Recognizing & Describing Lesions in the Field

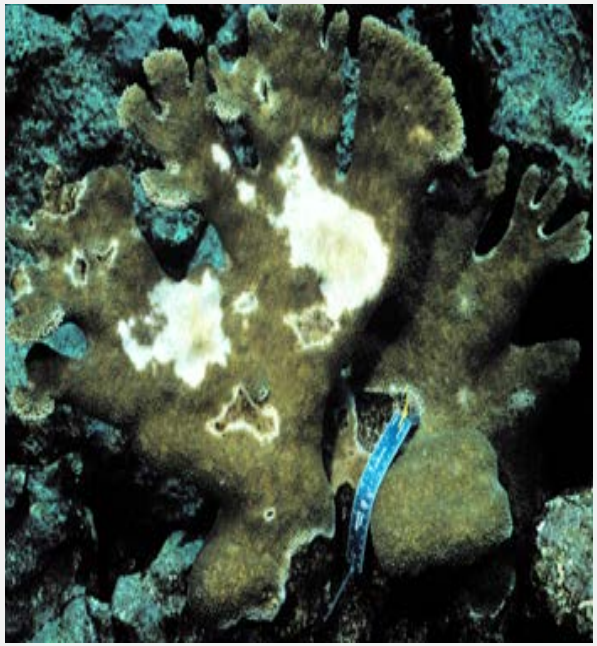
Module 3

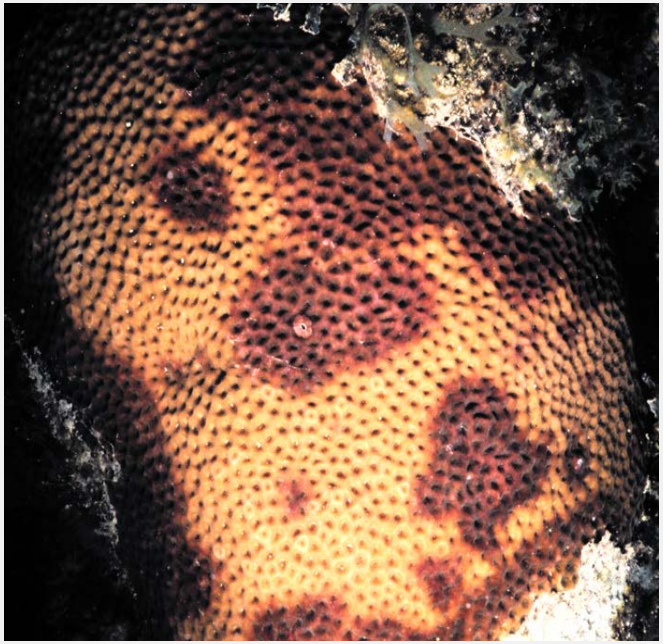
Caribbean Coral Diseases:

Andy Bruckner

How many stony coral diseases are there?

Over 40 reported from the Caribbean!





How many stony coral diseases are there?

- Black band disease (BBD)
- White band disease (WBD)
  - type I, type II
- White plague (WP)
  - type I, II, III, WP-like
- Red band disease (RBD)
  - type I, II
- Yellow band disease (YBD)
- Dark spots disease (DSD)
  - DSD type I, II
  - dark band disease
  - purple band disease
- White patch disease (WPD)
  - white pox
  - patchy necrosis
  - necrotic patch syndrome
- Caribbean ciliate infection
- Growth anomalies
  - hyperplasia, neoplasia
  - tumor

How many stony coral diseases are there?
Con't

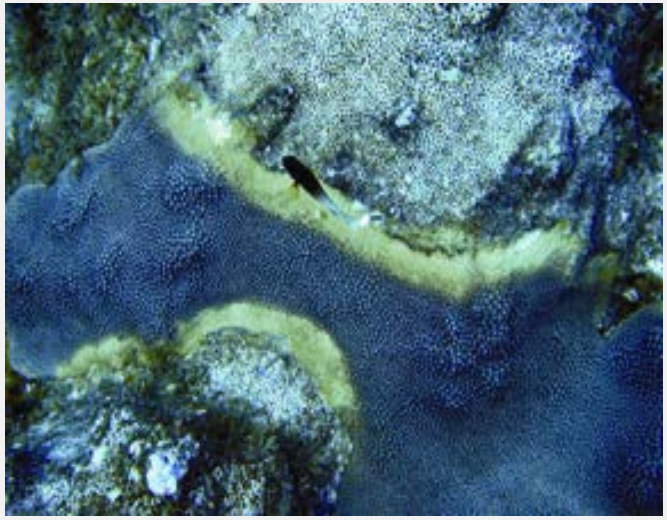
- Shutdown reaction (SDR)
- Ridge mortality disease
- Rapid wasting disease
- White-spot syndrome
- White syndrome
- Finger coral denuding syndrome
- Ring disease
- Coccidium infection
- Light patch syndrome
- Pale ring syndrome
- Mottling syndrome
- Tissue necrosis
- Ulcerative white spots
- Bleaching

.....AND MORE!!

"Traditional" criteria used to separate diseases

- Color of affected tissue (lighter/darker/discoloration)
- Presence &color of visible microbial band or mat
- Shape of the lesion
- Pattern of tissue loss
- Rate of tissue loss
- Presence of bleached areas
- Species affected

"Traditional" criteria used to separate diseases

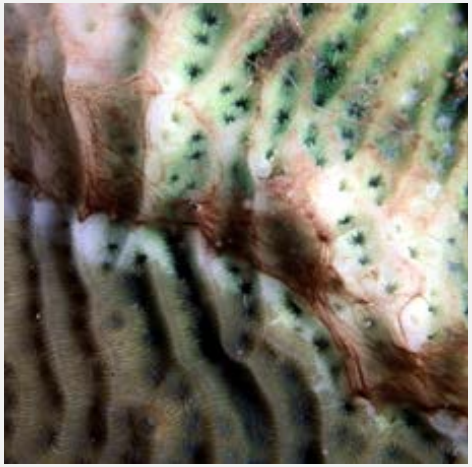


Yellow band

Growth anomaly

White band

White plague

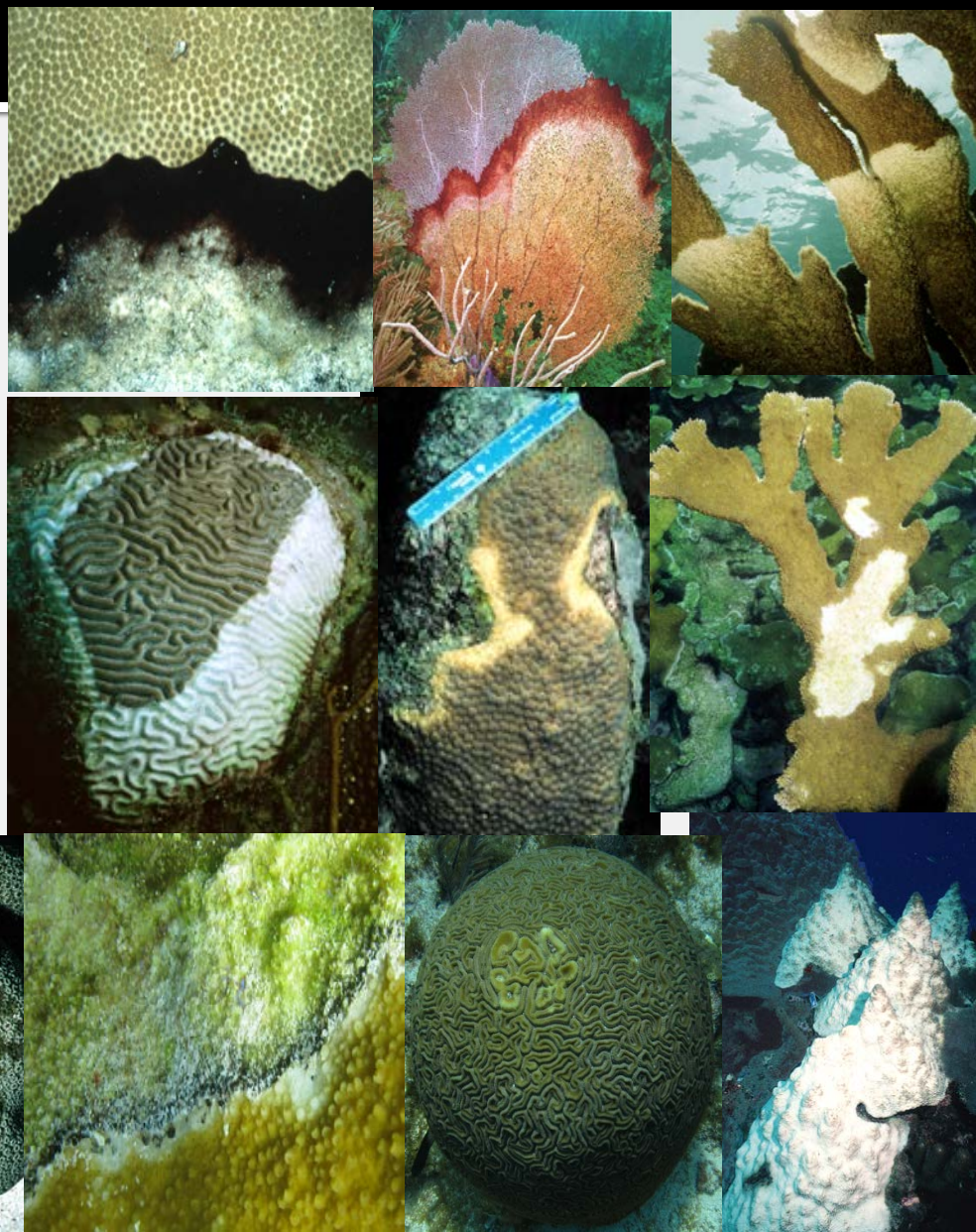


Red band

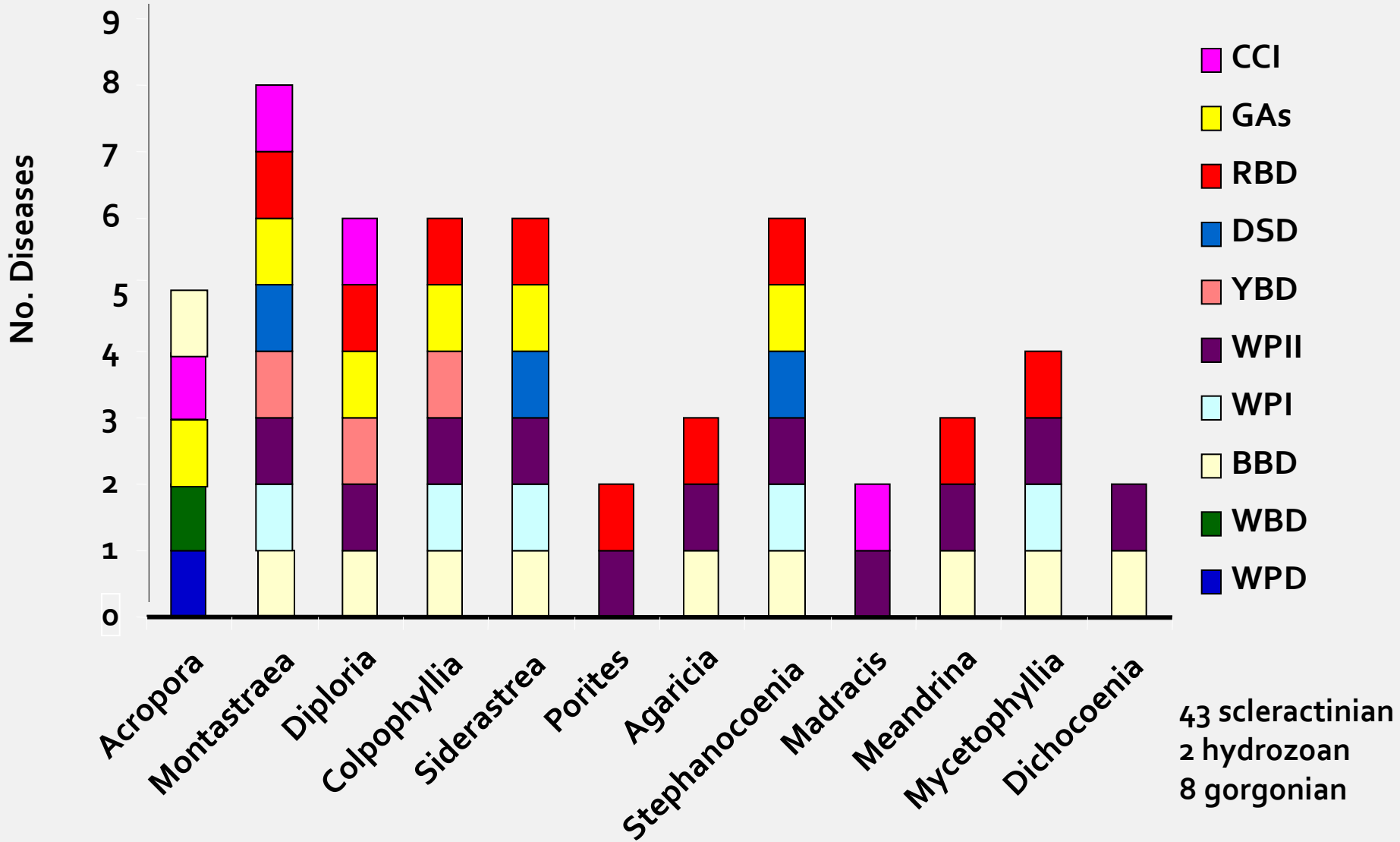
Ten Common Caribbean Coral Diseases

Module 3

- Black band disease (BBD)
- Red band disease (RBD)
- White band disease (WBD)
- White plague (WP)
- Yellow band disease (CYBD)
- White patch disease (WPD)
- Dark spots disease (DSD)
- Carib. ciliate infection (CCI)
- Growth anomalies (GAs)
- Bleaching



Diseases affecting Caribbean corals



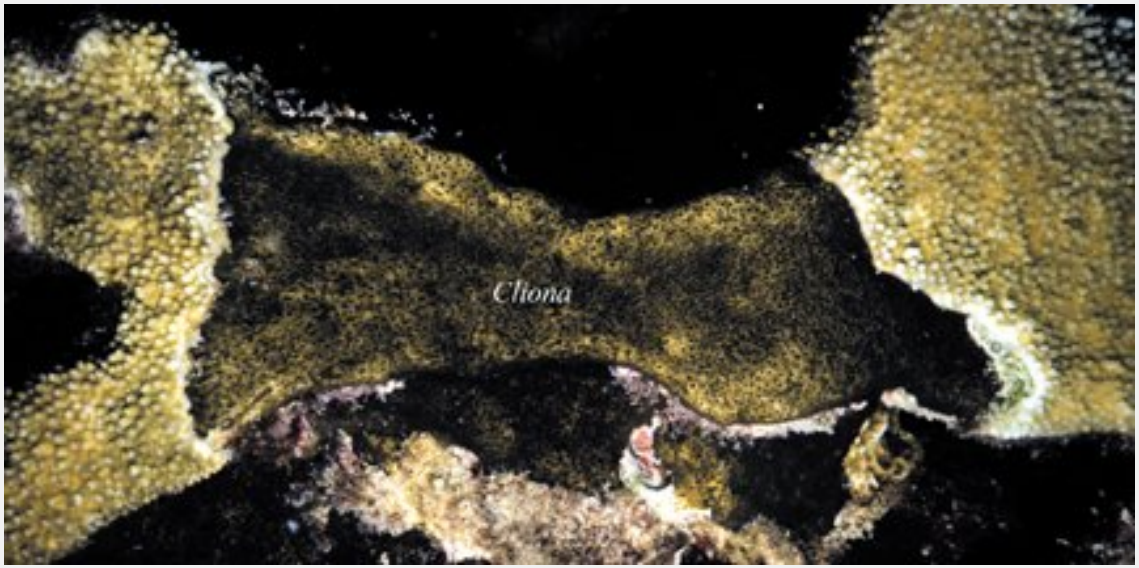
Field Diagnosis

Step1: Identify the presence of lesions

- What species are affected?
- How common is it?
- Is it spreading?
- Is it killing coral colonies?
- Are there unusual environmental factors at the site?
- Can you identify a cause ?

A coral may exhibit multiple signs

Step 2. Determine if lesion is due to a disease or something else

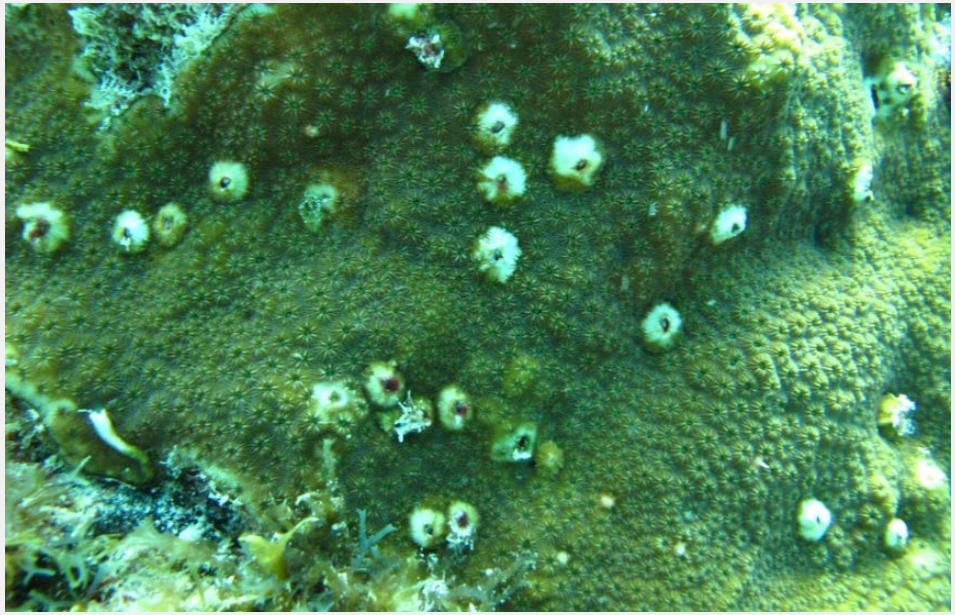


Sponge bioerosion/overgrowth

Abrasion/fin damage

Competition/overgrowth

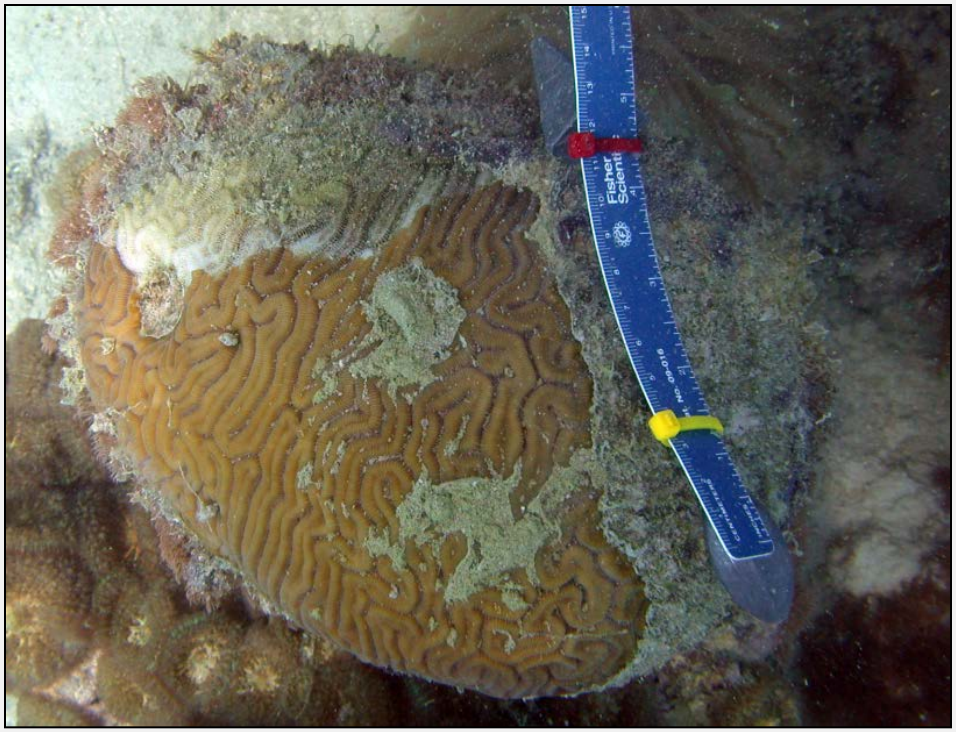
Step 2. Determine if lesion is due to a disease or something else



