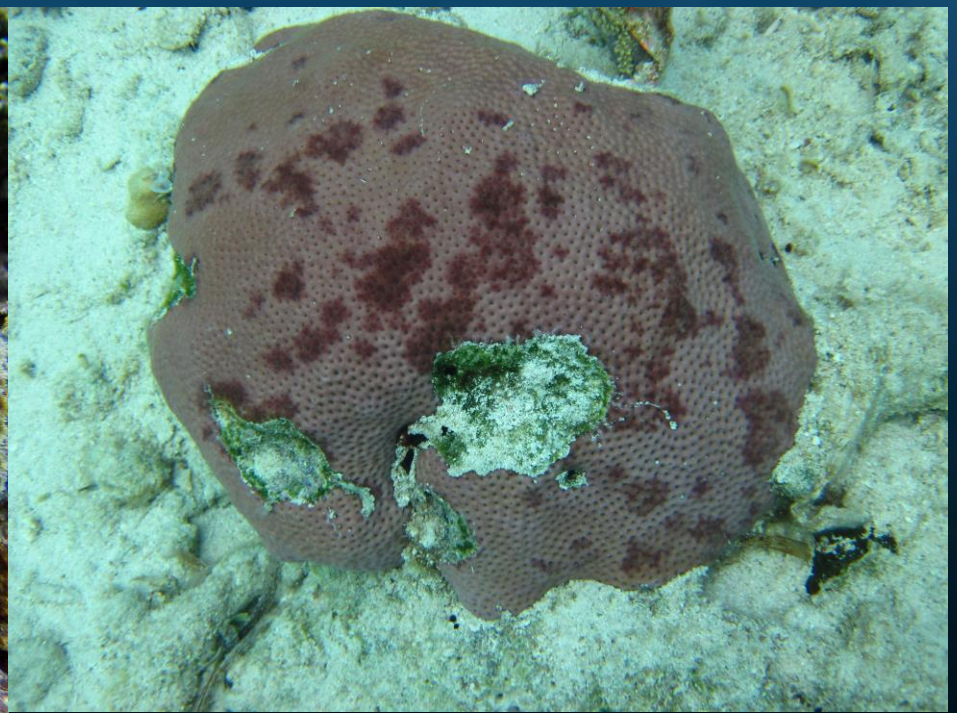


Identification of coral disease

Color change

mucous sheathing

endolithic hypermycosis
(Dark Spot)



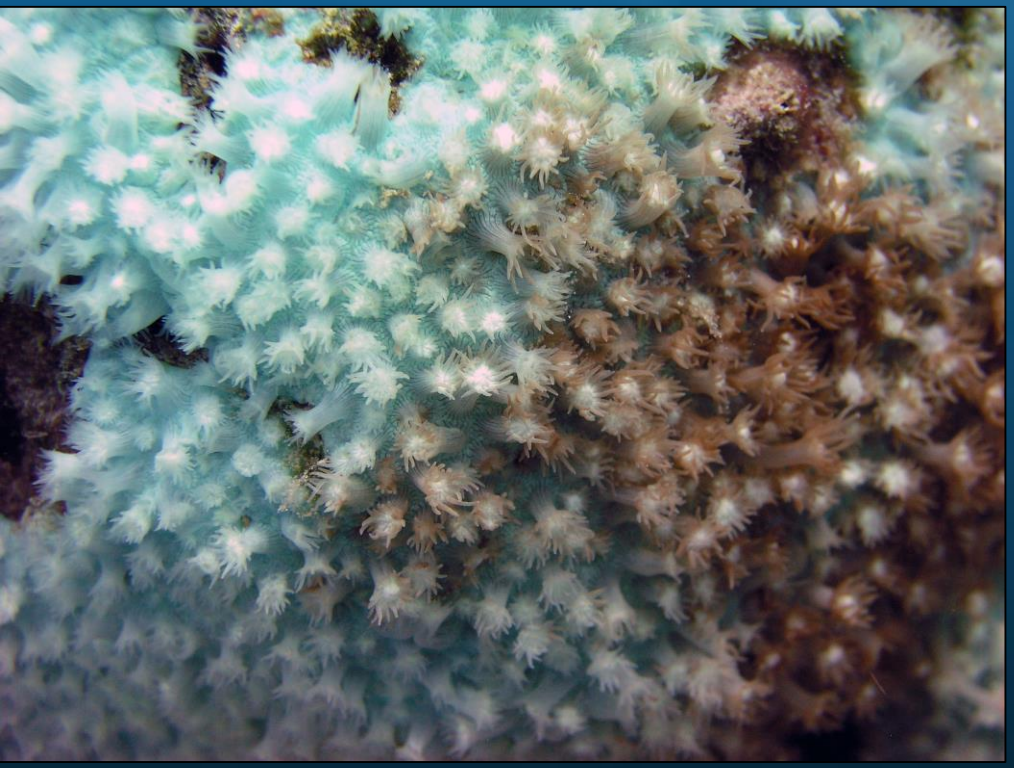
Discriminate between disease & other biological factors

White on colony

Bleaching

Bare Skeleton

Bleaching



- **loss of symbiotic algae within coral tissue**
  - Polyps are alive and present
  - Leaves transparent coral tissue

Tissue loss:

White on coral colony

bleaching

bare skeleton

predation

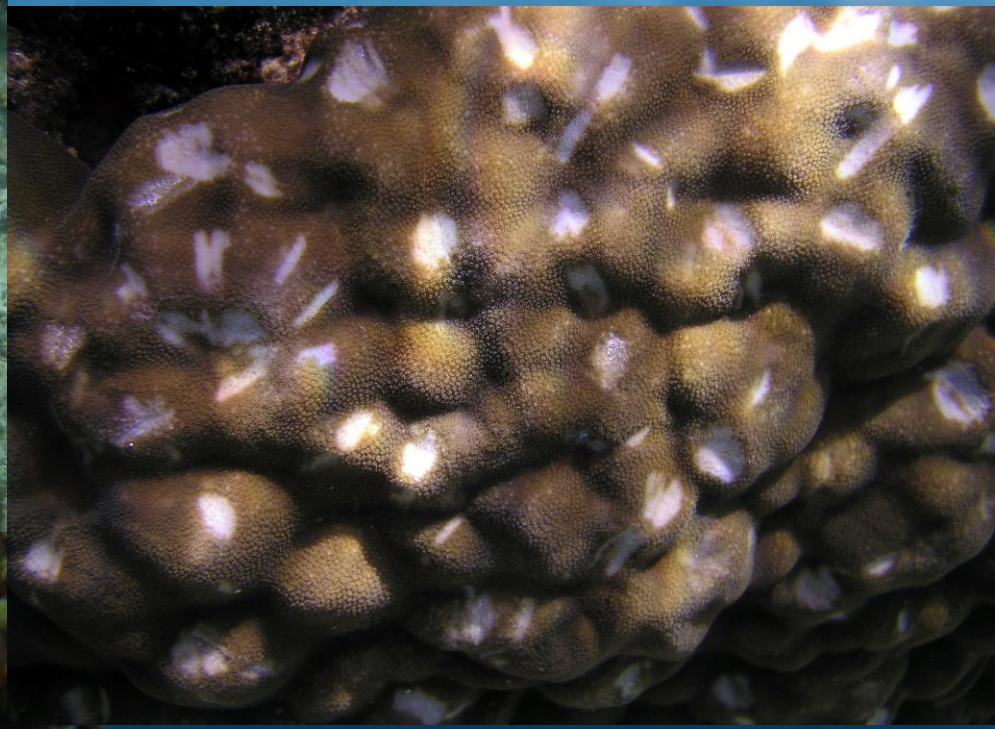
disease

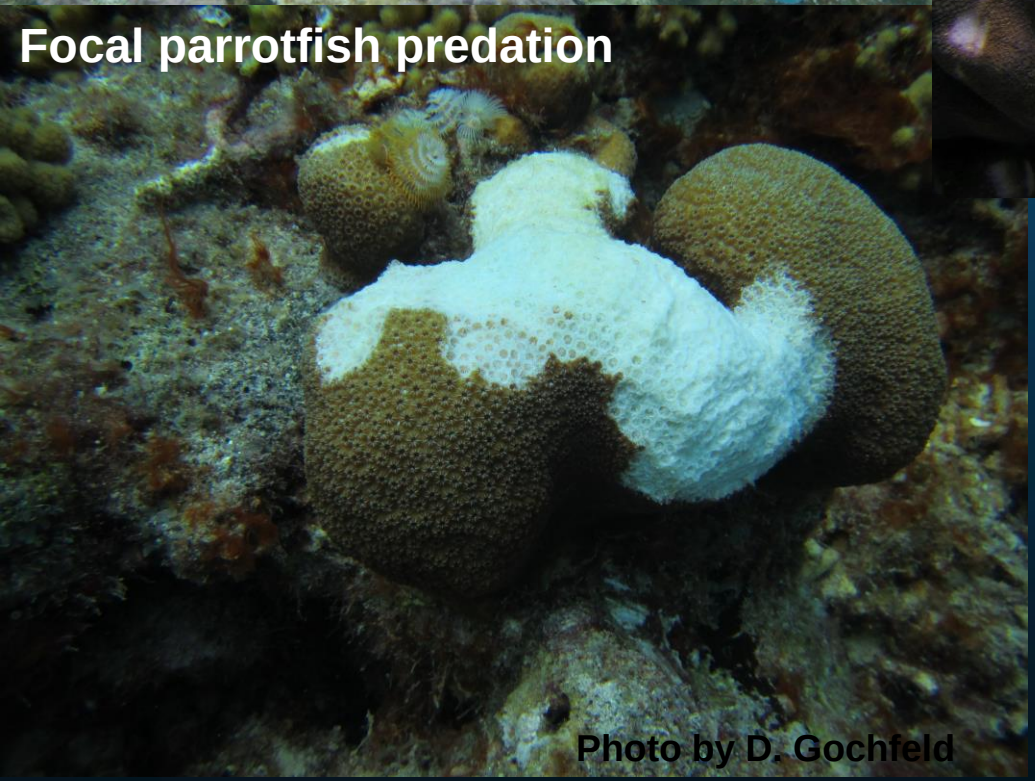
Predator present?
Pattern of tissue loss
Rate of tissue loss

Common coral predators