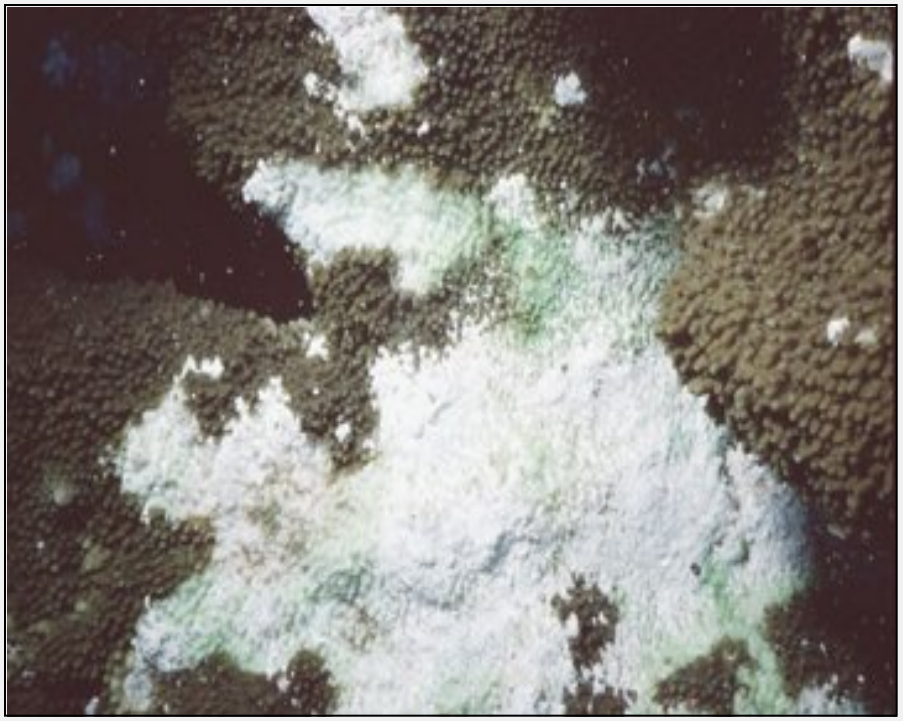
Galls/tumors/tube dwellers

Aggression

Other causes of mortality (cont.)



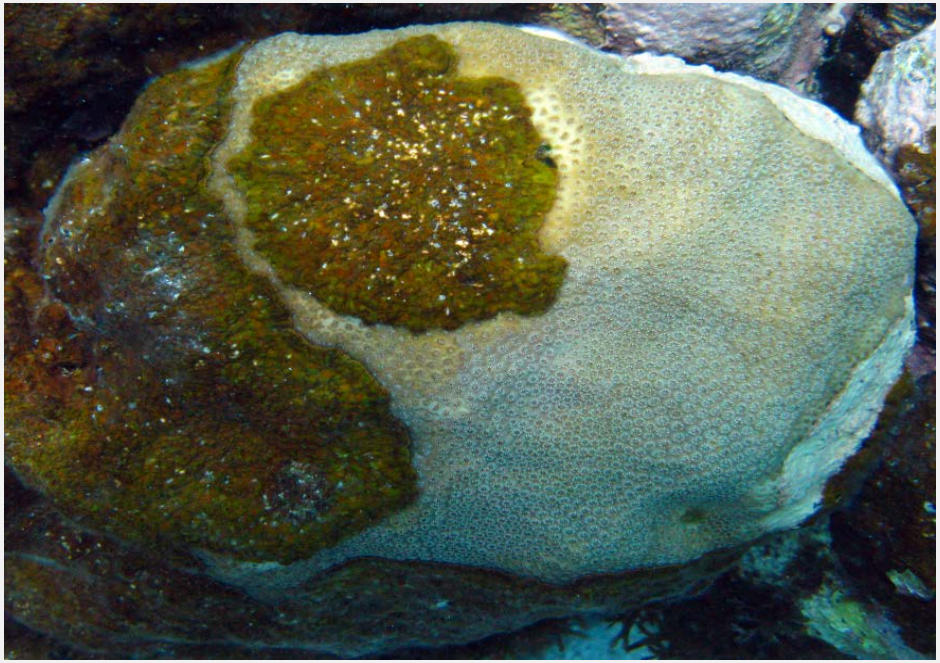
Sediment damage



Fish poop

Other causes of mortality (cont.)

Algal abrasion



Algal abrasion/overgrowth

Other causes: Predation

1. Is a predator present (fireworm/snail)?

Other causes: Predation

2. Do you see a motile predator feeding on coral (fish)?

Other causes: Predation

3. Is there tissue loss and loss of underlying skeleton?

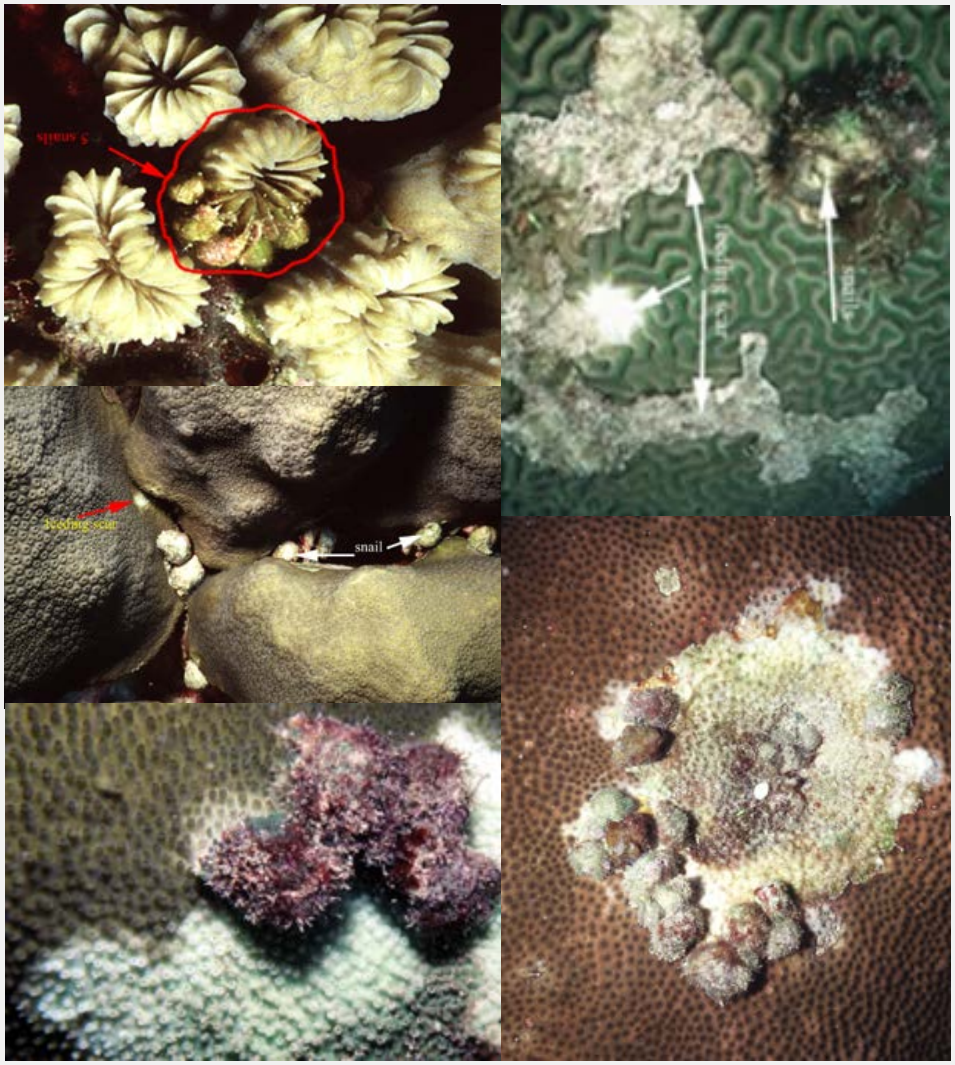
Other causes: Predation

4. What are the patterns of tissue loss?

Snail predation

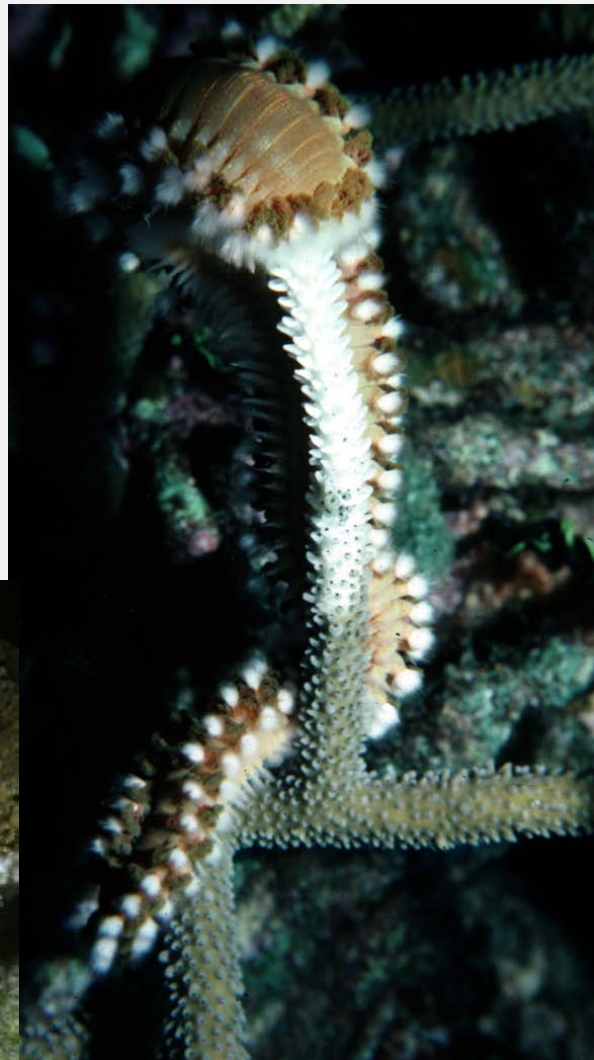
Coralliophila abbreviata

- Snails may be on or around injury; may retreat to base of coral (or underside)
- Aggregate (2-50+ snails)
- Create characteristic scallop-shaped injury or a "trail" that extends across colony
- Tissue adjacent to exposed skeleton non-necrotic
- Snails often associated with disease bands
- Occur on almost all species of stony corals



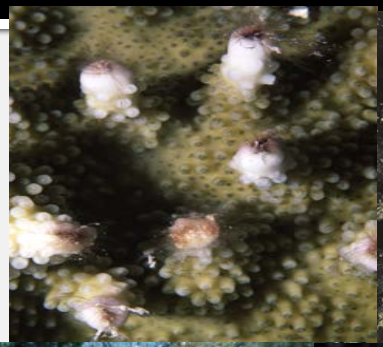
Hermodice predation

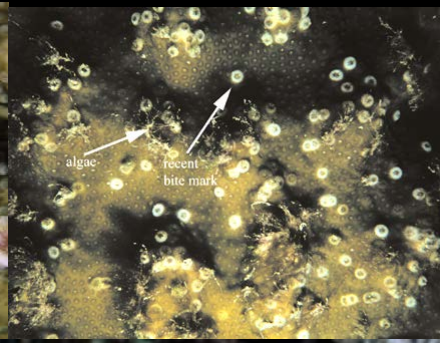
- Fireworms consume branch tips, projections or knobs; also seen on necrotic tissue
- Tissue adjacent to exposed skeleton is non-necrotic
- Most feeding at night – fireworms often not seen near injury

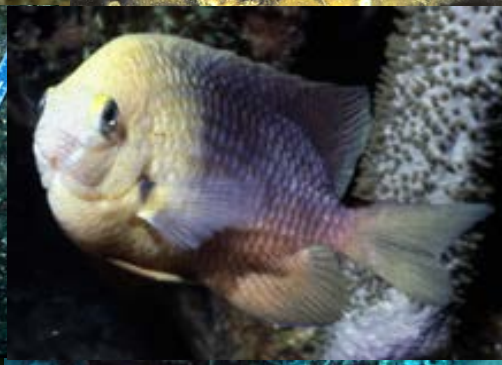


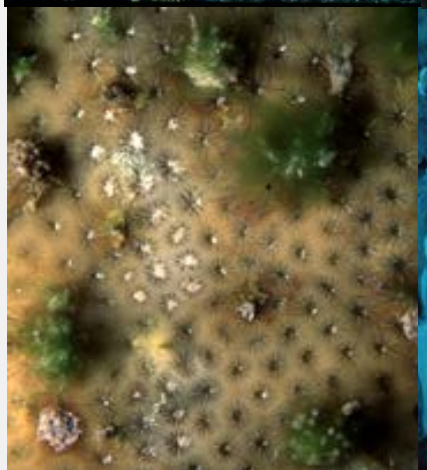
Damselfish predation

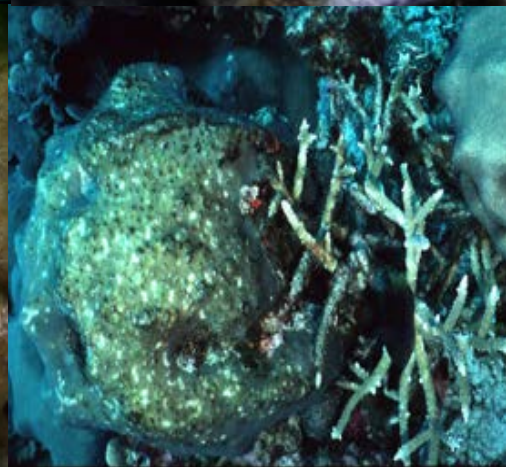
- Threespot and yellowtail damselfish remain around colony and create lesions & algal lawns
- Referred to as "ridge mortality" on brain corals
- Lesions often colonized by algae; small bite marks will heal
- *Acropora* may produce chimneys to contain algae; lesions may continue to enlarge and coalesce