Photo by E. Mueller

Parrotfish predation





Focal parrotfish predation

Photo by D. Gochfeld

Damselfish predation

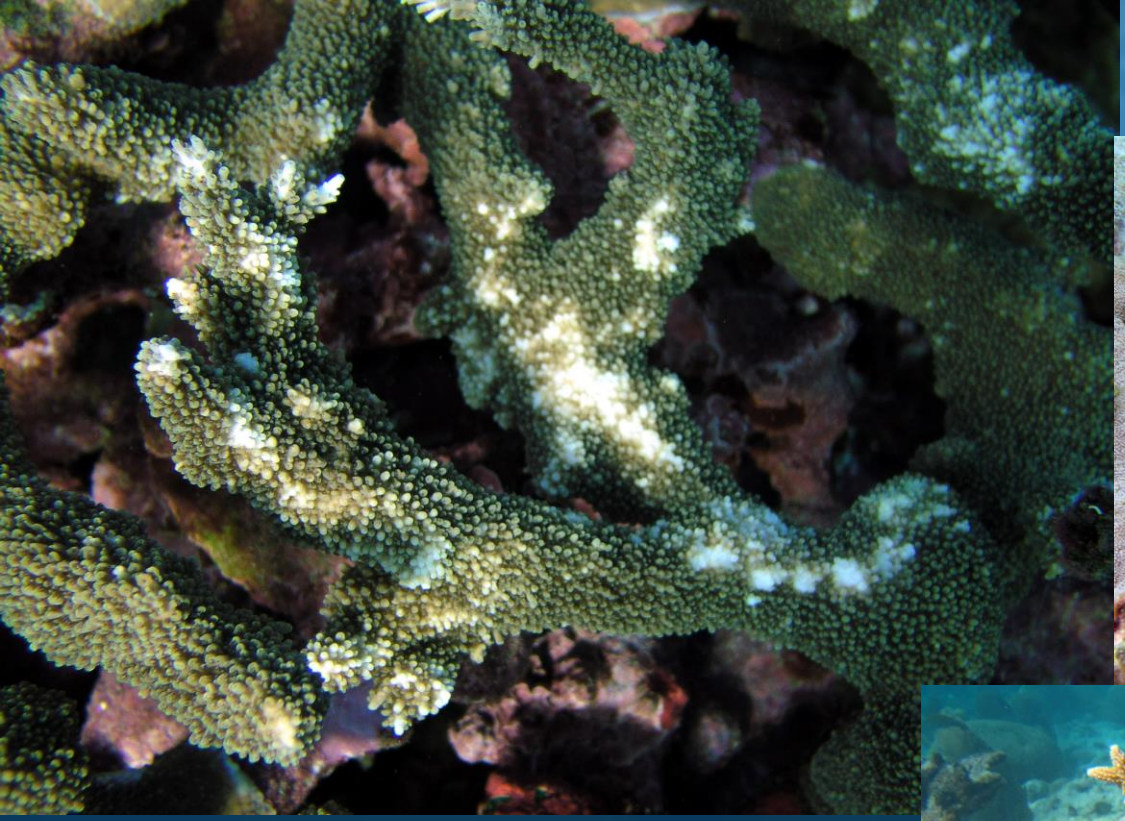
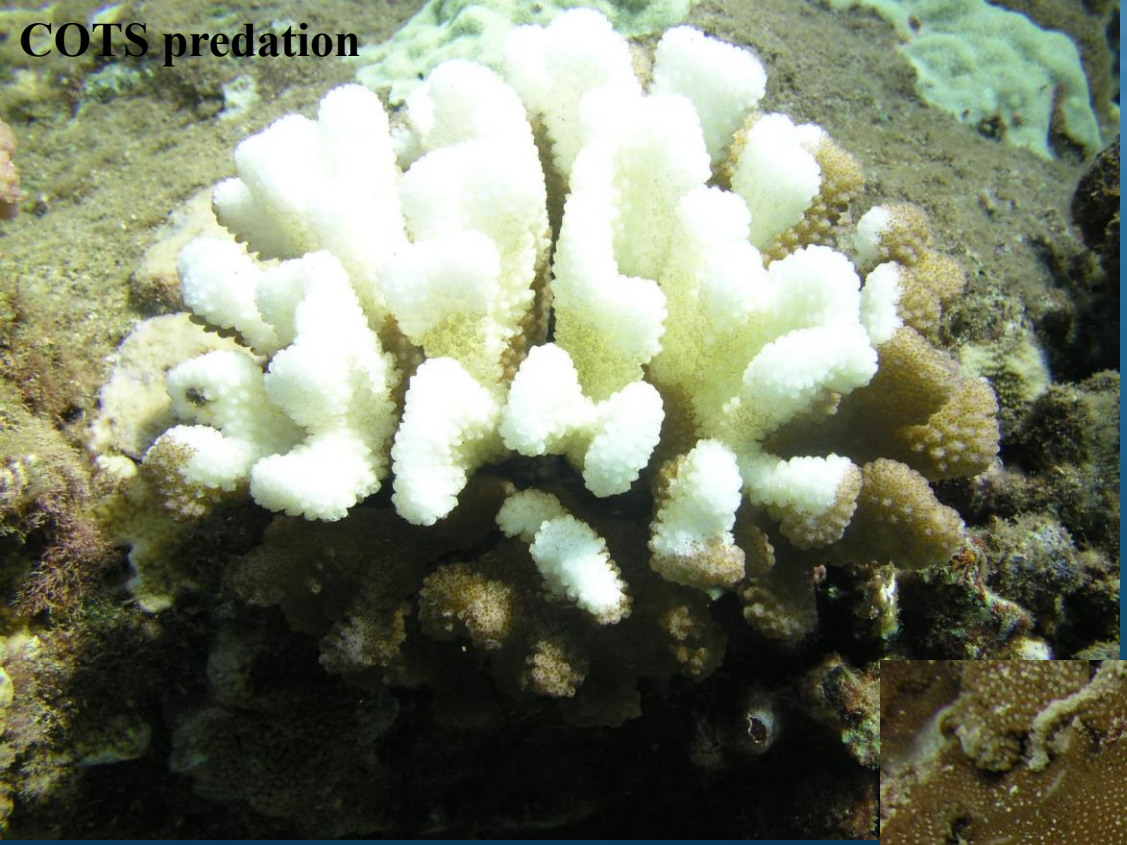
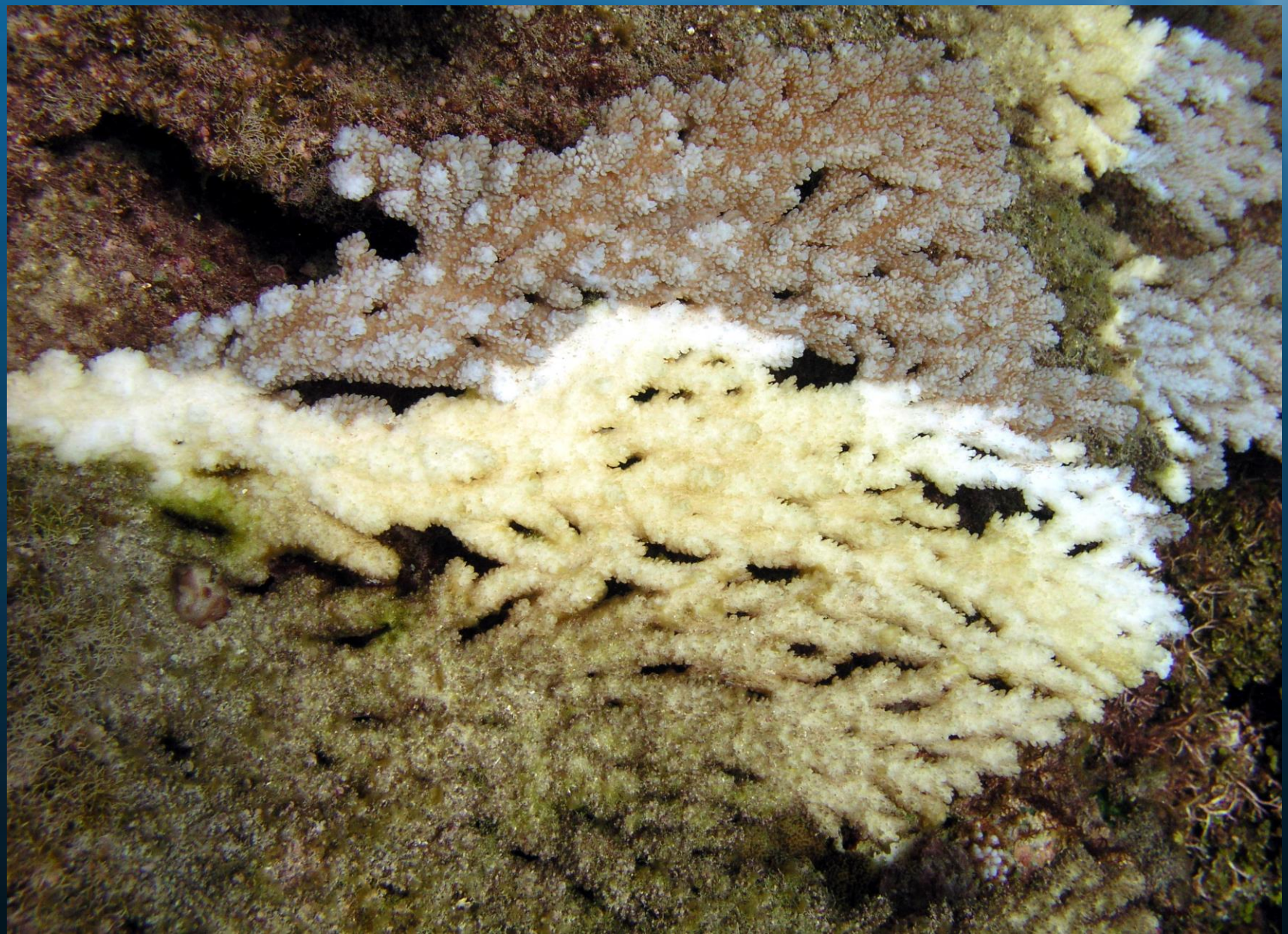