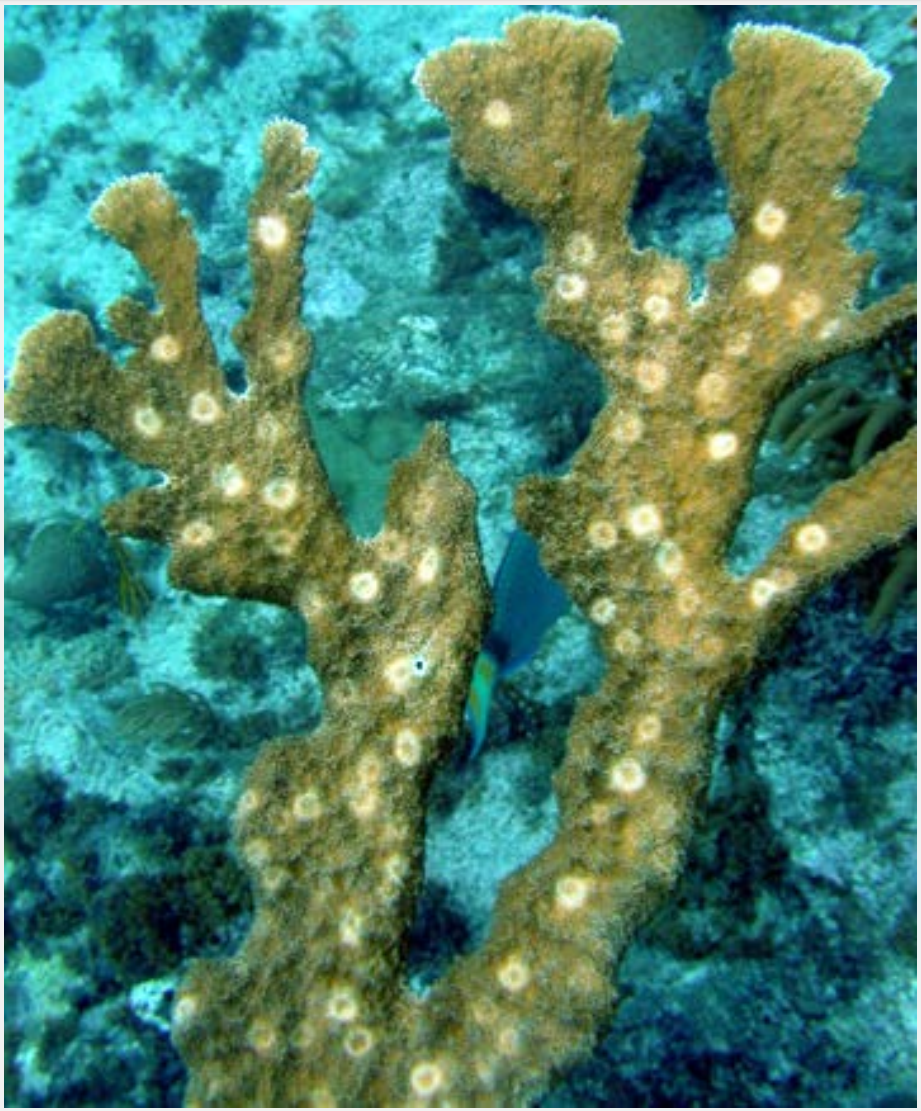


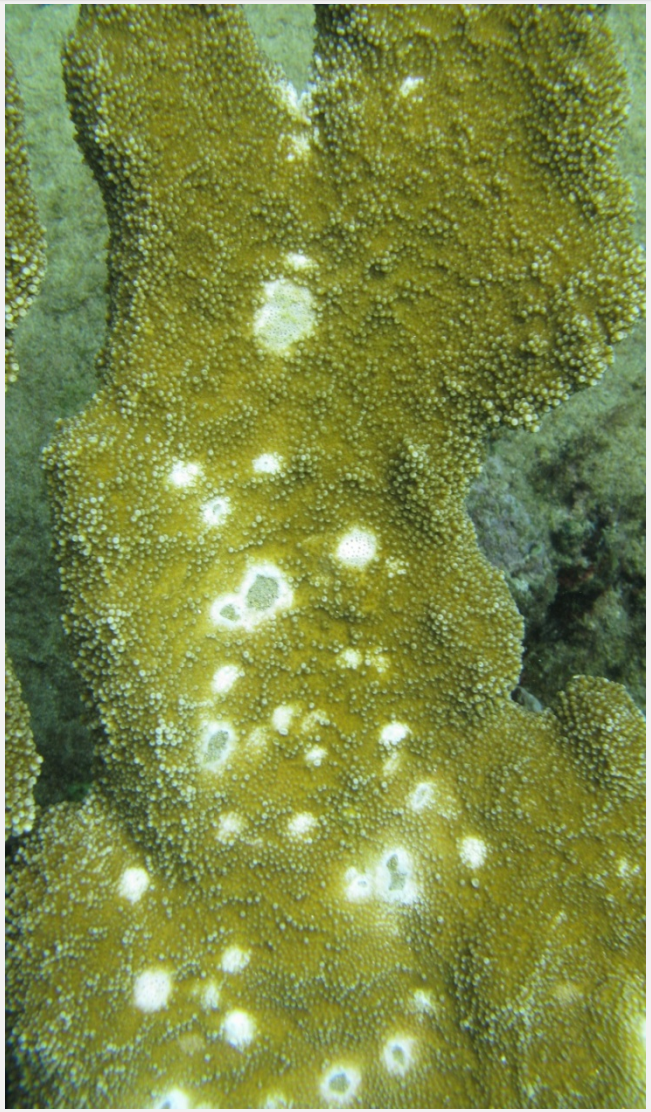






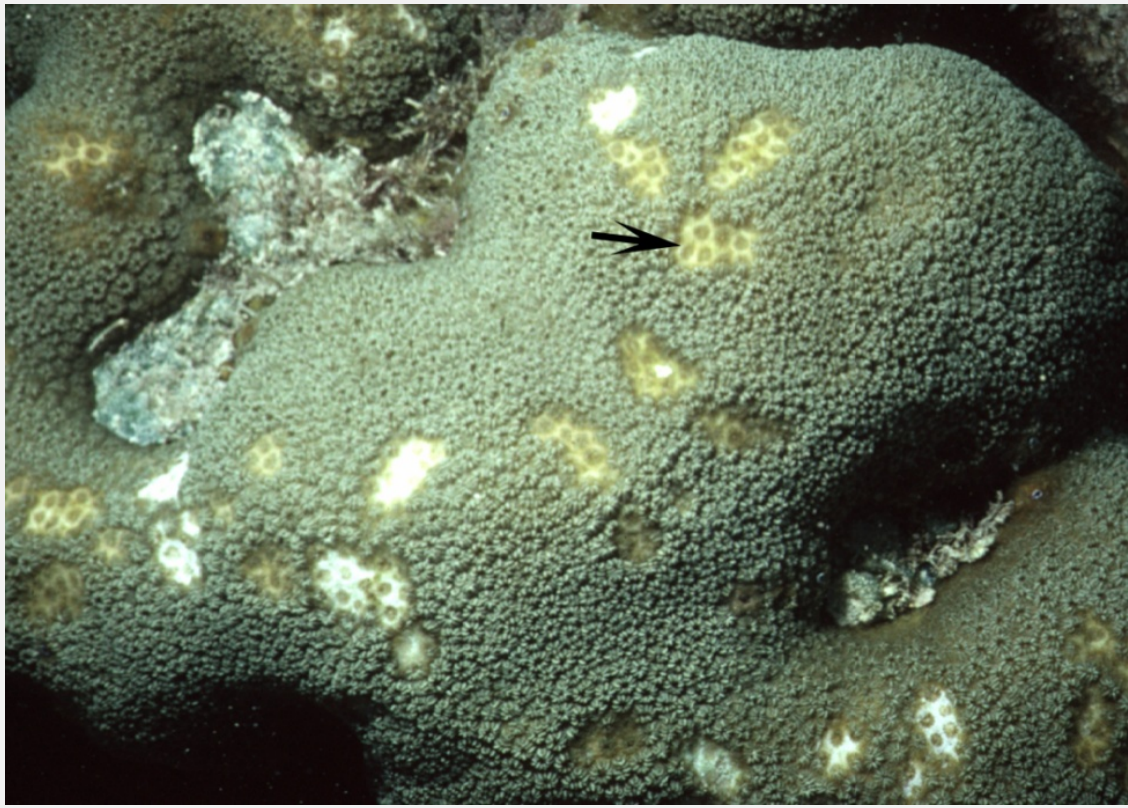
Yellowtail damselfish lesions





Parrotfish White Spot Biting (PWSB)

- one or more fish
- many species of scarids
- scraping behavior
- tissue regenerates in weeks
- fish return repeatedly



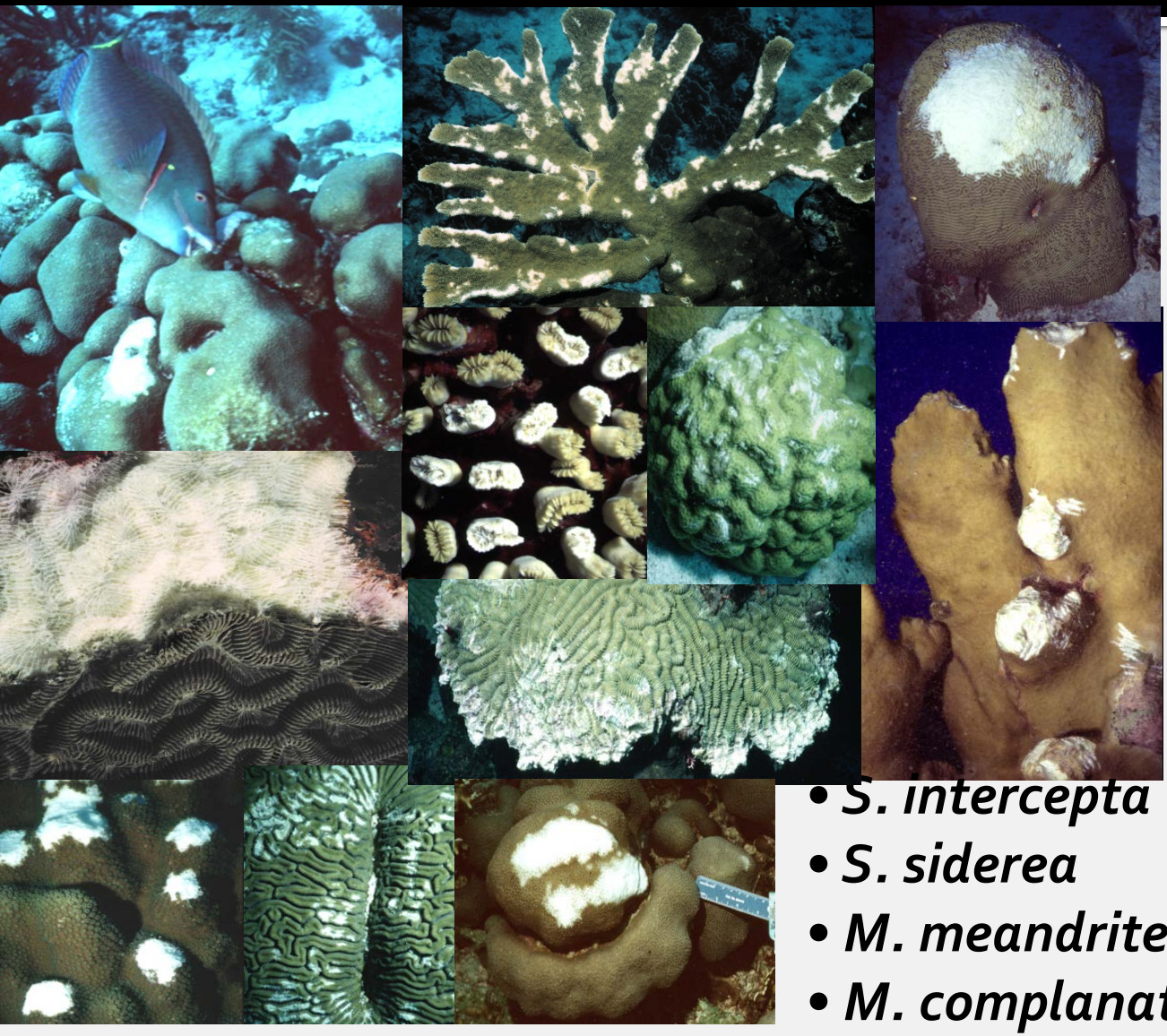
Spot biting

Parrotfish White Spot Biting (PWSB)

- one or more fish
- only *Sparisoma viride*
- excavating behavior
- tissue often regenerates
- fish return repeatedly

Focused biting

Coral prey of *Sparisoma viride*

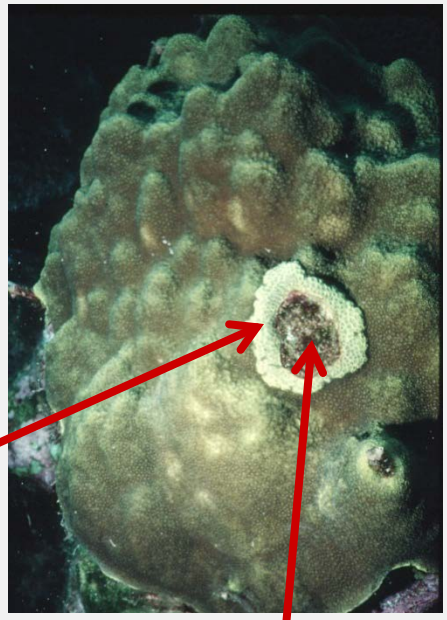


- *S. intercepta*
- *S. siderea*
- *M. meandrites*
- *M. complanata*
- *M. annularis*
- *M. faveolata*
- *M. franksi*
- *M. cavernosa*
- *C. natans*
- *D. strigosa*
- *D. labyrinthiformis*
- *P. porites*
- *P. astreoides*
- *M. mirabilis*
- *M. decactis*
- *A. palmata*
- *E. fastigiata*
- *A. agaricites*

Field Diagnosis

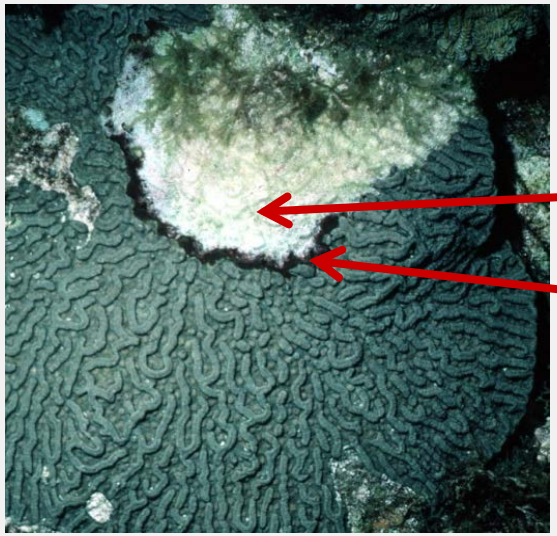
Step 3: Characterize the type of lesion

- Tissue loss
- Discolored (lighter/darker) tissue
- Presence of pigmented material overlying tissue at/near lesion border
- Unusual pattern of growth



Growth anomaly (lighter tissue)

Old tissue loss



Recent tissue loss

Pigmented band

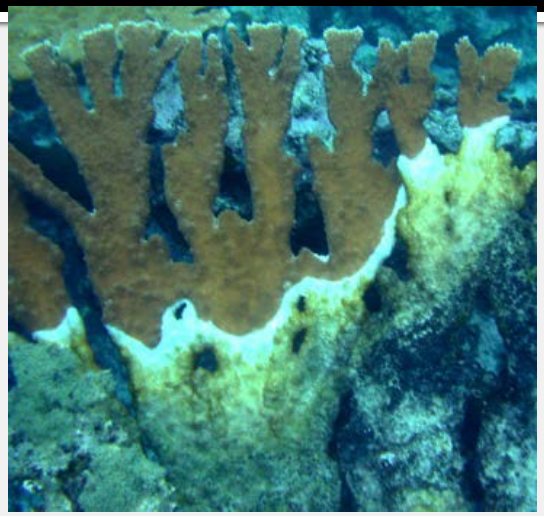
A coral may exhibit multiple signs

Field Diagnosis

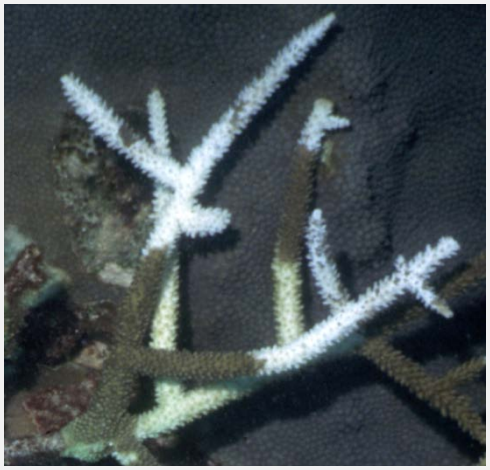
Step 4: Characterize the lesion

- Lesion location
  - Colony margin: base, side, top, branch tips
  - Within colony: central, medial
- Lesion distribution/shape
  - linear, annular, focal, multifocal, coalescing, diffuse
- Lesion margin: shape, thickness, border
- Lesion color and relief: smooth, protruding, deformed
- Rate of progression: rapid, moderate, slow