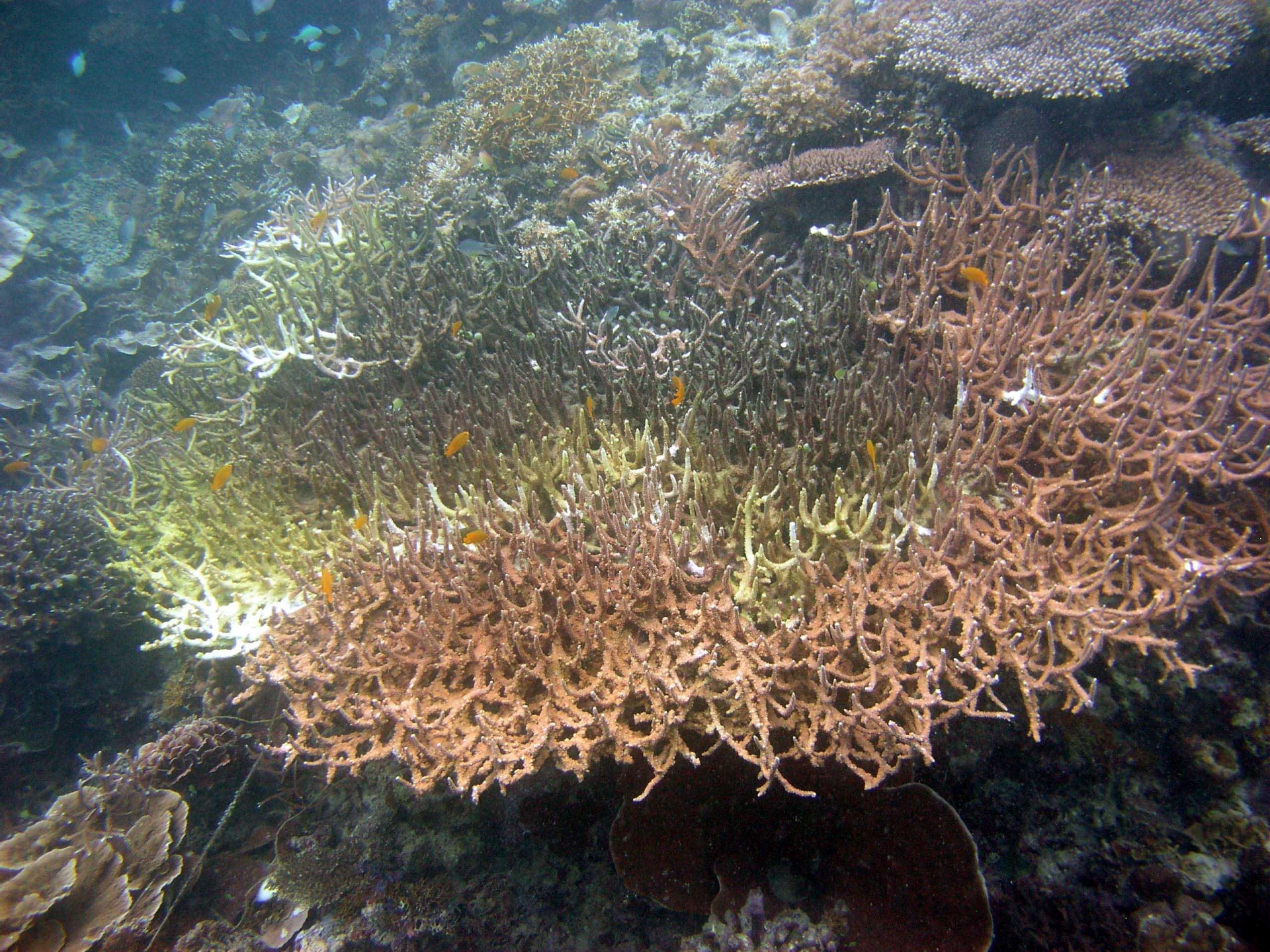
Photo by D. Gochfeld

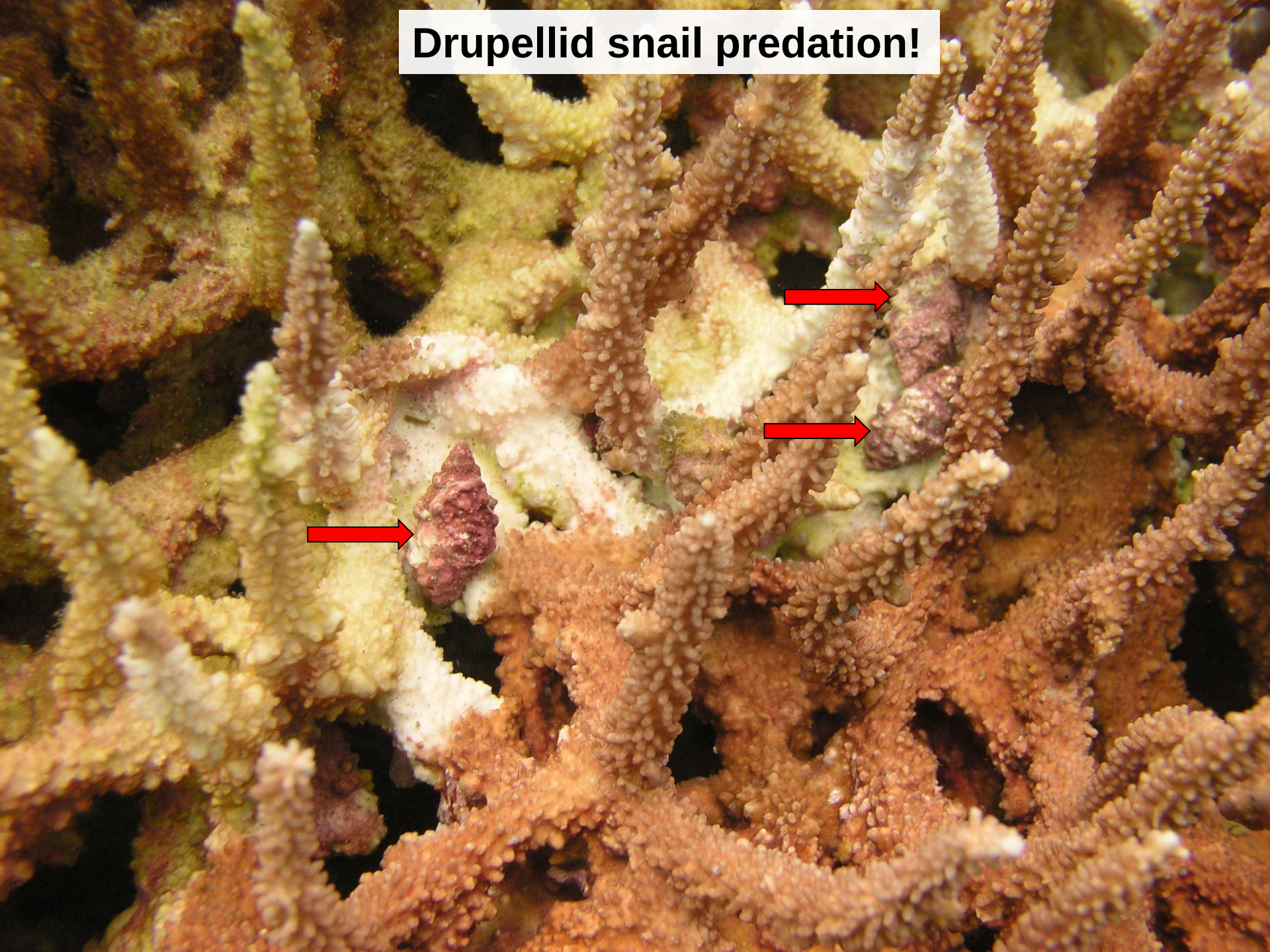


Pattern of tissue loss

Evidence of progressive tissue loss?






Drupellid snail predation!

Tissue loss:

White on coral colony

bleaching

bare skeleton

predation

disease

Predator present?
Pattern of tissue loss
Rate of tissue loss

Lab studies:
Histology, microscopy, microbial

Growth anomalies

protruberant growth
distinct margins
aberrant calyx formation
enlarged calices
reduced # calices
color change

Investigation of coral disease

1) Type of lesion:

Tissue loss, Color change, Abnormal growths

2) Discriminate bet/ disease & other biological factors

Field investigation -> laboratory studies

3) Describe the lesion

Host affected

Acute vs. subacute vs. chronic

Focal, multi-focal, coalescing

Location on colony

Lesion margin

4) Disease nomenclature

Host affected

Lesion type

Investigation of coral disease

3) Describe the lesion:

Tissue loss disease: rate of tissue loss

Chronic (<1cm) subacute (1-5cm) acute (>5cm)

Photo by D. Gochfeld

Different ecologies

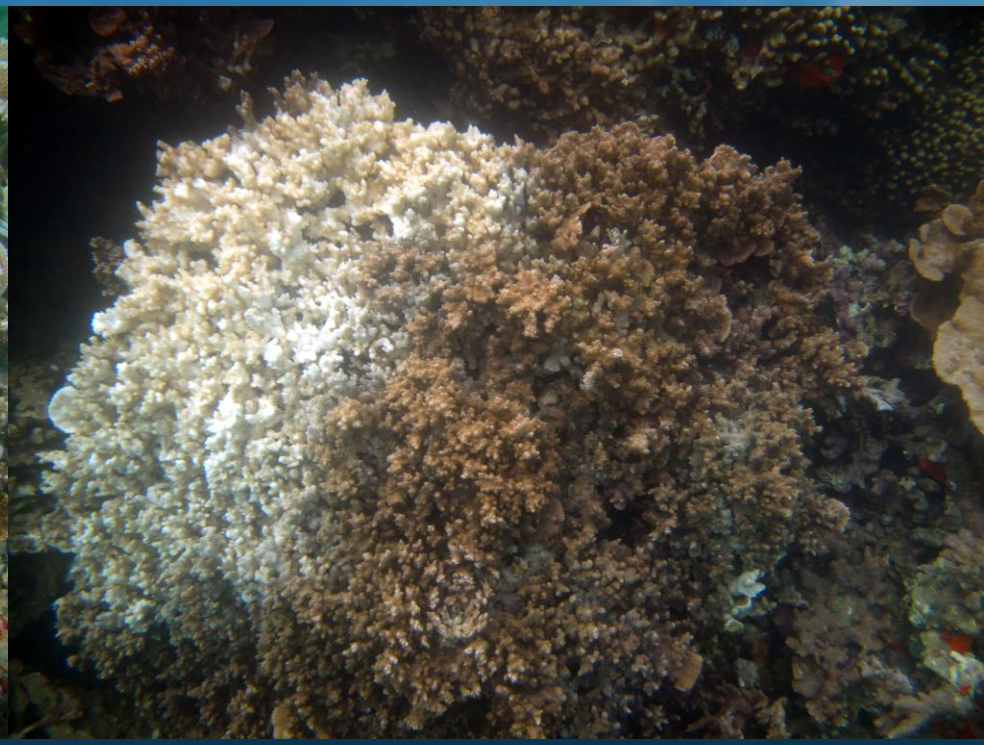
Montipora chronic tissue loss

slow tissue loss

Chronic: year-round

Vibrio owensii

Montipora acute tissue loss



fast tissue loss

Seasonal: winter

Vibrio coralliilyticus
Pseudoalteromonas sp.