Lesion location

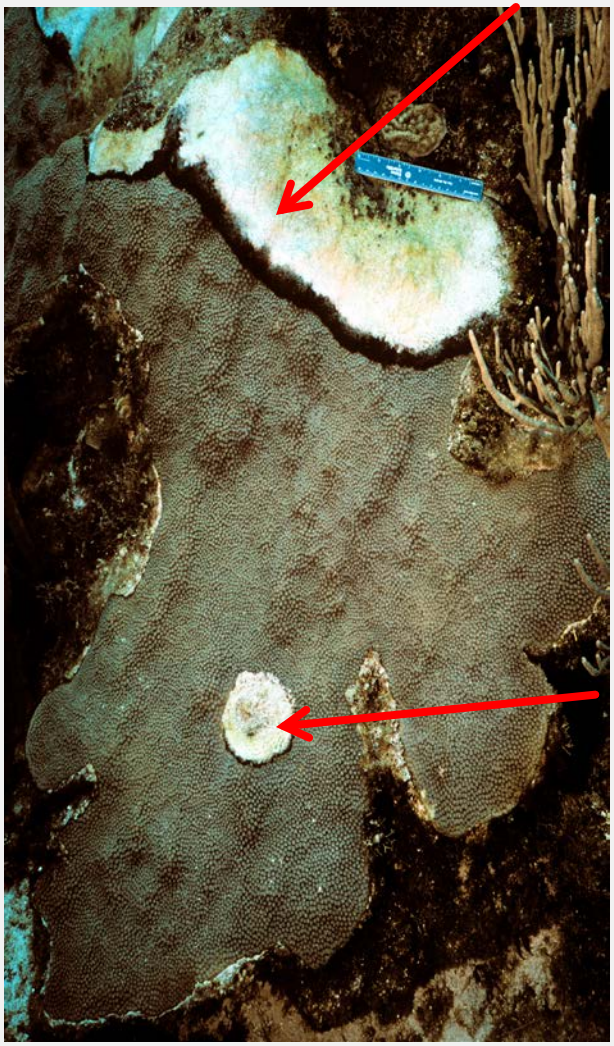


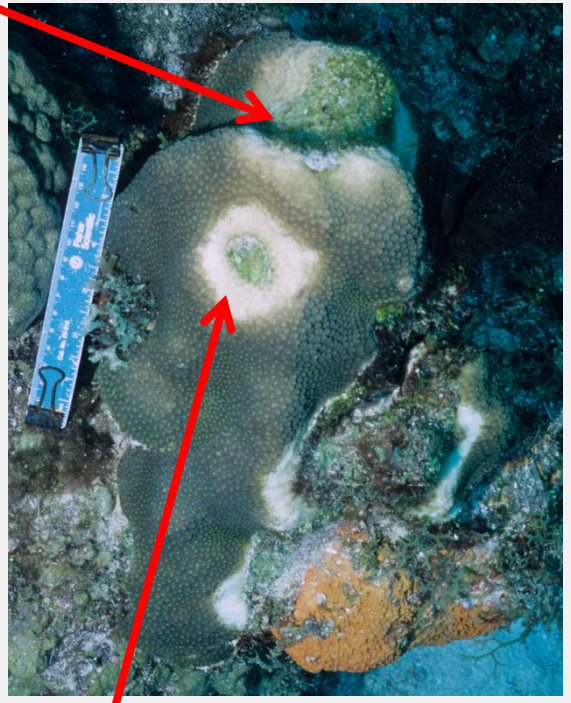
basal, spreading up



apical, spreading down

top, spreading down

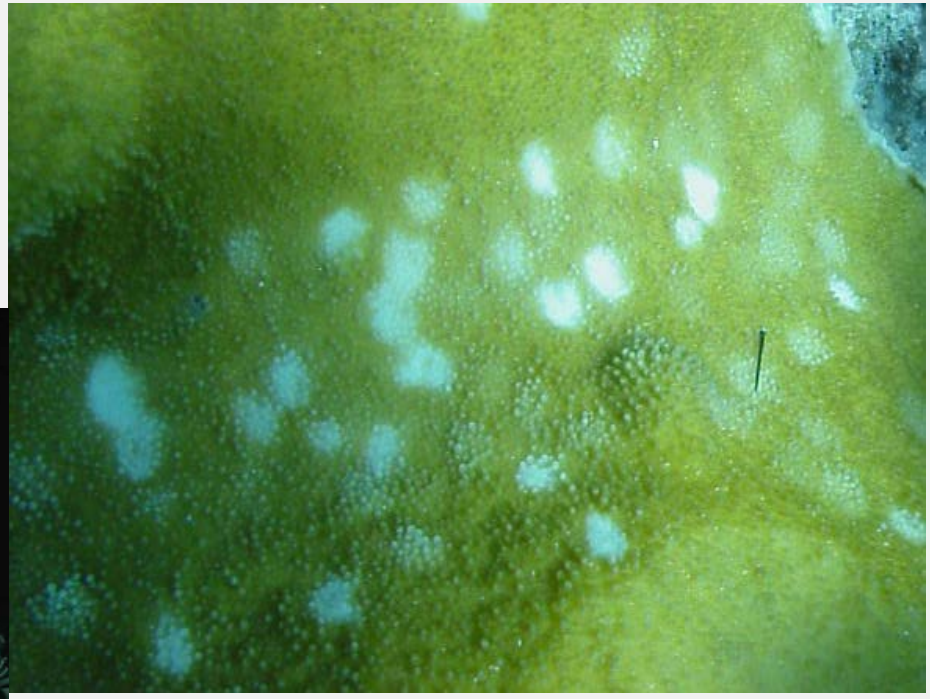




central, radiating out

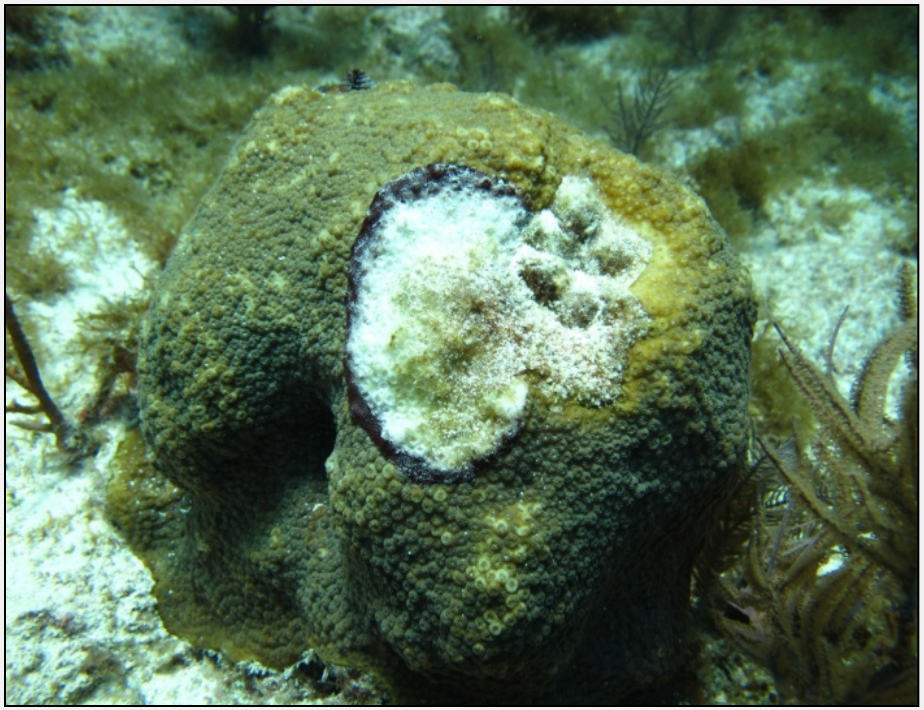
Lesion distribution & shape

Linear/annular

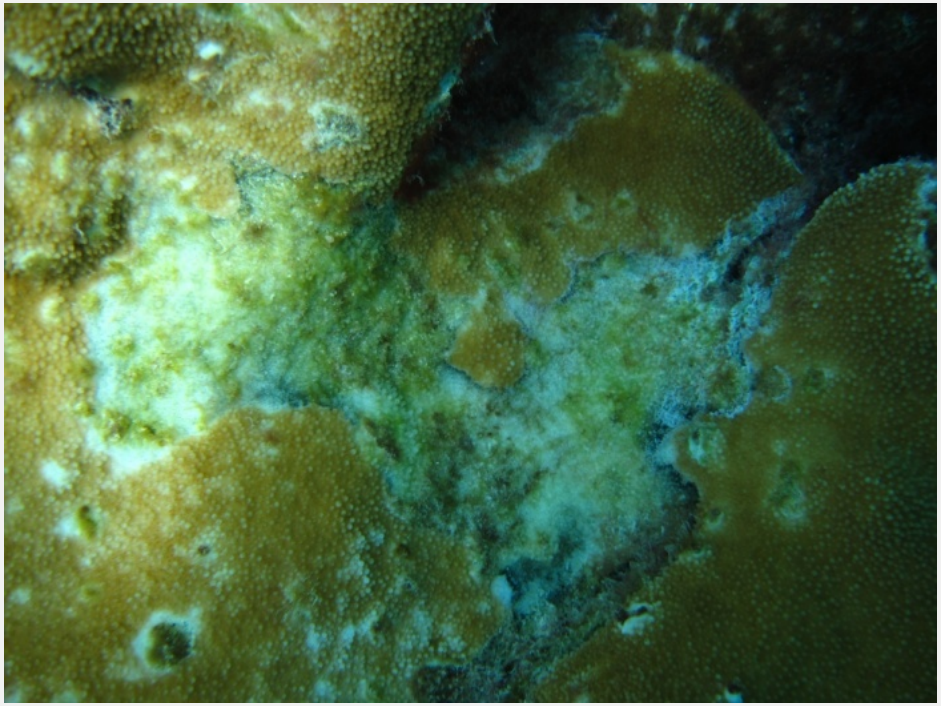


Multifocal-coalescing

Lesion distribution

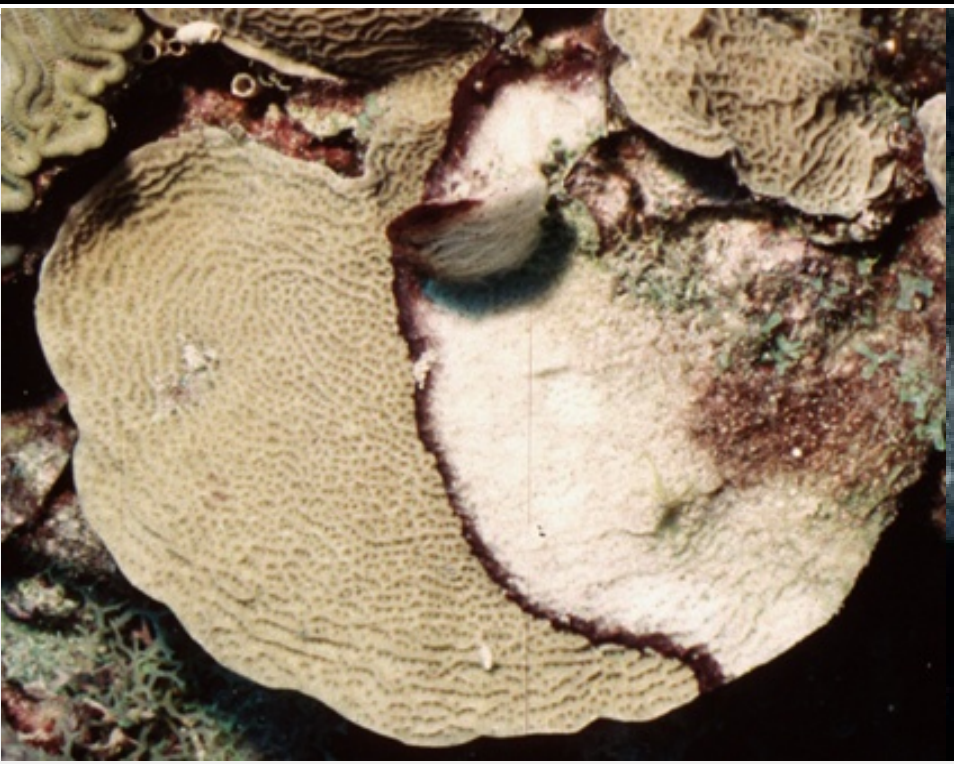


Focal



Diffuse

Lesion margin



Linear discrete

Shape: linear, annular, irregular
Border: discrete, diffuse
Thickness: (measure dimensions)
Color: (describe color)

Annular

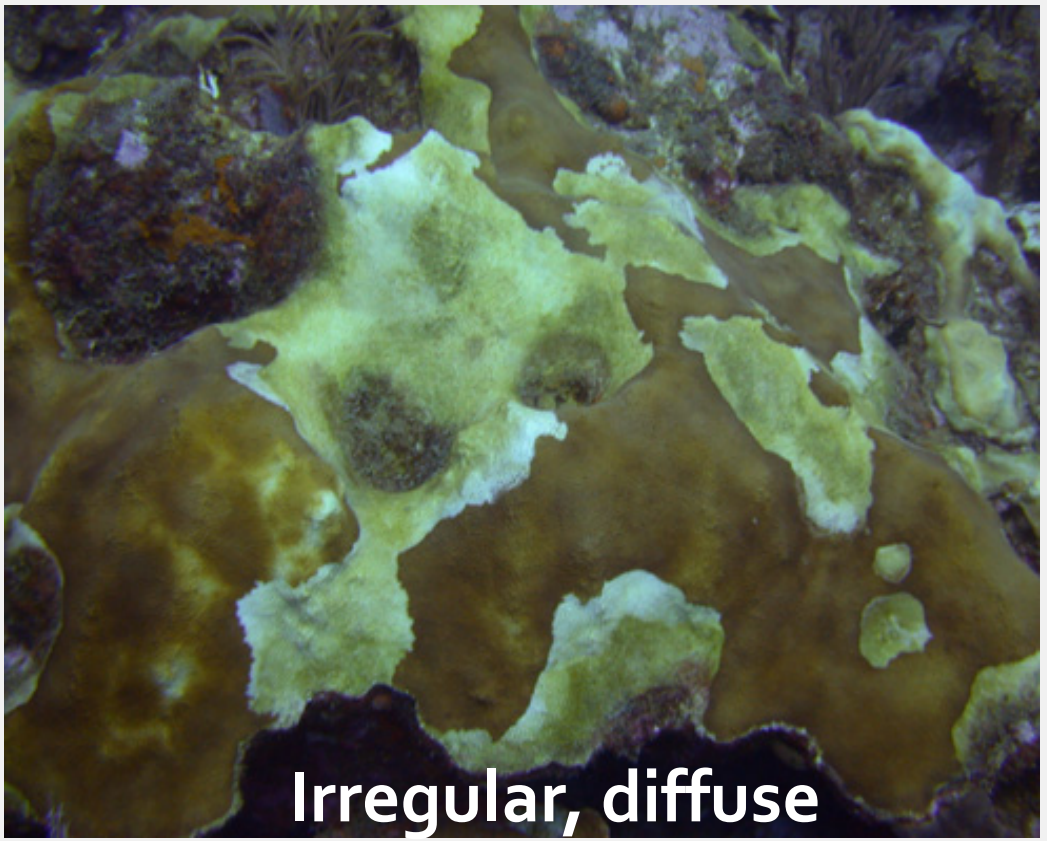
Lesion margin

Shape: linear, annular, irregular

Thickness: (measure dimensions)

Color: (describe color)

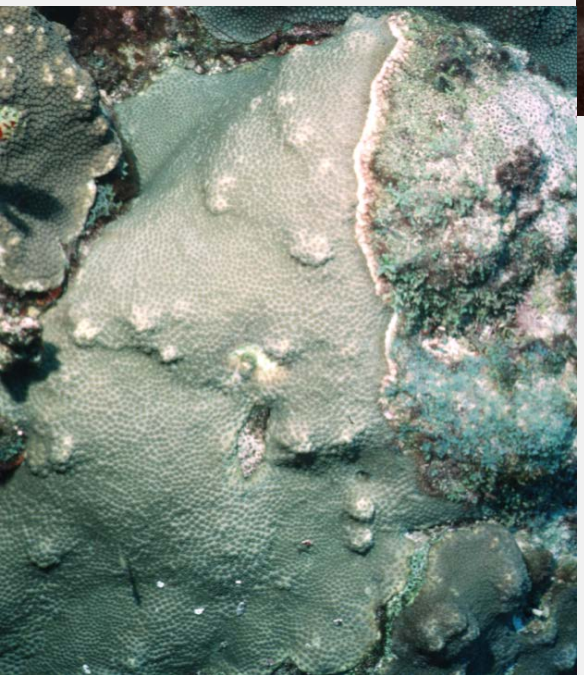
Border: discrete, diffuse



Lesion severity

mild

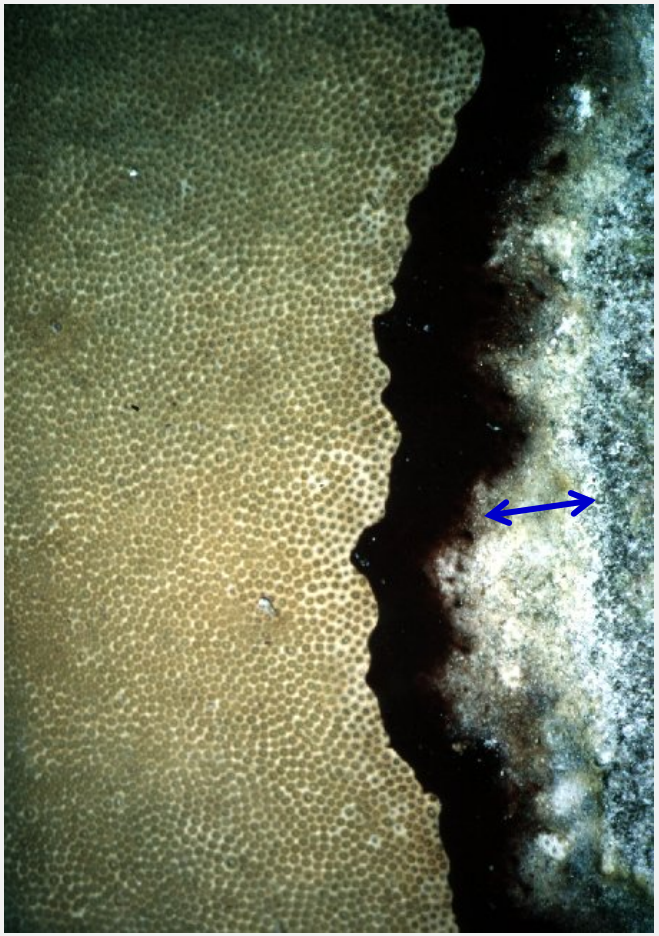
moderate



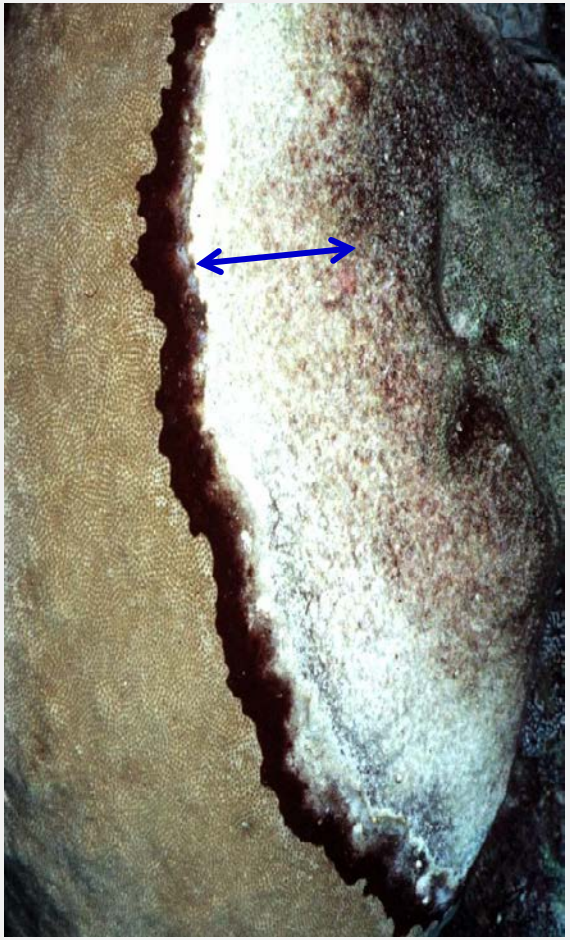
severe

Rate of Progression

Slow (chronic)

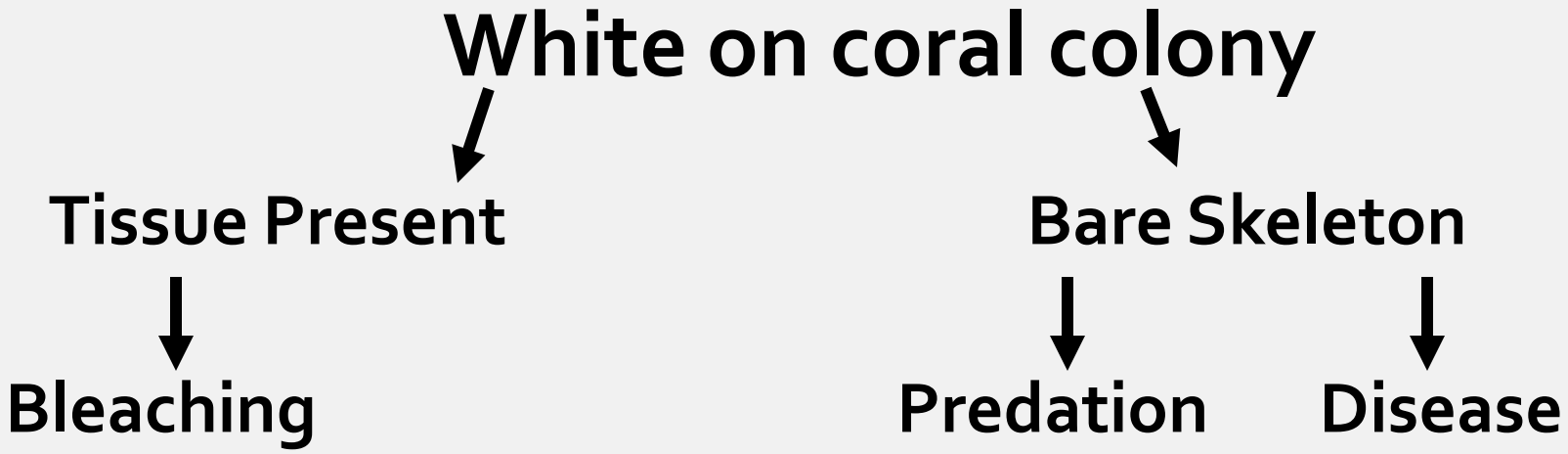


Moderate (subacute)



Rapid (acute)

Tissue loss:



Features to look for:

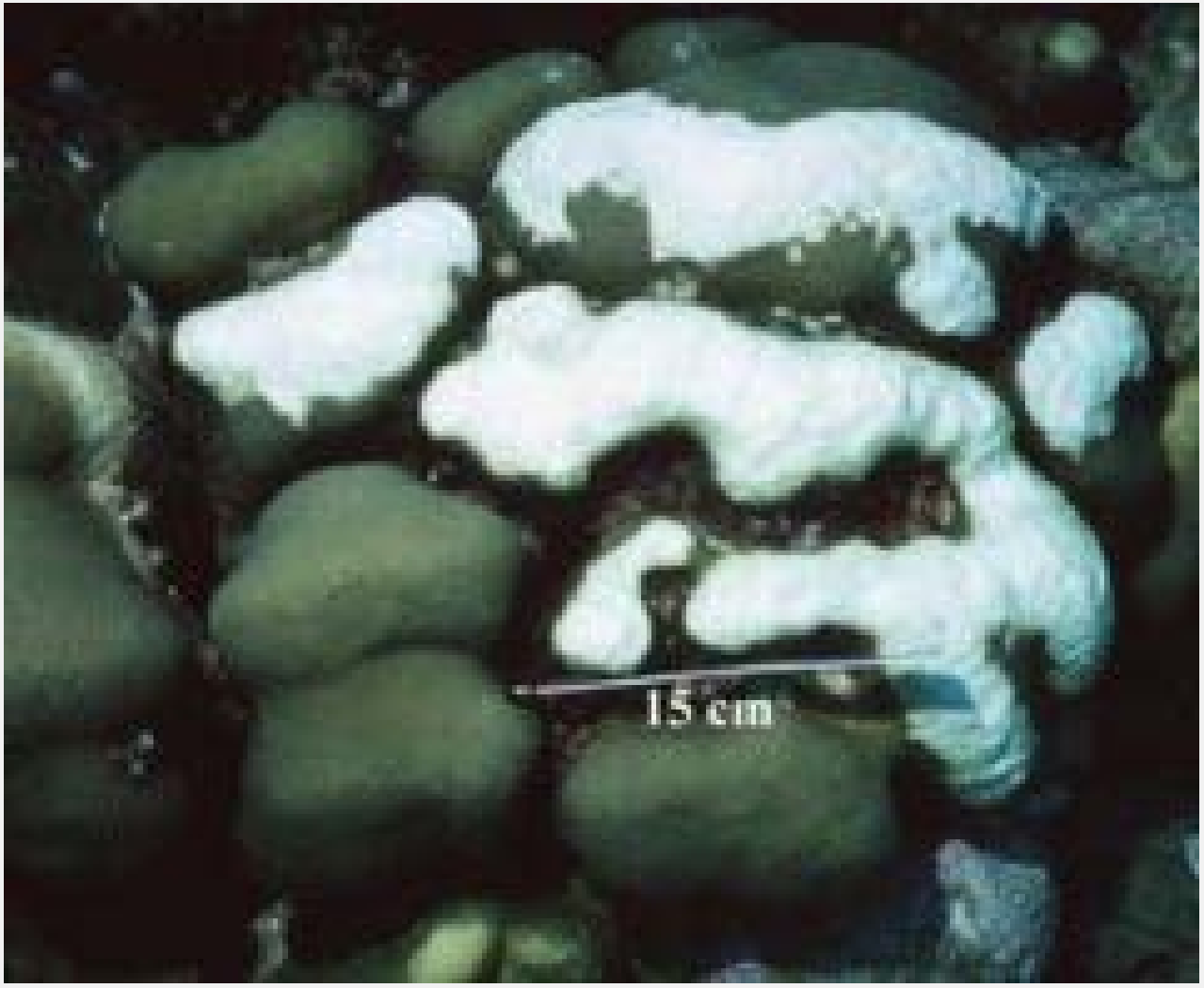
- Skeletal damage
- Predator present?
- Pattern of tissue loss
- Rate of tissue loss
- Presence of loose tissue

Tissue loss:

bleaching

Tissue loss:

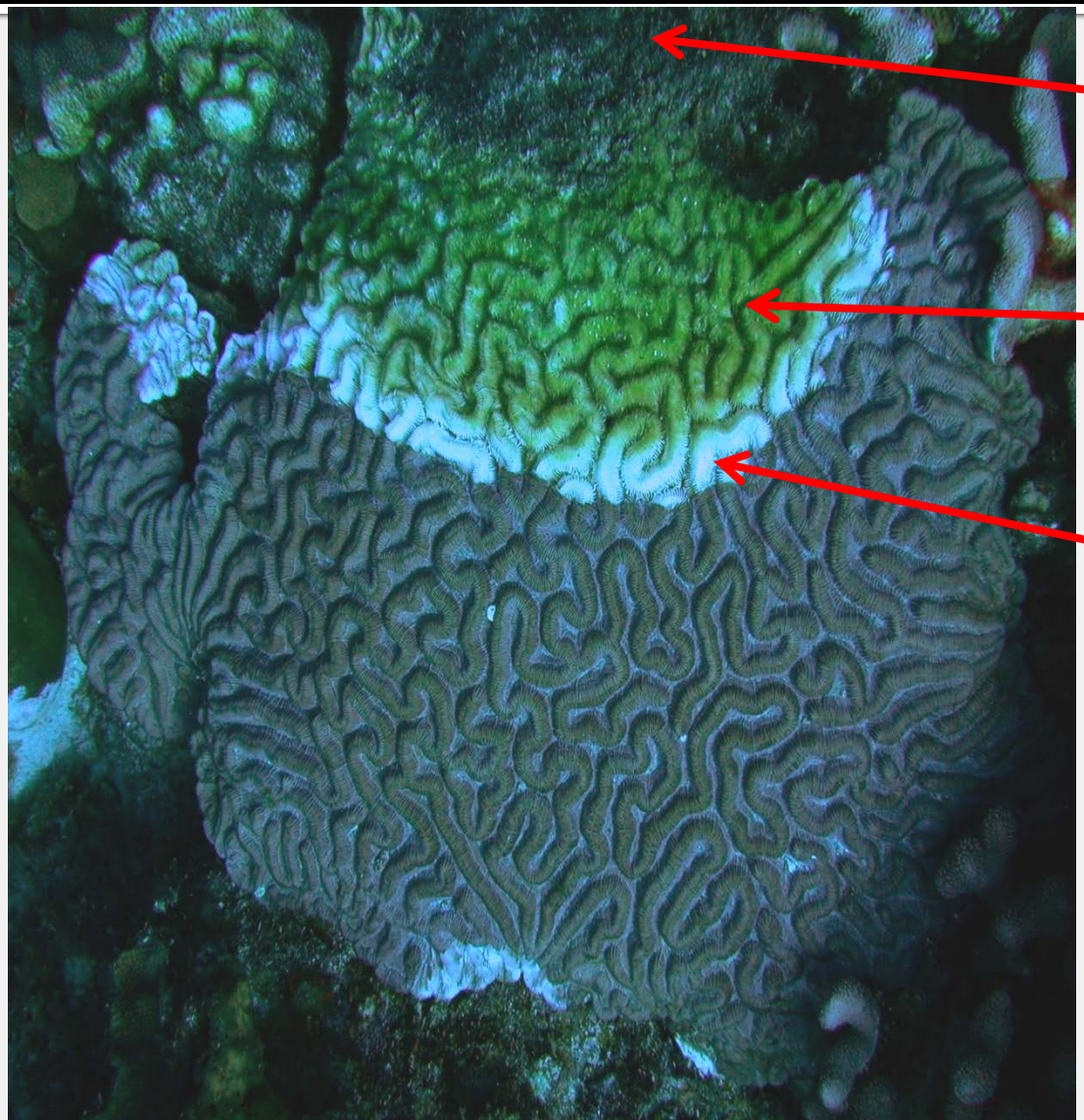
predation



Tissue loss:

disease

Tissue Loss



Tissue Loss

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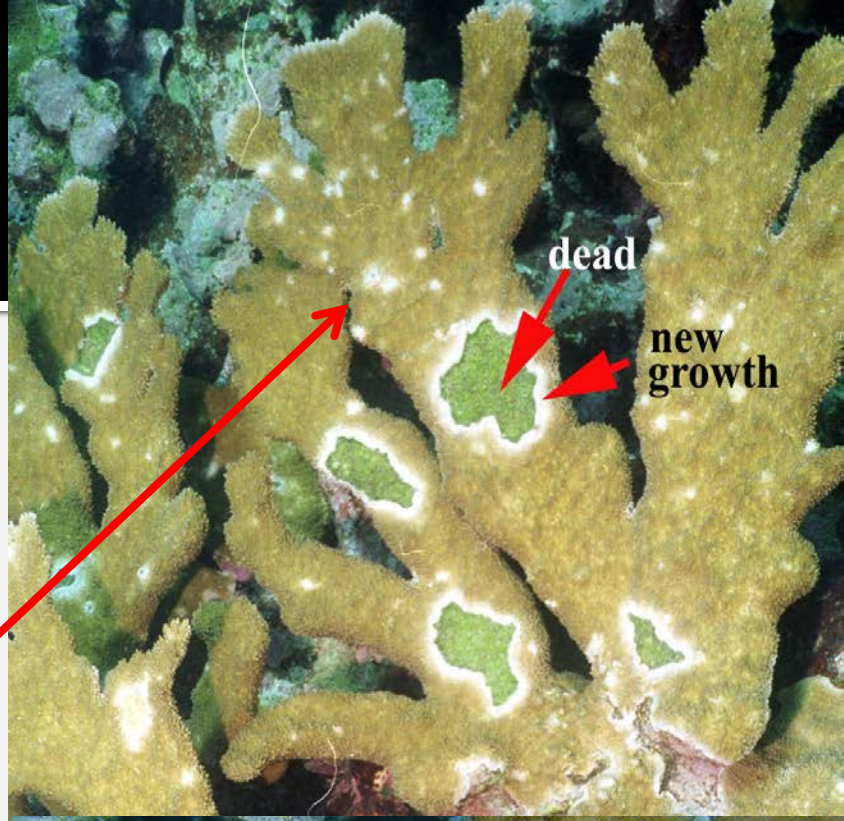
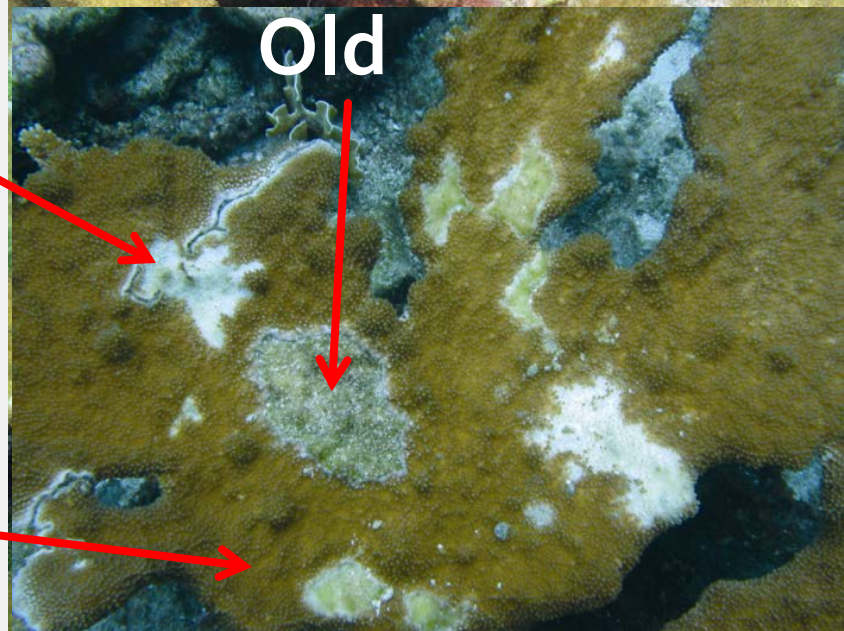


Recent

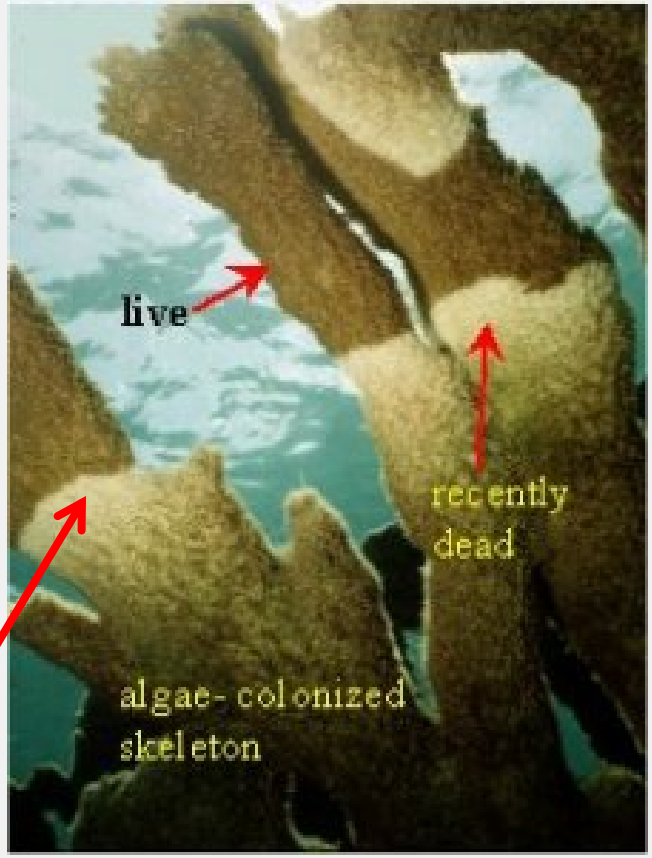


Transitional

White syndromes

- Distinctive white annular or linear band (~1-5 cm), focal, multifocal or coalescing lesions within colony, or diffuse pattern of tissue loss.
- Recently denuded (white) skeleton adjacent to live tissue; white area may separate areas of older mortality, colonized by filamentous algae and other epibionts
- No distinctive pigmented band, no tissue discoloration, no unusual patterns of growth
- No skeletal damage

White syndromes



Includes:

White band disease

White plague

White patch disease

Ulcerative white spots

Caribbean white syndromes

White band disease

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Only reported in *Acropora*

- Linear, discrete band of acute tissue loss, 1-10 cm wide
- May circumscribe the branch; or occur only on top or underside
- Tissue fragments and sloughing may be visible at margin
- Band often separates live tissue & exposed skeleton colonized by epibionts
- Snails, fireworm predators often colonize disease front

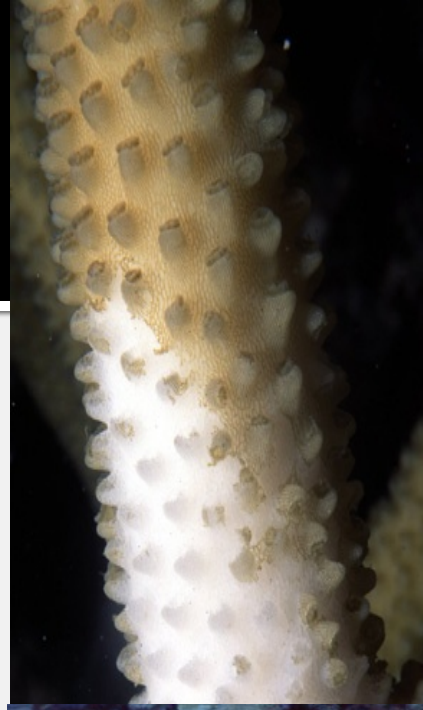
White band disease

WBD-I: develops in basal regions and progresses to branch tips

WBD-II: starts at base, where branch furcates, or at tips; spreads up or down; death preceded by band of bleached tissue

Similar signs: PREDATION by fireworms and snails

Tissue loss: 5 mm/day; max = 2 cm/day

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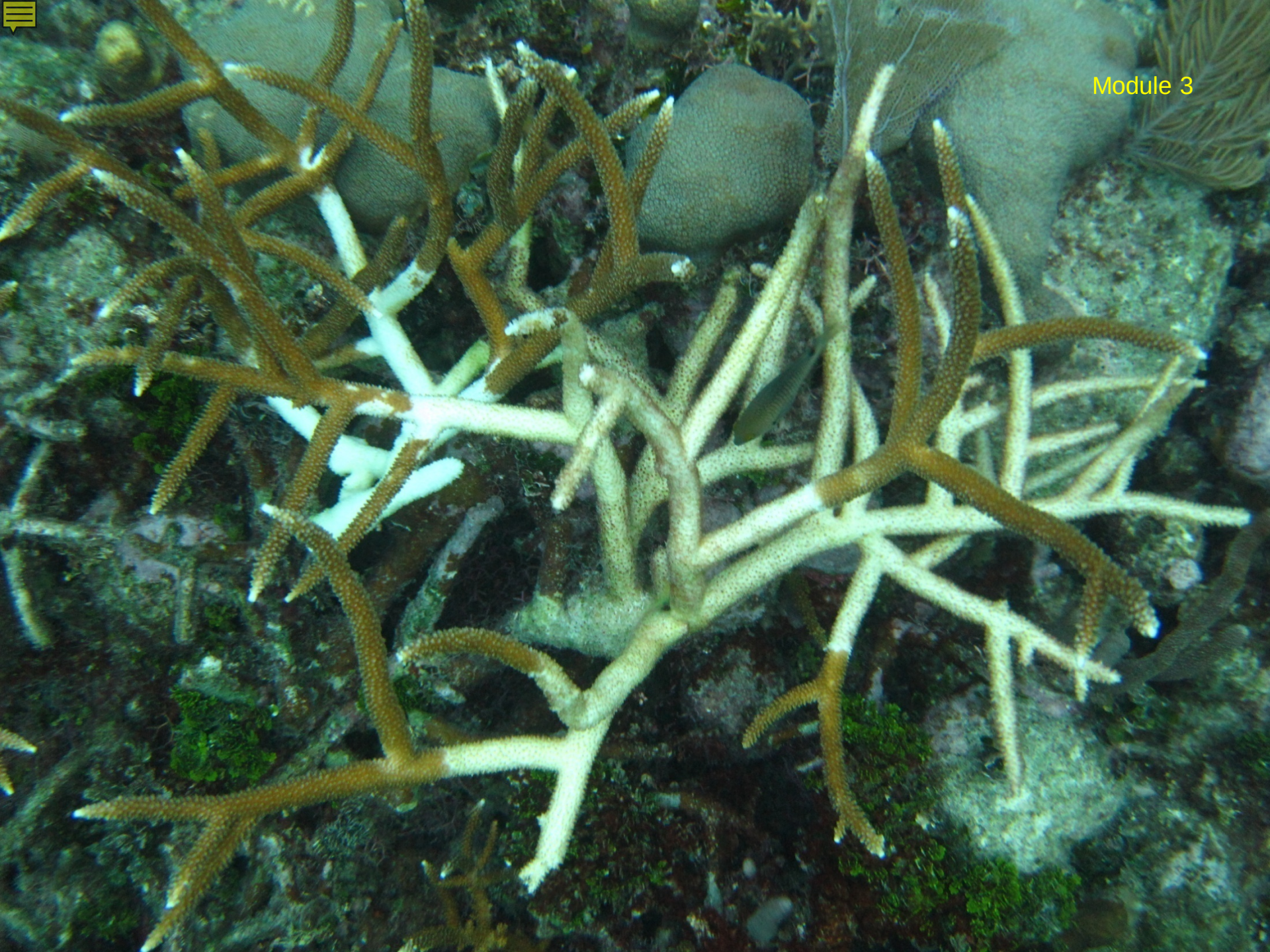
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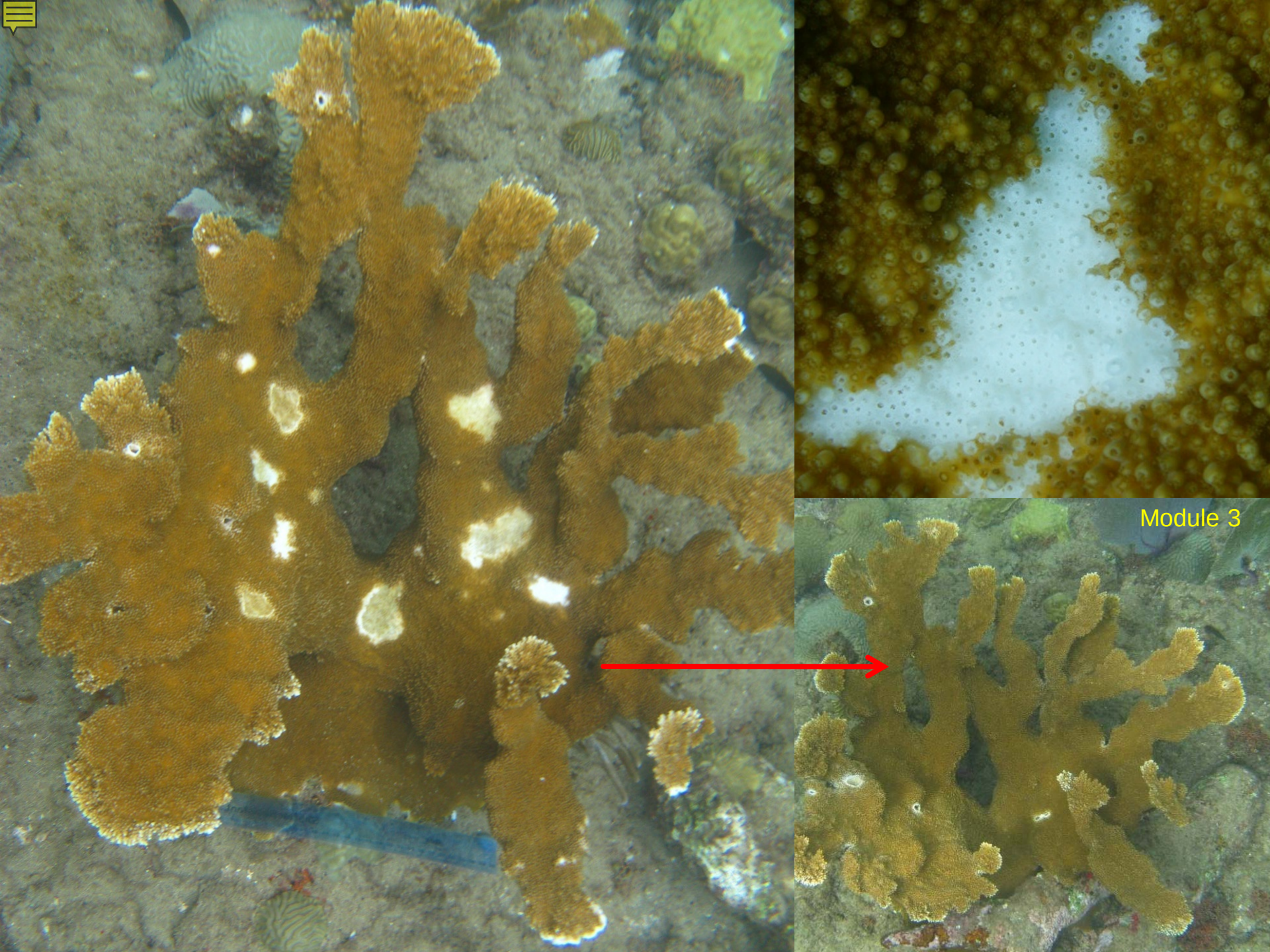
White patch disease