Identification of coral disease

3) Describe the lesion:

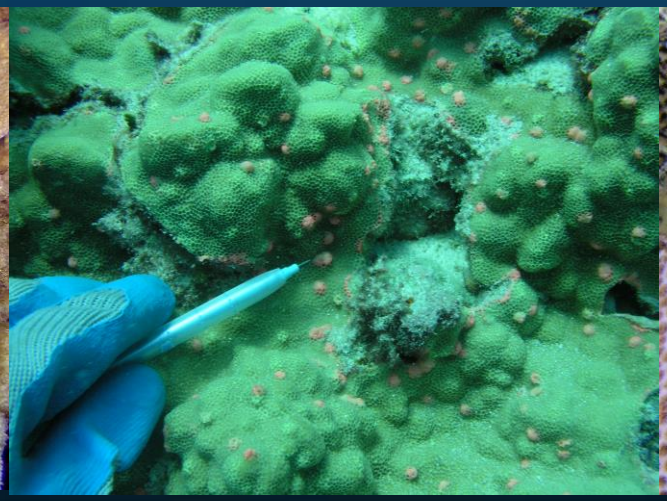
Focal, multi-focal, coalescing

Location on colony

Lesion margin

Focal

Multi-focal

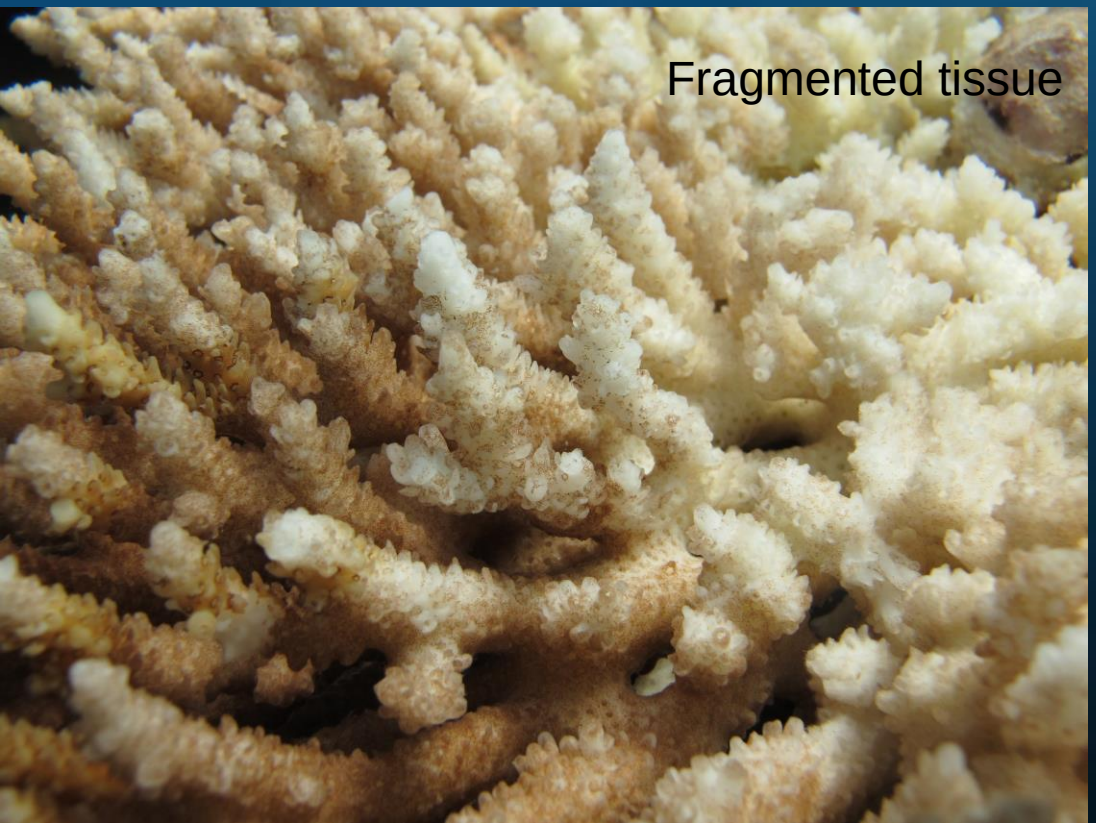


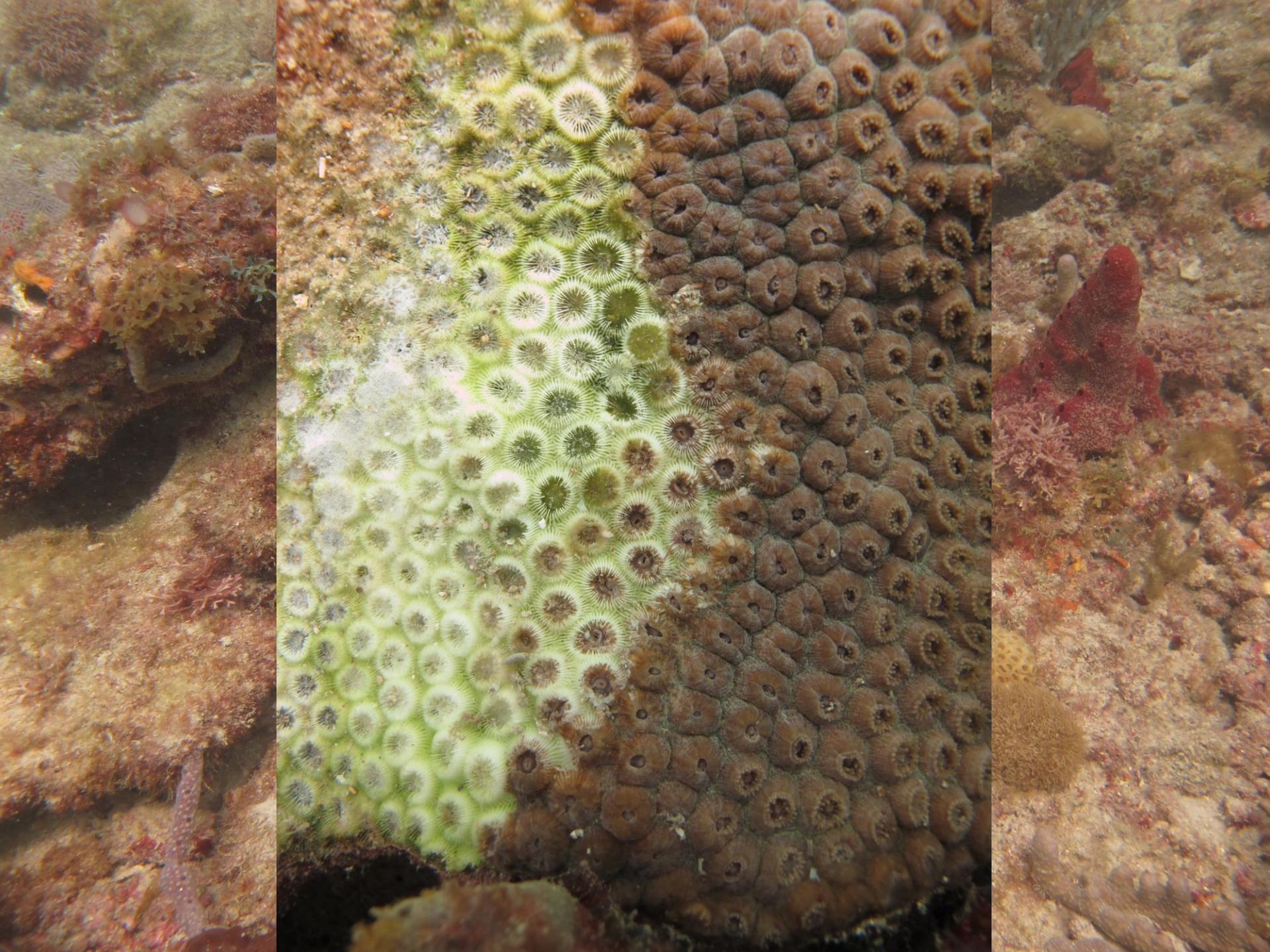
Coalescing

Investigation of coral disease

3) Describe the lesion:

- Focal, multi-focal, coalescing
- Location on colony
- Lesion margin





Identification of coral disease

1) Type of lesion:

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Field investigation -> laboratory studies

3) Describe the lesion

Host affected
Acute vs. subacute vs. chronic
Focal, multi-focal, coalescing
Location on colony
Lesion margin

4) Disease nomenclature

Host affected
Lesion type

Coral Disease & Health Consortium

Solutions today for reefs tomorrow

Diagnostics

Standardized nomenclature and diagnostic criteria were developed by the Coral Disease and Health Consortium (CDHC) to assist in the identification of coral disease in the field. Through application of a series of steps, a researcher can determine a common field name for a coral lesion which can be further refined based on a morphologic diagnosis and an etiologic diagnosis. The approach involves describing the lesion in general terms based on visual appearance. The terms and accompanying photographs are provided to assist in this process.

The coral disease assessment consists of describing the lesion using standardized terms and recording this information on the coral disease assessment form. Once the coral lesion is described the researcher can make a field diagnosis using the diagnostic decision tree and the coral disease identification keys.