- Reported as *White Pox* (Florida, 1996); similar conditions (*Patchy Necrosis*, *Necrotic Patch Syndrome*) Caribbean wide; may be confused with signs of predation
- Focal/multifocal, irregular-shaped white patches of recently exposed skeleton; may develop simultaneously on all surfaces
- 1-80 cm diameter, sharply demarcated leading edge
- Tissue remnants present within lesion; corallites often eroded
- Colonies often exhibit recent, older and regenerating lesions simultaneously; lesions may coalesce
- Lesions expand outward on average 2.5 cm^2/day
- may become quiescent and recrudescent
- Abraded corallites may be present
- Lesions may show regrowth of tissue
- Lesions also may become colonized by epibionts

Reported in *A. palmata*; similar signs in other corals

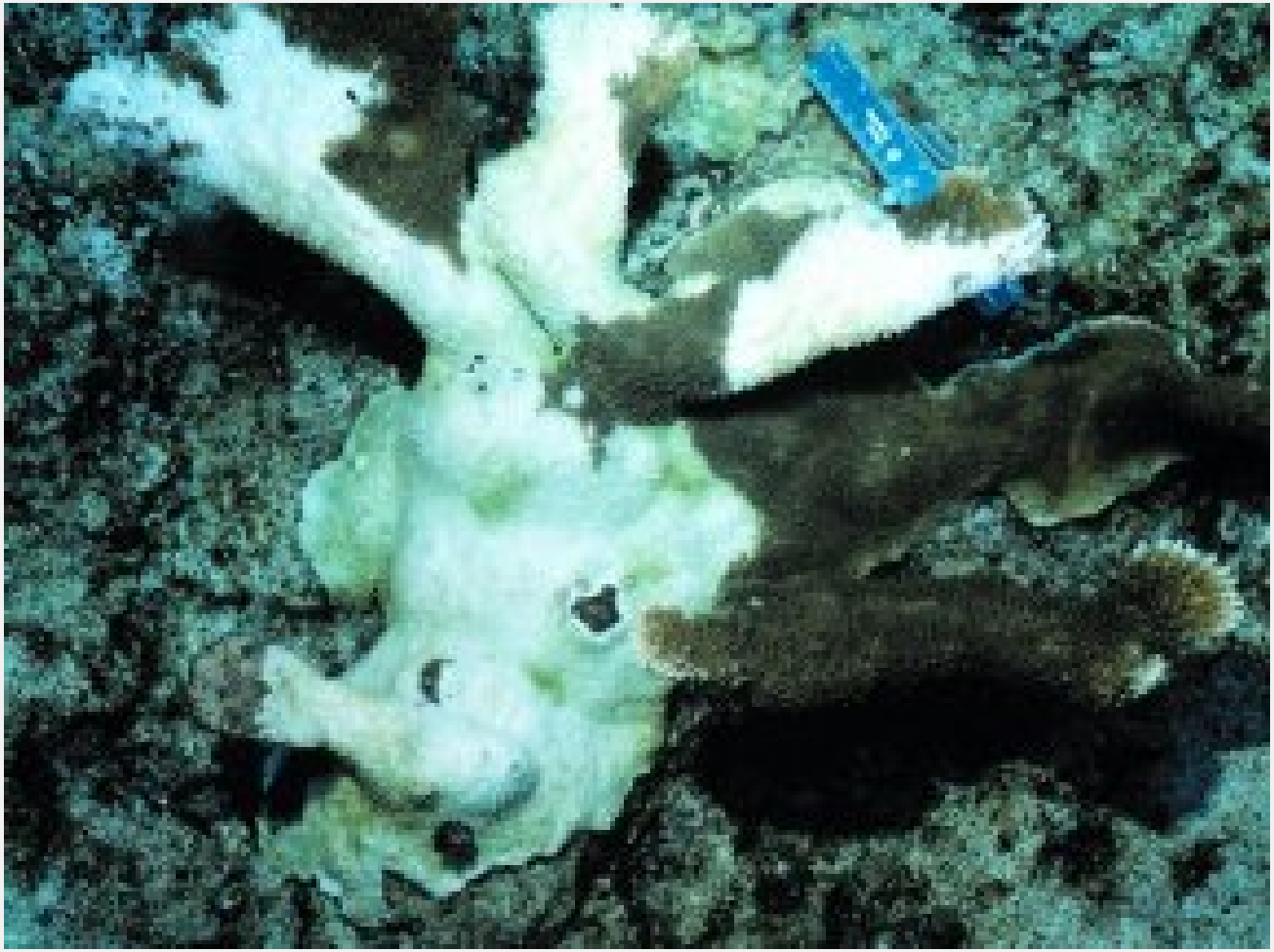

Module 3

Caribbean white syndromes

Many conditions on *Acropora* do not fit classic WBD/WPD signs

Rapid tissue loss of most of coral within days

Caribbean white syndromes

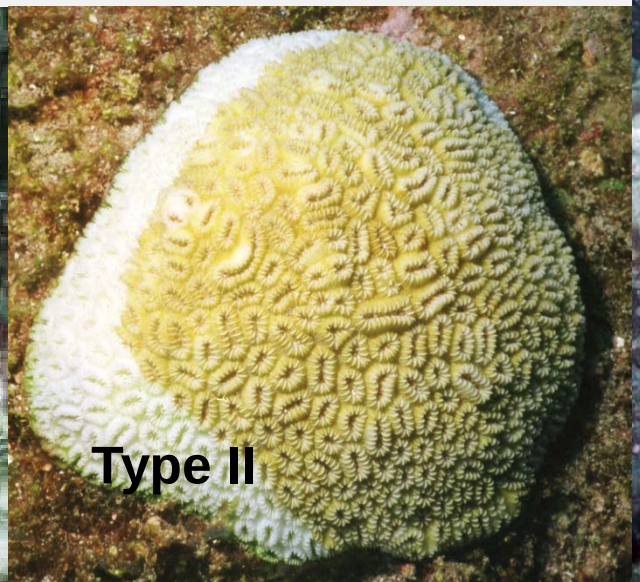


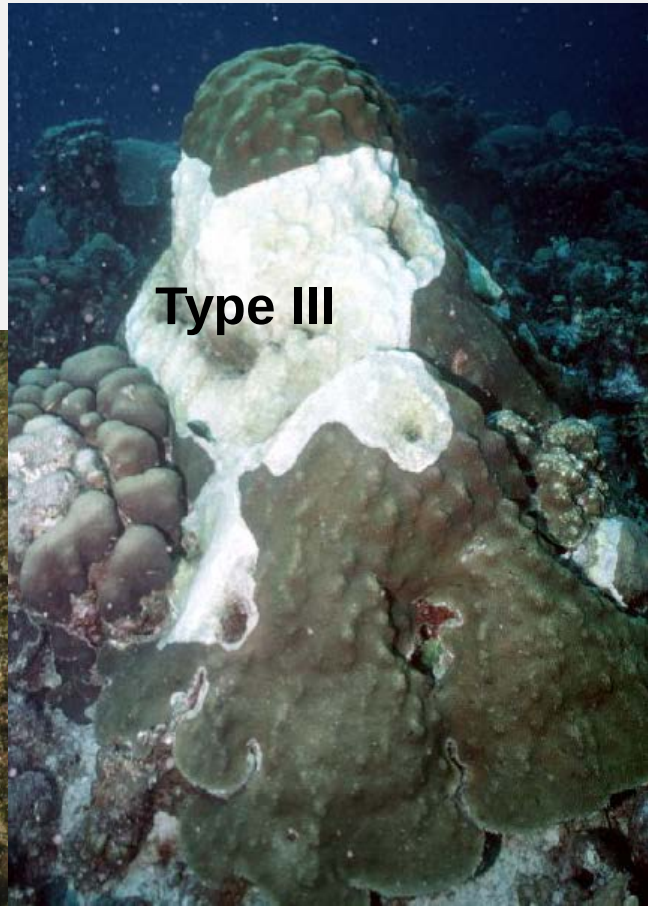
Irregular patterns of tissue loss with no distinct band or focal, multifocal lesions

Yellowtail damselfish lesions

White Plague

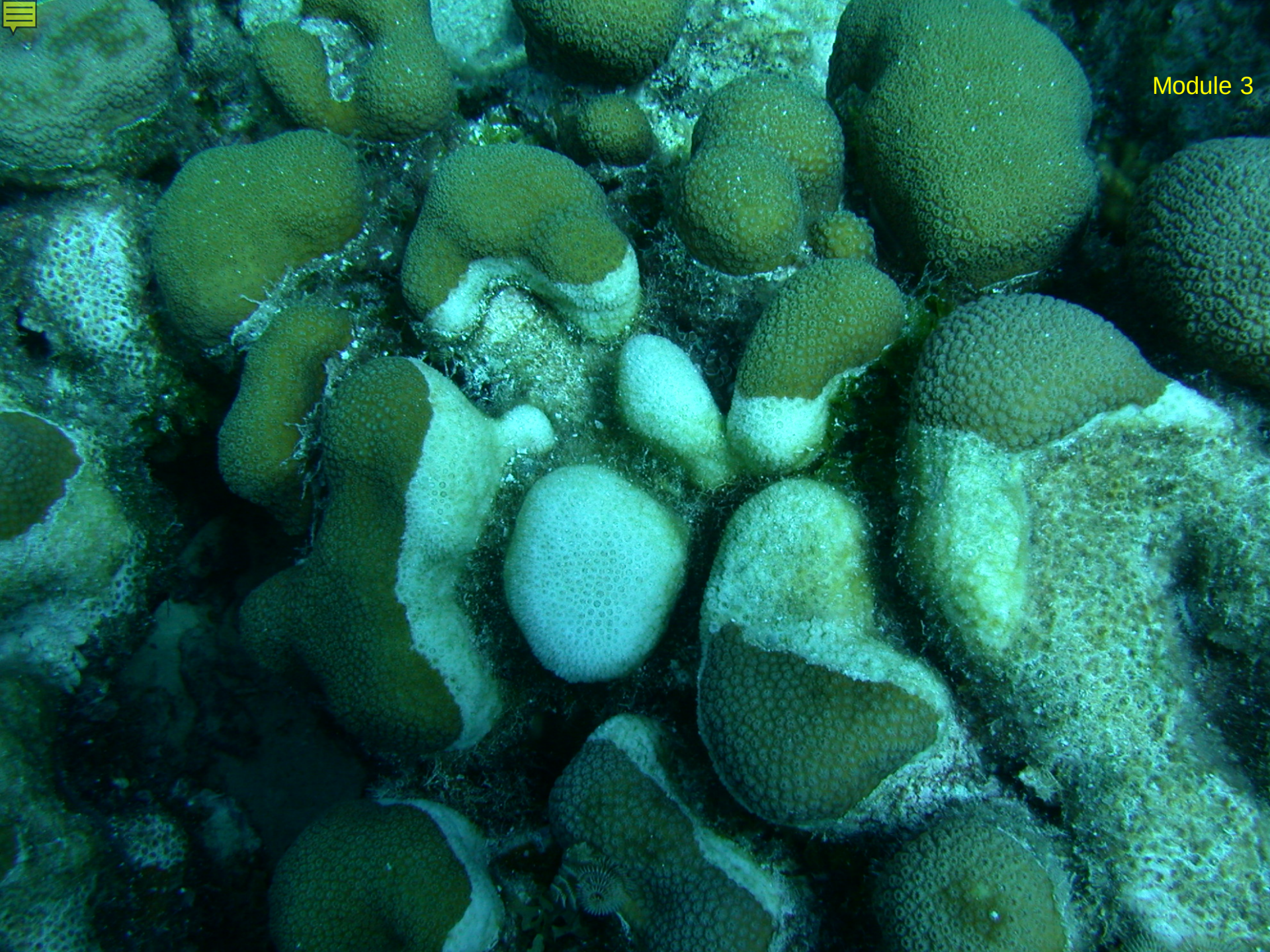
- 41 species of massive and plating corals; not *Acropora*
- Separated into Type I, II and III based on rate and patterns of spread and species affected





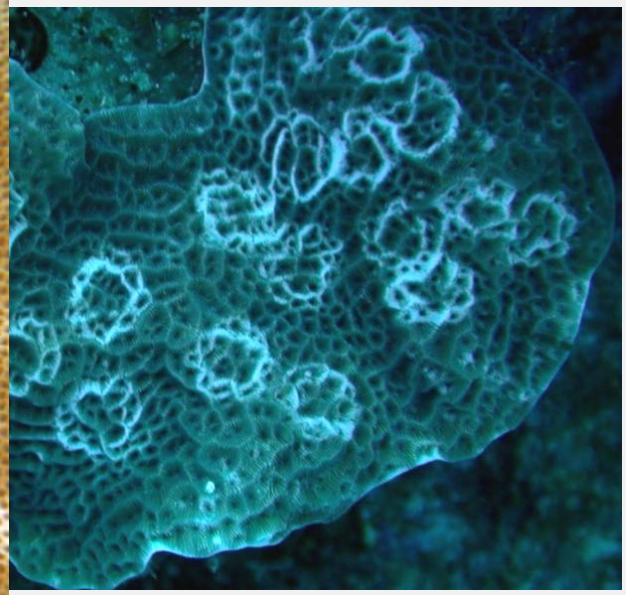
White plague

- Discrete band of bare skeleton adjacent to live tissue & successional algal growth on skeleton
- Lesions usually start at the edge/base/margin of a coral & progressively radiate outward in a linear or annular manner
- Lesions also focal, or multifocal to coalescing & may emanate from algal patch within colony surface
- Different parts of band may advance at varying rates; lesion margin may have bleached front
- Sharp demarcation between normal tissue and bare skeleton; no visible pigmented band


Module 3

Ulcerative white spots

- Most common in *A. palmata*, *Millepora*, massive *Porites*
- Previously described as "white pox" & ring bleaching



Ulcerative white spots

- Focal to multifocal, circular white spots <1-3 cm diameter
- Lesions may be bleached or devoid of tissue
- Lesions have discrete margin
- Lesions may coalesce, become colonized by algae, or heal
- Lesions may be associated with fish bites (but not excavating parrotfish):
  - May have some damaged corallites
  - Underlying skeleton is intact and fish jaws marks not visible

Tissue Discoloration

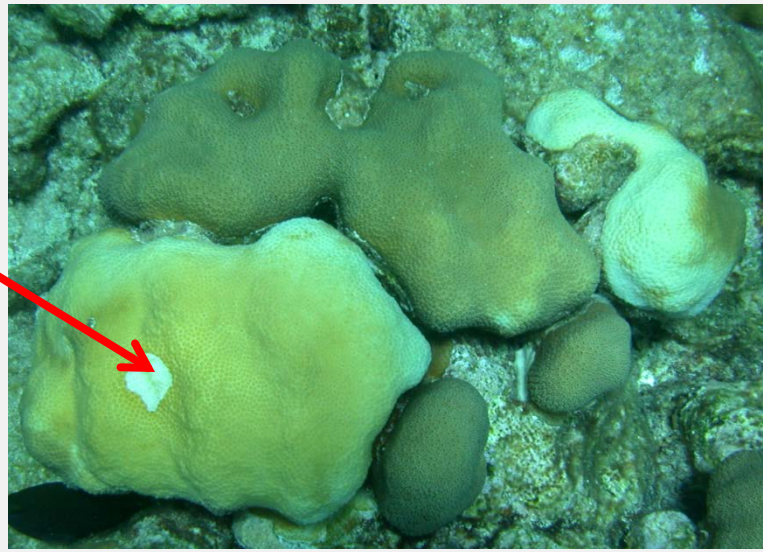
- Affected tissue may be darker, lighter or different from normal
- May be associated with tissue loss (but not necessarily)
- Patterns of discoloration focal, multifocal, annular or diffuse with annular, linear or irregular margin
- Color change may be seasonal; may disappear and reappear
- Coral surface may be altered (depressed, smaller corallites)

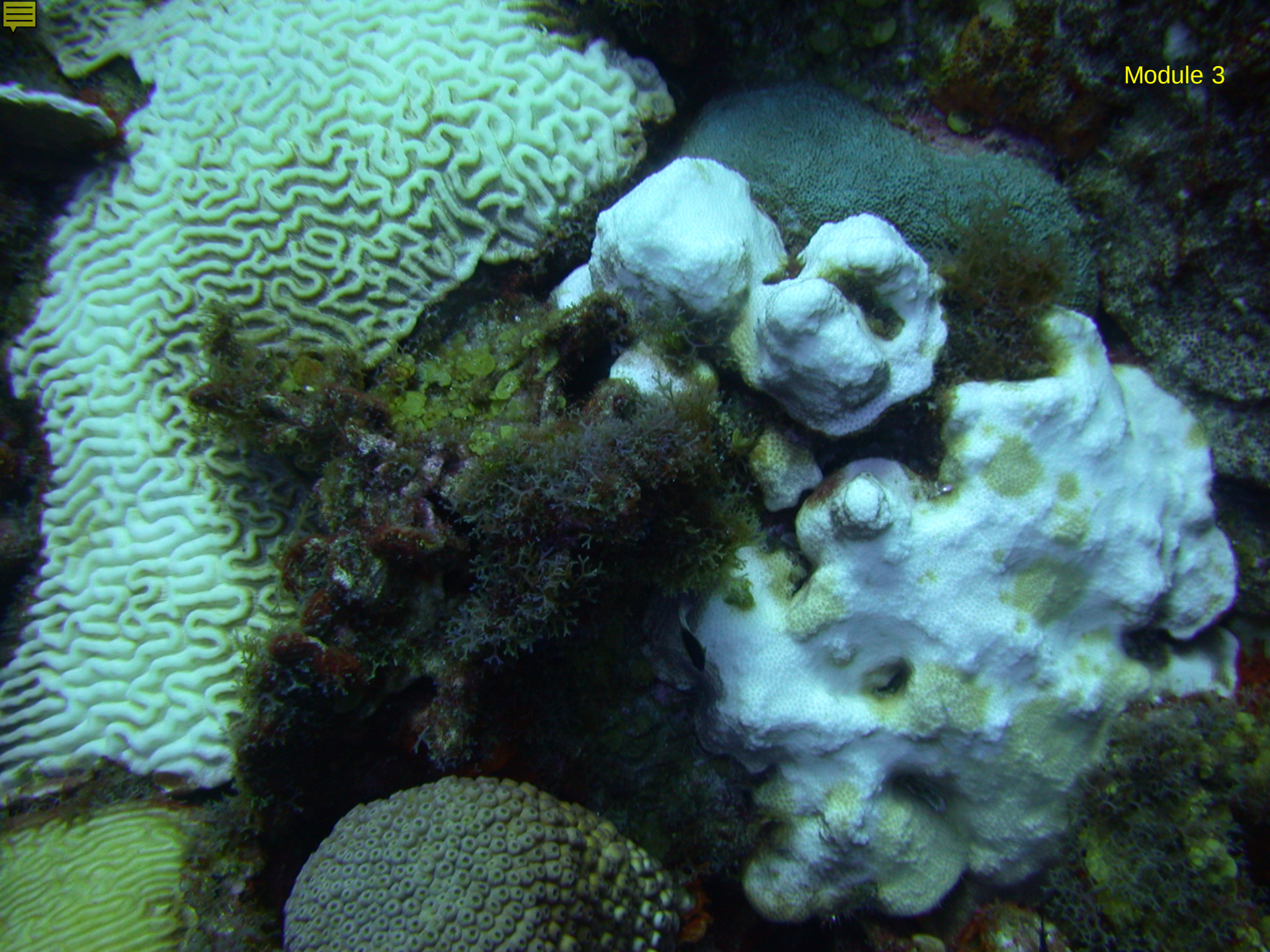
Includes:

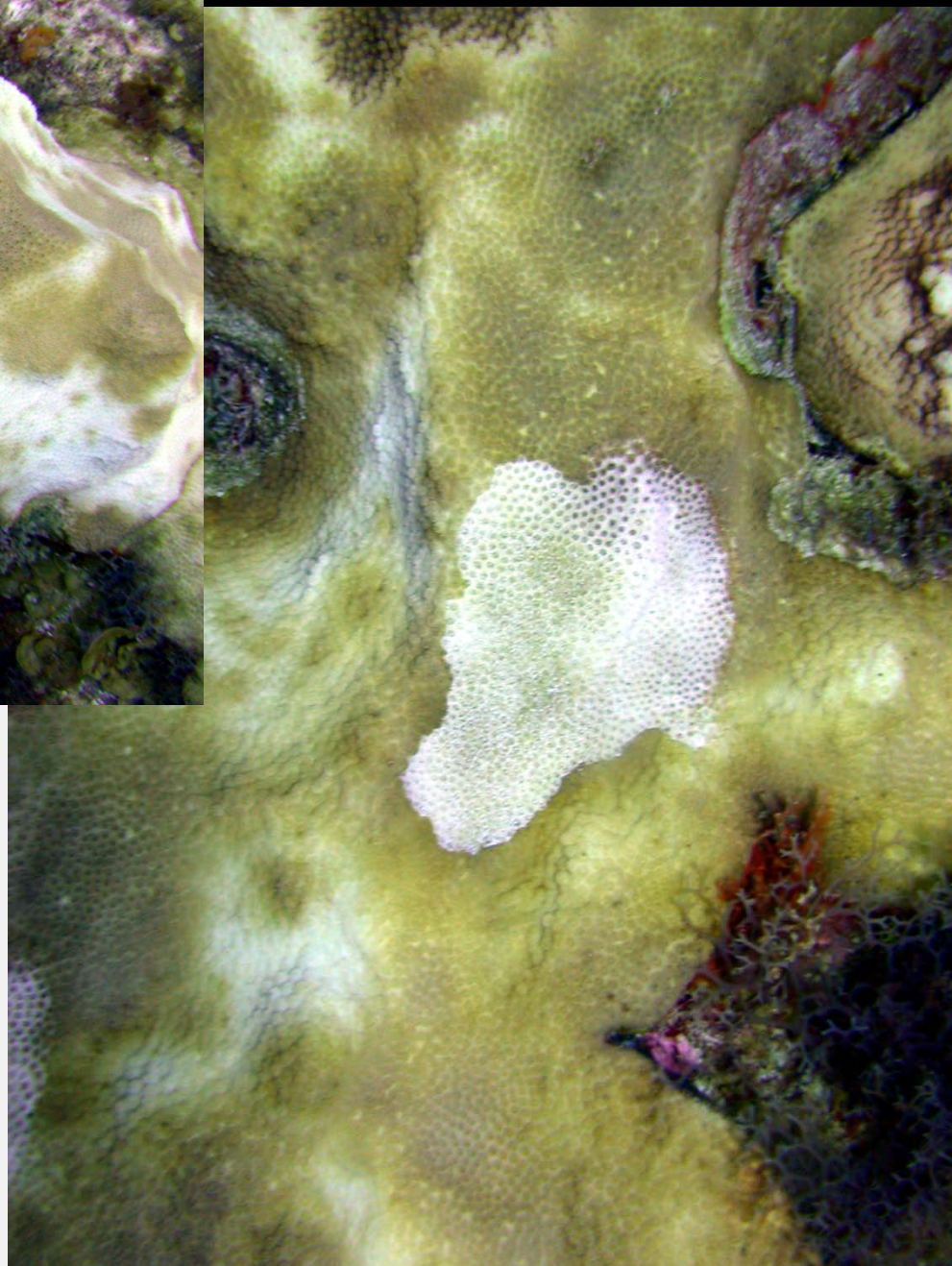
- Caribbean yellow band disease
- Dark spots disease
- Bleaching
- Pigmentation response

Bleaching

- Loss of symbiotic algae (zooxanthellae) and/or pigmentation resulting in pale to translucent tissue
- Bleached areas focal, multifocal, coalescing, diffuse or colony-wide
- Bleaching may affect base, top or medial portions or discrete patches
- Tissue is present, although bleached tissue may be associated with irregular patterns of tissue loss
- Corals may be white to pale




Module 3

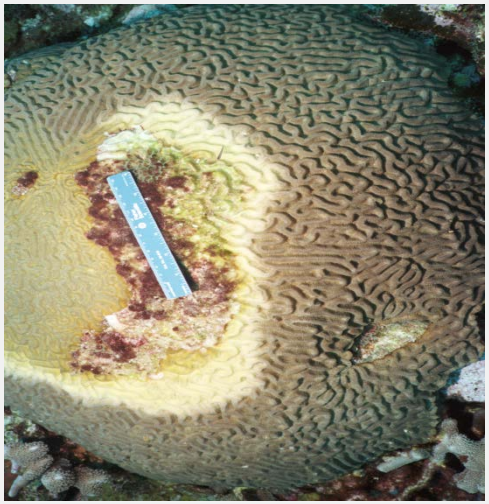


Bleaching-associated mortality

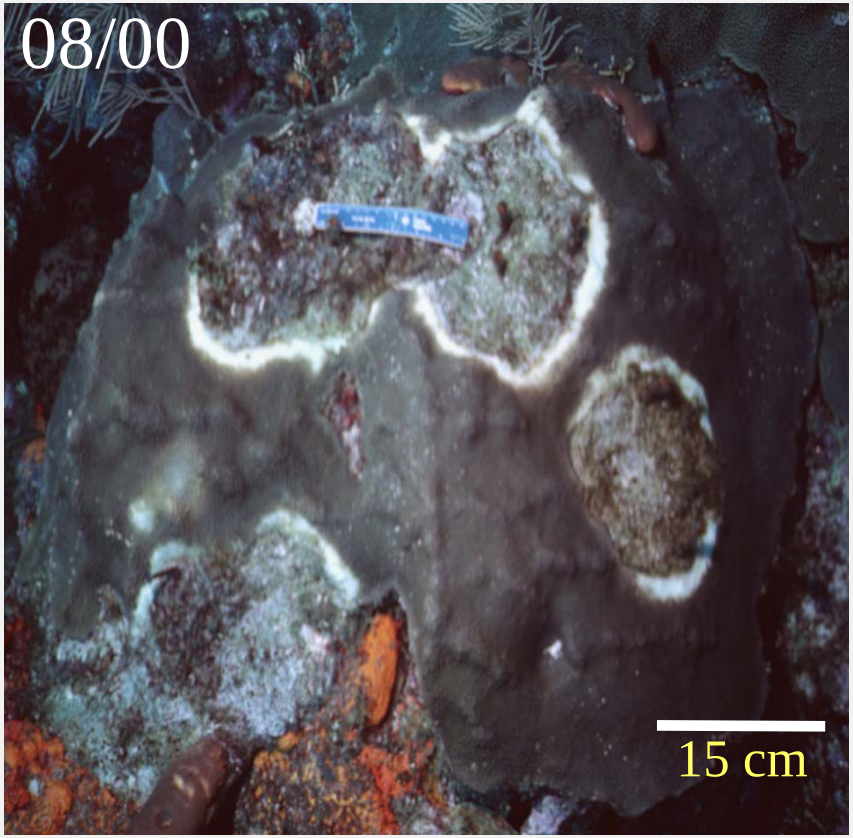
Caribbean yellow band disease

- Primarily affects *Montastraea annularis* (complex) & *M. cavernosa*, *C. natans*, other faviids
- Slow spread: 6-12 cm/yr, but:

- YBD appears in multiple locations
- Lesions coalesce & continue spreading
- Long duration: 3-12 years or until coral dies



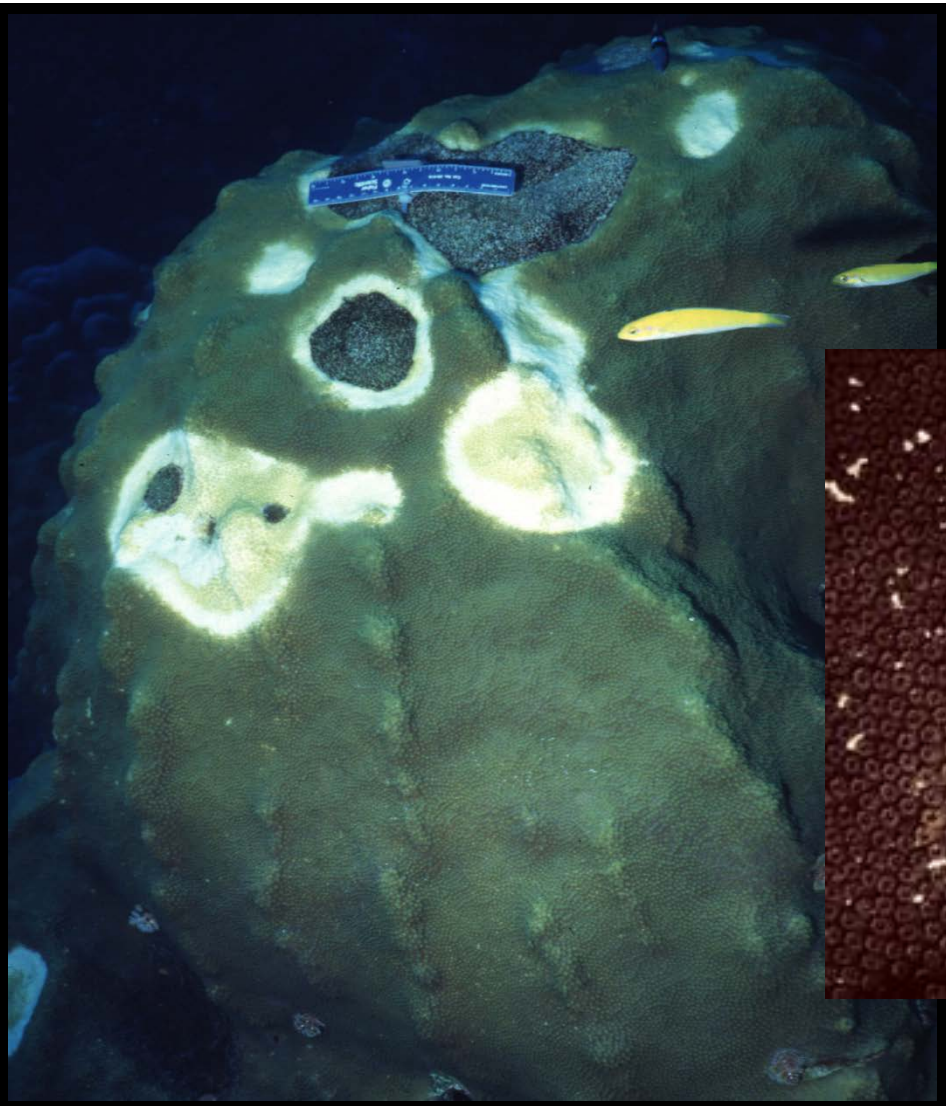
Caribbean yellow band disease

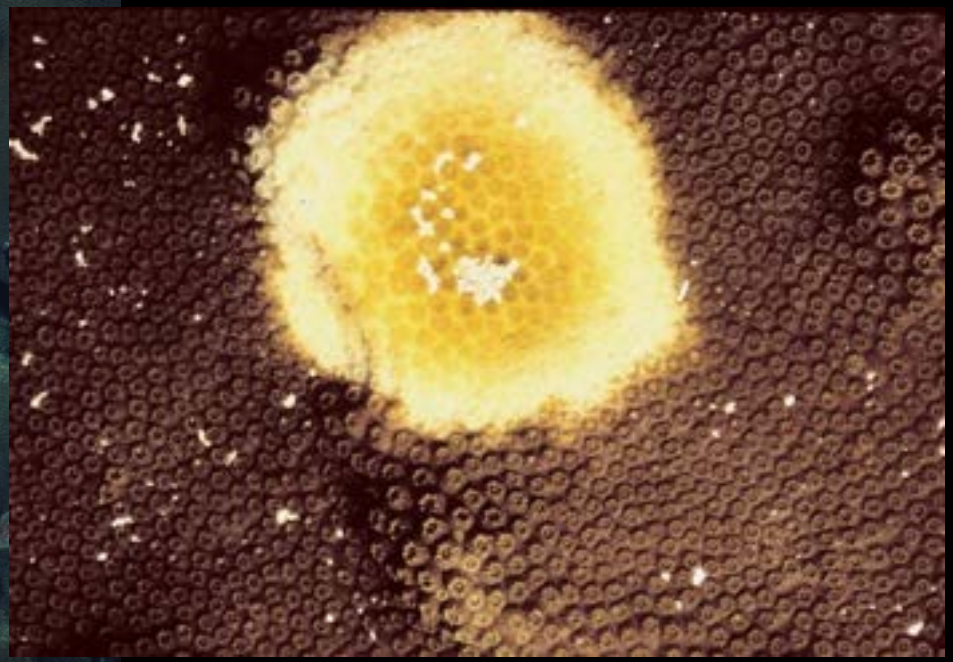


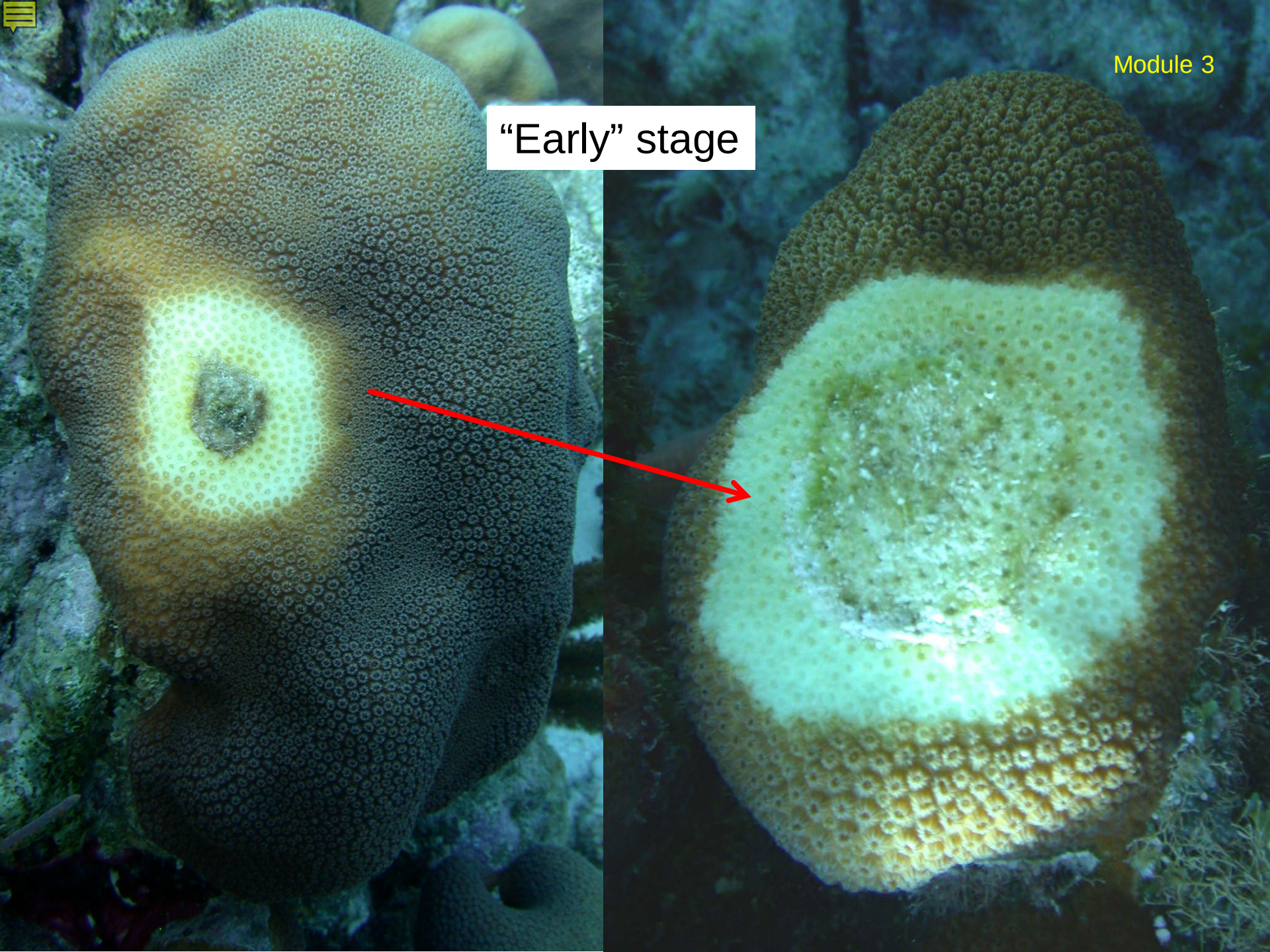
Caribbean yellow band disease

- Lesions focal, multifocal, coalescing, linear or annular
- Initiate within colony on live tissue or at edge of dead patch, or at colony margin
- Tissue darkens before dying
- Blotch forms a circular/ linear band as central area dies
- Very little recent mortality (white skeleton) usually visible