Identification of coral disease

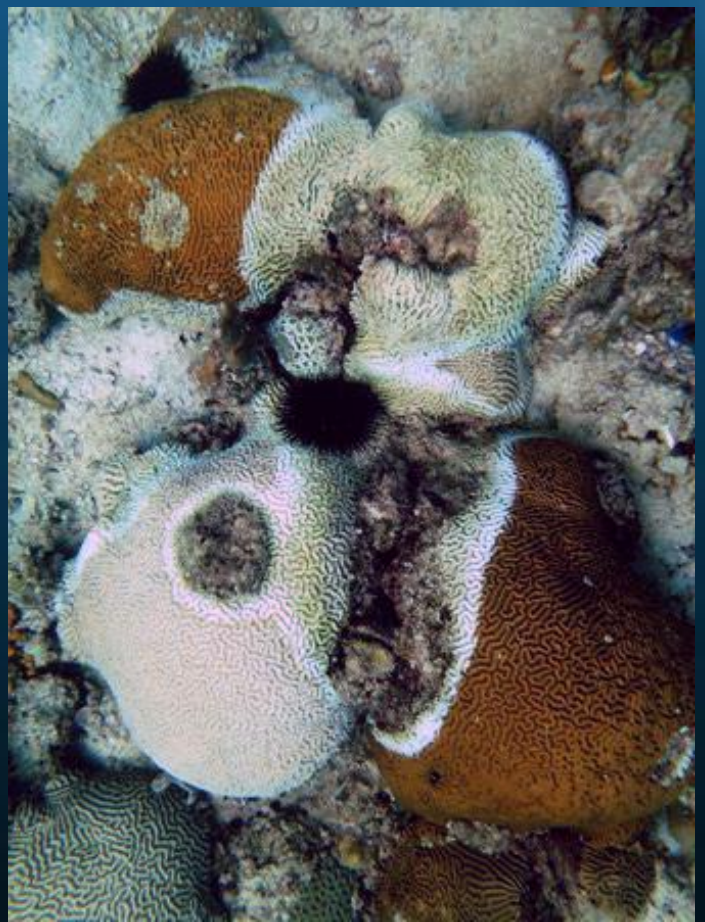
White syndrome = tissue loss disease of unknown etiology

4) Disease nomenclature

Host affected

Lesion type

***Platygyra* acute tissue loss**

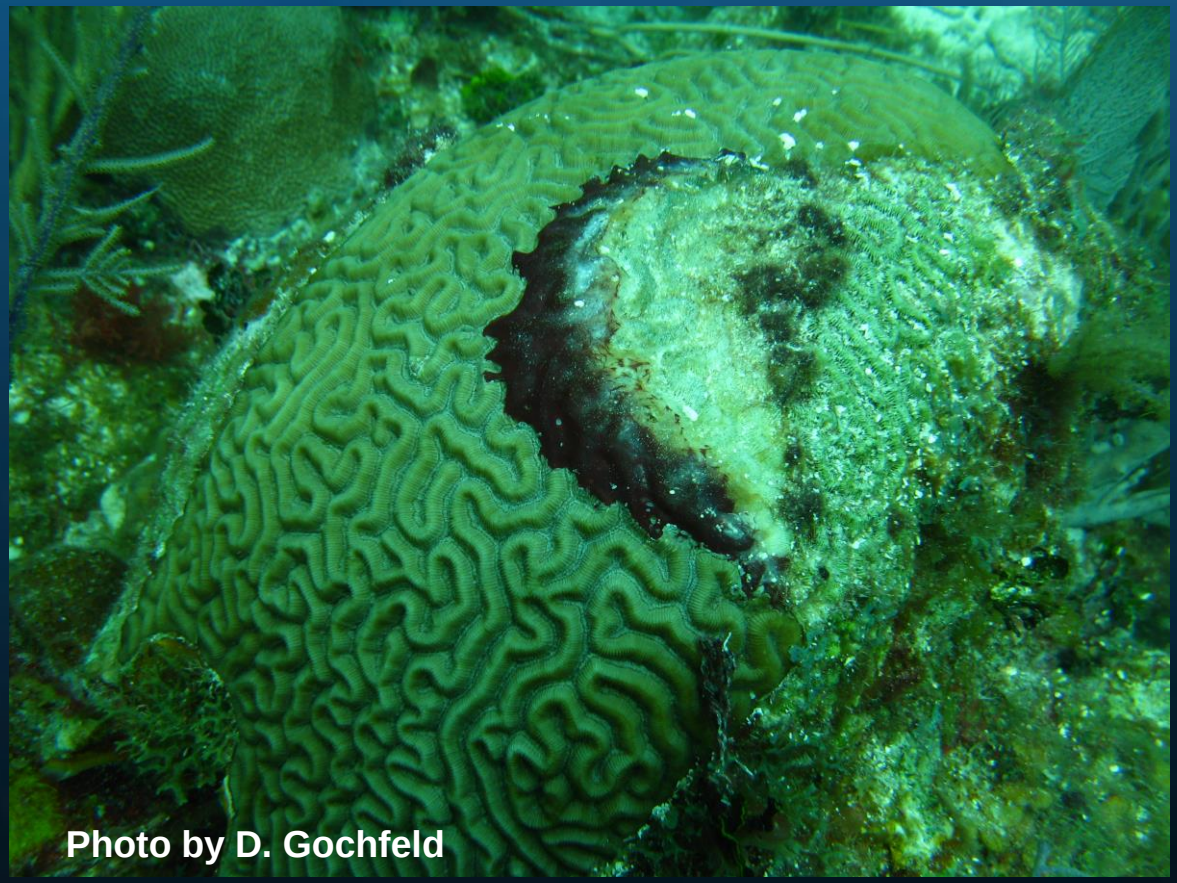


***Porites* growth anomalies**

Identification of coral disease

Diseases that can be diagnosed in the field

- **black band disease**



Identification of coral disease

Diseases that cannot be diagnosed in the field

- **Tissue loss diseases**

Photo by D. Gochfeld

Identification of coral disease

4) Disease nomenclature: **Tissue loss diseases**

White band disease - acroporids

White plague – other species

Aurantimonas coralicida (Richardson 1998, Denner et al. 2003)

White pox - *A. palmata*

Serratia marcescens (Patterson 2002)

Yellow band – *Montastrea*, *Orbicella*

Vibrio consortia - (Cervino et al. 2008)

Identification of coral disease

> Current Issue > vol. 99 no. 13 > Kathryn L. Patterson, 8725–8730, doi: 10.1073/pnas.092260099

Check for updates

The etiology of white pox, a lethal disease of the Caribbean elkhorn coral, *Acropora palmata*

Kathryn L. Patterson*†, James W. Porter‡, Kim B. Ritchie§¶, Shawn W. Polson‖, Erich Mueller**, Esther C. Peters‡‡, Deborah L. Santavy††, and Garriet W. Smith§§

Shifting white pox aetiologies affecting *Acropora palmata* in the Florida Keys, 1994–2014

Kathryn P. Sutherland, Brett Berry, Andrew Park, Dustin W. Kemp, Keri M. Kemp, Erin K. Lipp, James W. Porter

Published 15 February 2016. DOI: 10.1098/rstb.2015.0205

Identification of coral disease

4) Disease nomenclature: **Tissue loss diseases**

White band disease – *Acropora* subacute tissue loss disease

White plague – acute tissue loss disease (multiple species)

White pox – *A. palmata* multi-focal subacute tissue loss disease

Yellow band – *Montastrea* yellow banded chronic tissue loss disease

Lesion description

Tissue loss, growth anomaly, discoloration?

Disease or biological interaction?

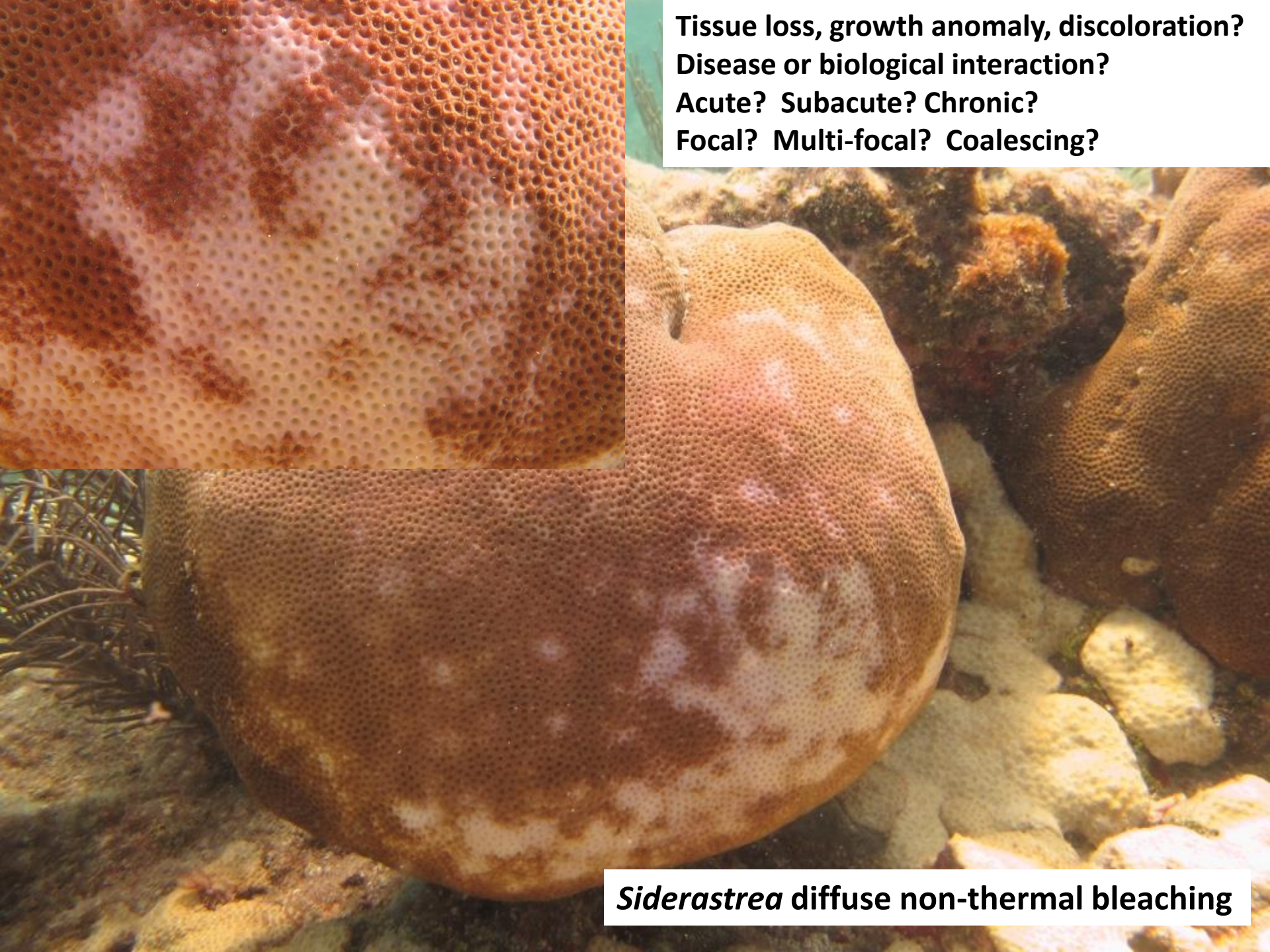
Acute? Subacute? Chronic?

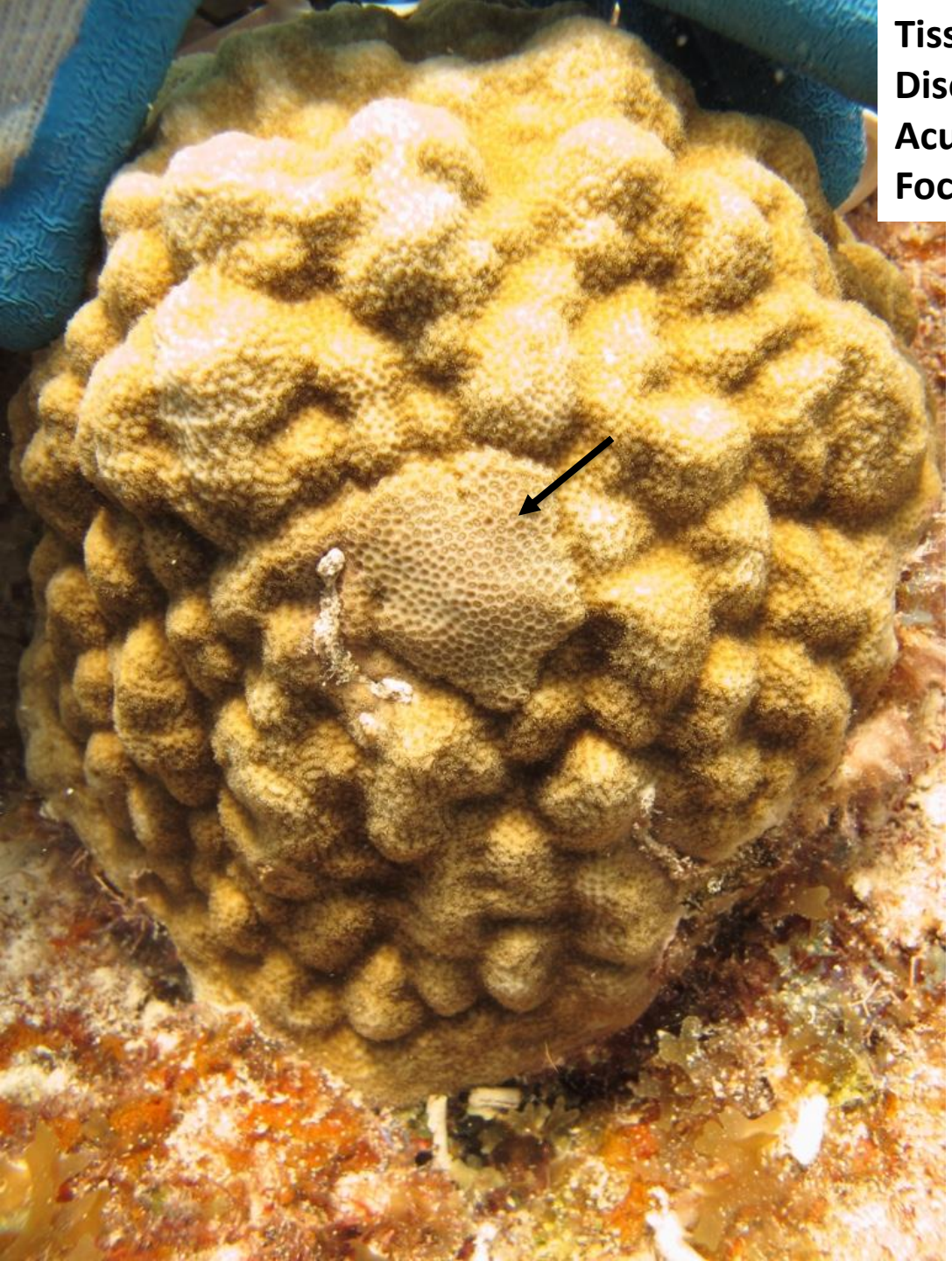
Focal? Multi-focal? Coalescing?


Tissue loss, growth anomaly, discoloration?
Disease or biological interaction?
Acute? Subacute? Chronic?
Focal? Multi-focal? Coalescing?

Damselfish predation

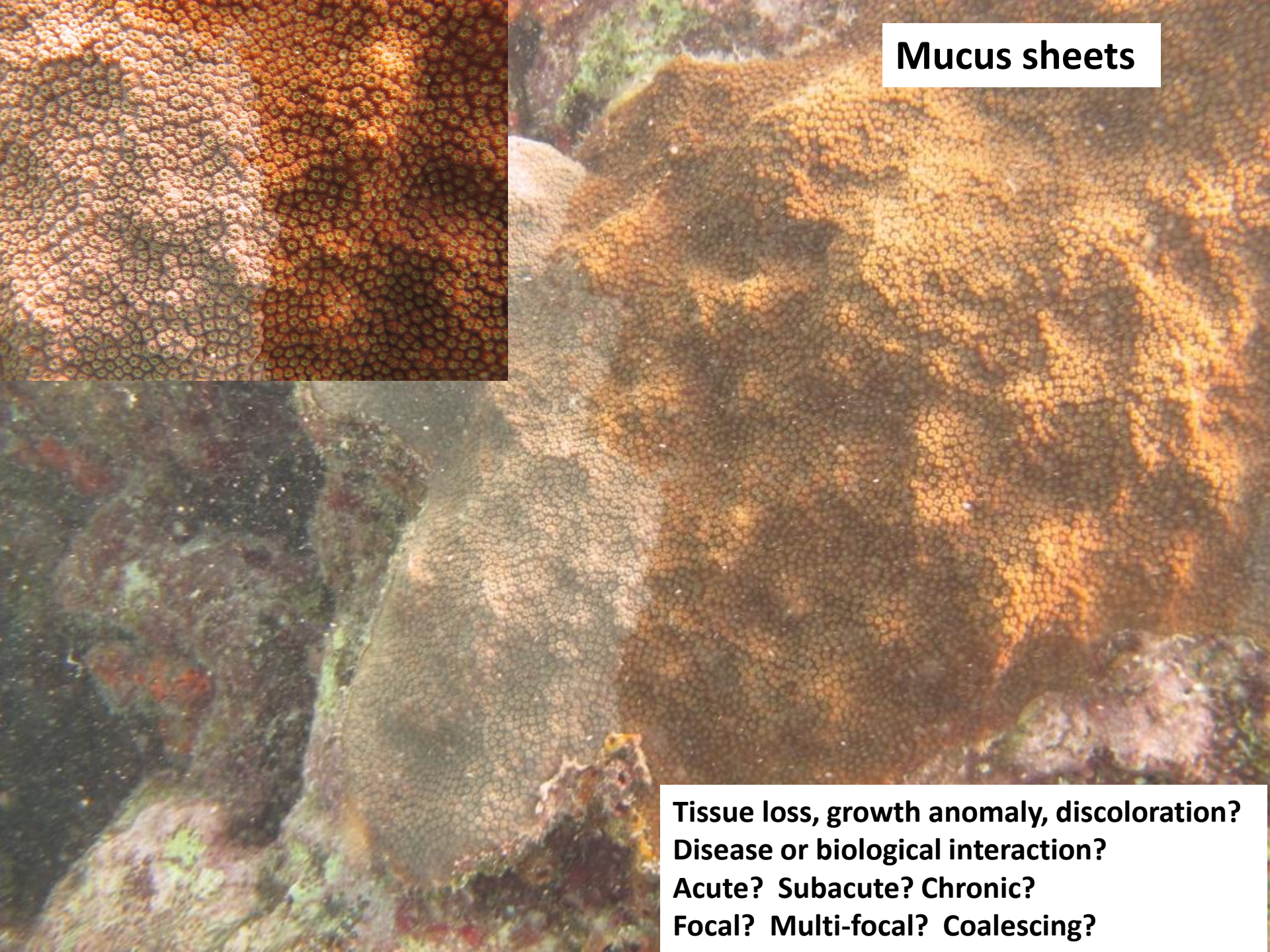

Damselfish nest

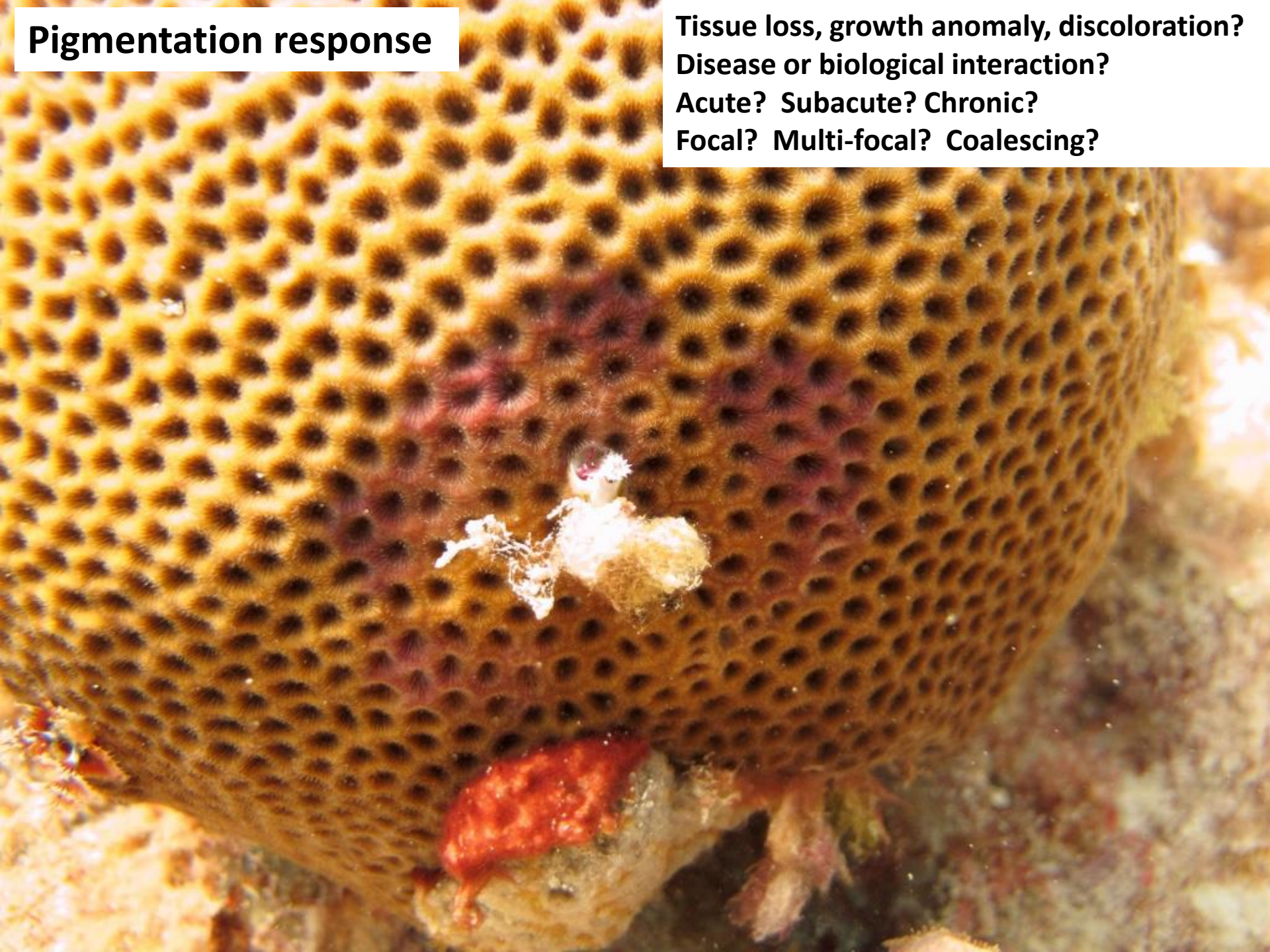

Tissue loss, growth anomaly, discoloration?
Disease or biological interaction?
Acute? Subacute? Chronic?
Focal? Multi-focal? Coalescing?
Siderastrea diffuse non-thermal bleaching



Tissue loss, growth anomaly, discoloration?
Disease or biological interaction?
Acute? Subacute? Chronic?
Focal? Multi-focal? Coalescing?

***Porites* growth anomaly**


Mucus sheets
Tissue loss, growth anomaly, discoloration?
Disease or biological interaction?
Acute? Subacute? Chronic?
Focal? Multi-focal? Coalescing?


Pigmentation response
Tissue loss, growth anomaly, discoloration?
Disease or biological interaction?
Acute? Subacute? Chronic?
Focal? Multi-focal? Coalescing?

Identification of coral disease

1) Type of lesion:

Tissue loss, Color change, Abnormal growths

2) Discriminate bet/ disease & other biological factors

Field investigation -> laboratory studies

3) Describe the lesion

Host affected
Acute vs. subacute vs. chronic
Focal, multi-focal, coalescing
Location on colony
Lesion margin, size & shape

4) Disease nomenclature

Host affected
Lesion type


Protecting the health and beauty of coral reefs
•Research
•Management
•Protection