Caribbean yellow band disease



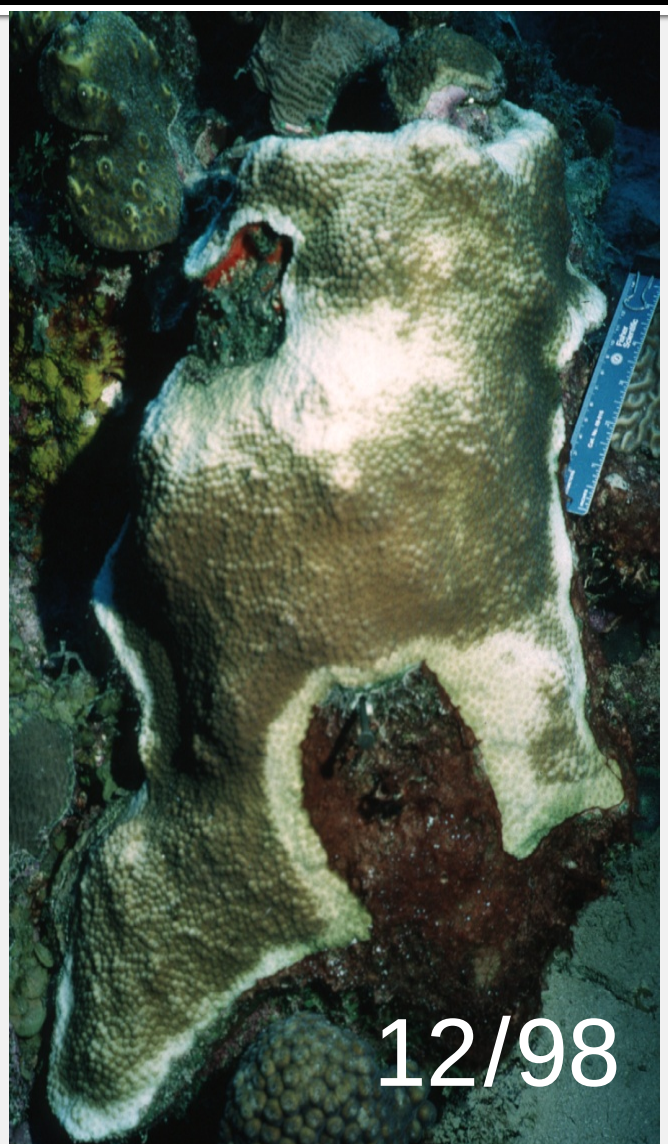



“Early” stage


“Later” stage

Caribbean Yellow Band Disease Progression

Module 3



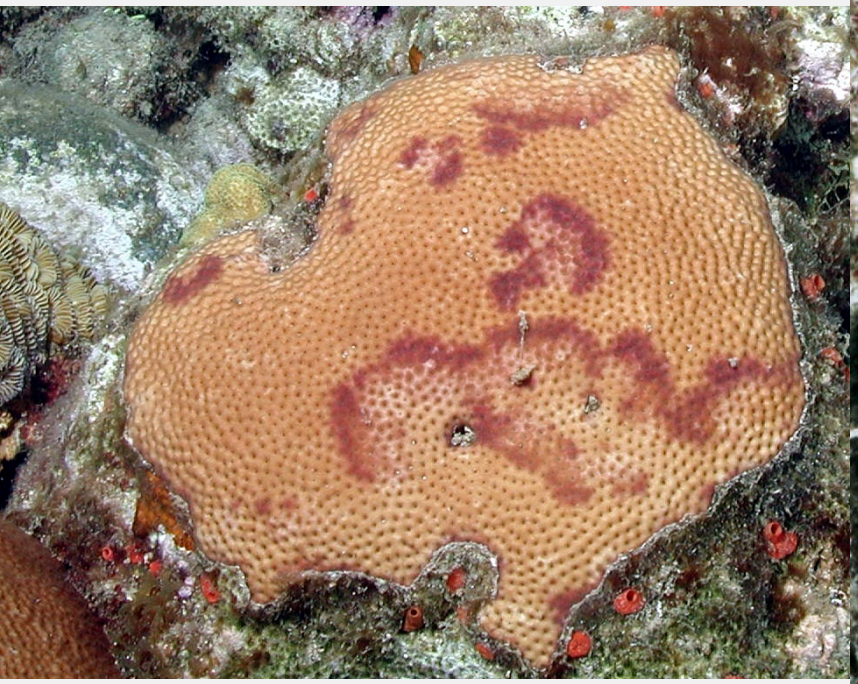
Dark spots disease (DSD)

- Observed primarily on *Stephanocoenia intersepta*, *Montastraea annularis* (complex), *Siderastrea siderea*
- Originally described as "*small round spots that apparently grow in size over time. Some can be associated with a depression in the coral surface and others expand into a ring surrounding dead coral*" Garzon-Ferriera and Gil, 1998

Dark spots disease (DSD)

Complications with DSD

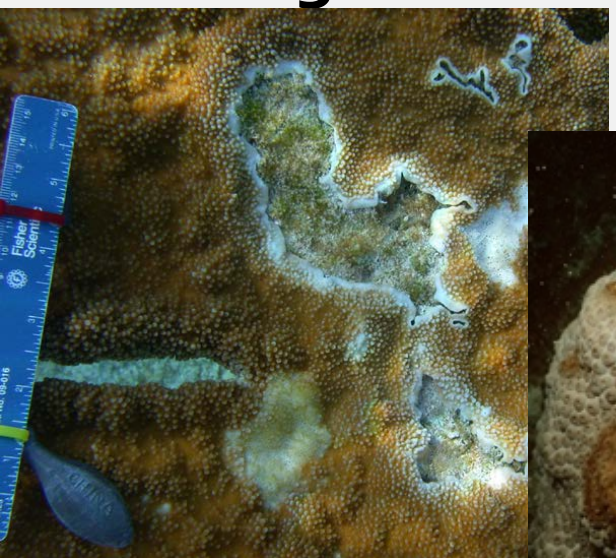
- Now reported on 12 species as five different diseases: DSD-I, DSD-II, DBS, PBS and tissue necrosis
- Many different manifestations:
  - Not always associated with mortality
  - DSD-II has larger spots and faster mortality
  - Other "types" produce dark/purple pigmentations & higher rates of mortality
  - Spots may turn into bands

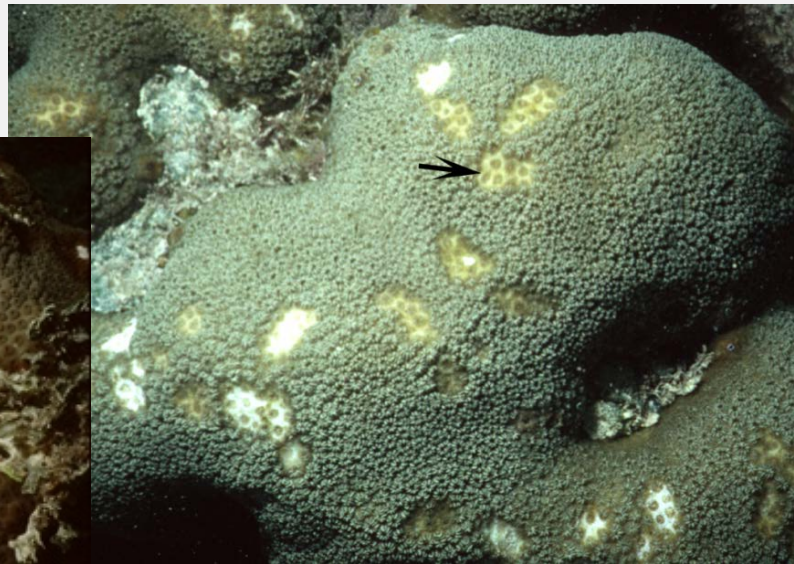



Module 3

Pigmentation response

- *Acropora* has apical polyps that are lighter than normal; *M. franksi* also has lighter polyps interspersed with dark polyps; regenerating tissue often lighter
- Altered pigmentation near injuries, algal overgrowth & from other stressors





Pigmented band diseases

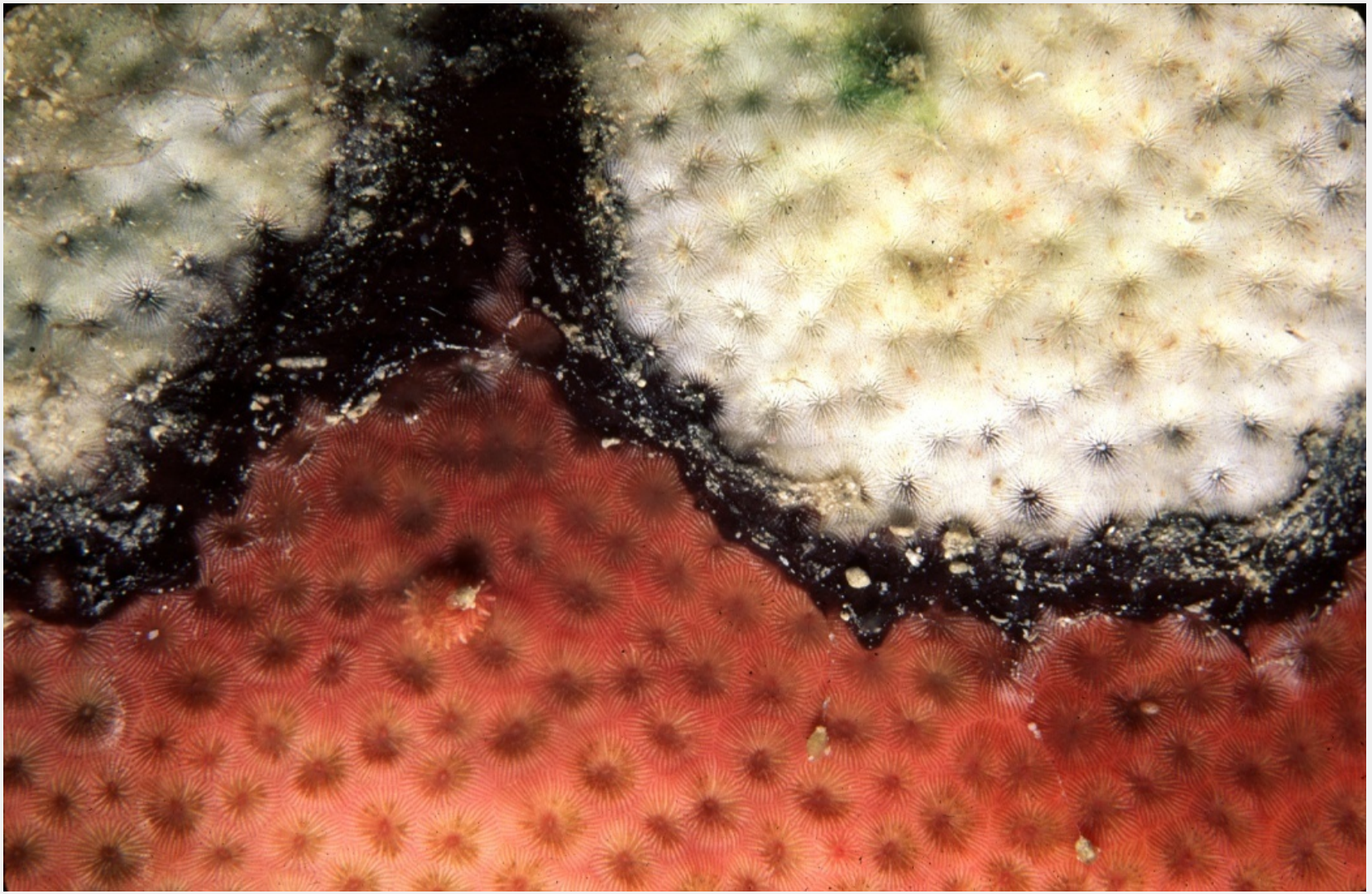
- Linear, annular, circular band, or a diffuse scattered patch, of pigmented material overlying tissue/skeleton
- Band may be diffuse or concentrated at lesion margin
- Band radiates outward from colony margin or old lesion within colony surface
- Band is typically black, grey, reddish/purple, often with white specks
- Band separates live tissue and exposed skeleton which may be white (acute loss) or algal-colonized

Includes:
Black band disease
Red band disease
Caribbean ciliate infection

Black band disease (BBD)

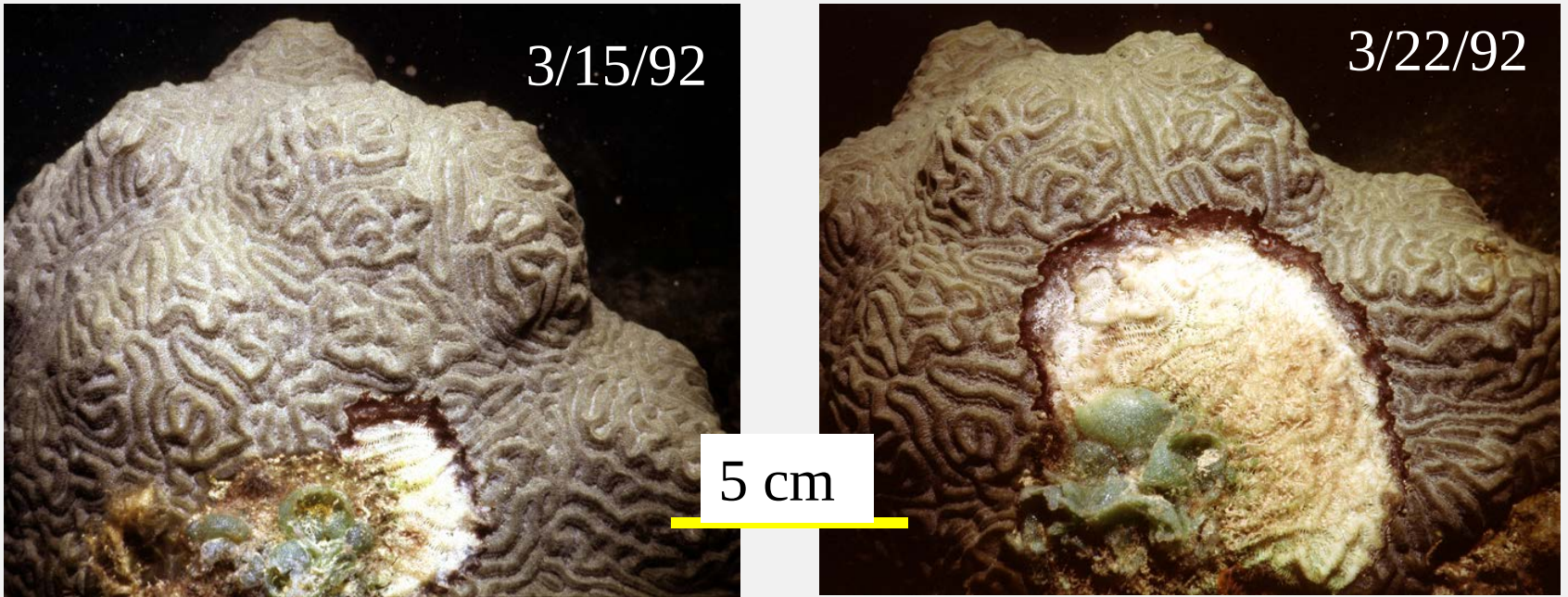
- Linear, annular, circular band of pigmented material separating exposed skeleton and live tissue
- Initiates at colony margin (base, top) or within colony in site of injury or algal colonized dead patch
- Dense mat or band consisting of cyanobacteria (black, may be reddish), Beggiatoa (white flecks) and other organisms
- Width of band varies (mm-cm) as does amount of white skeleton adjacent to the band; extent and type of algal colonization adjacent to band varies depending on duration of infection and rate of spread

Black band disease (BBD)

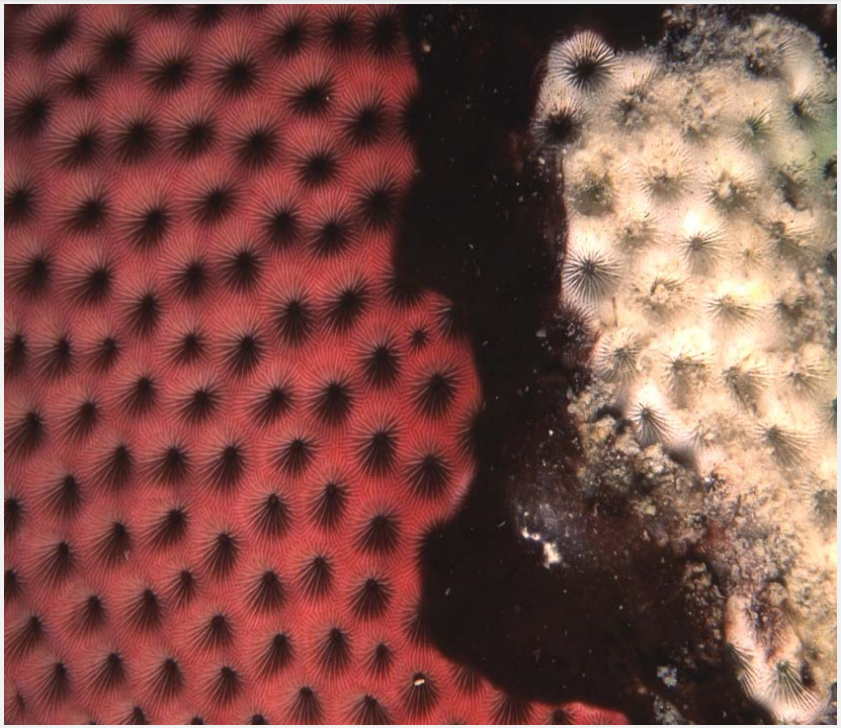


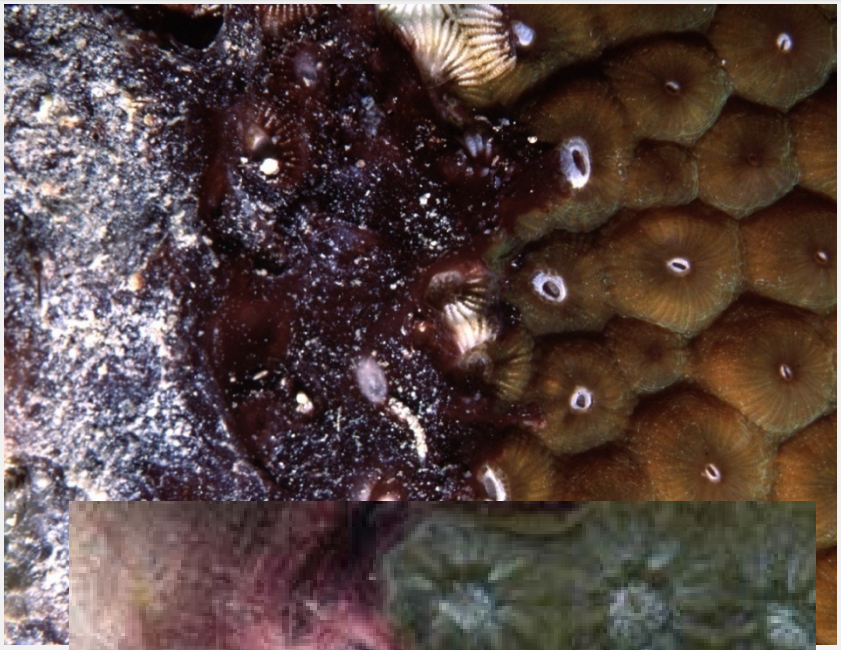
Black band disease (BBD)

- Affects at least 25 western Atlantic corals
- Spreads at up to 1 cm/day (mean=3 mm/day); differences among species, depths and seasons
- Kills small corals in days to weeks; most large colonies suffer partial mortality; colonies may be reinfected



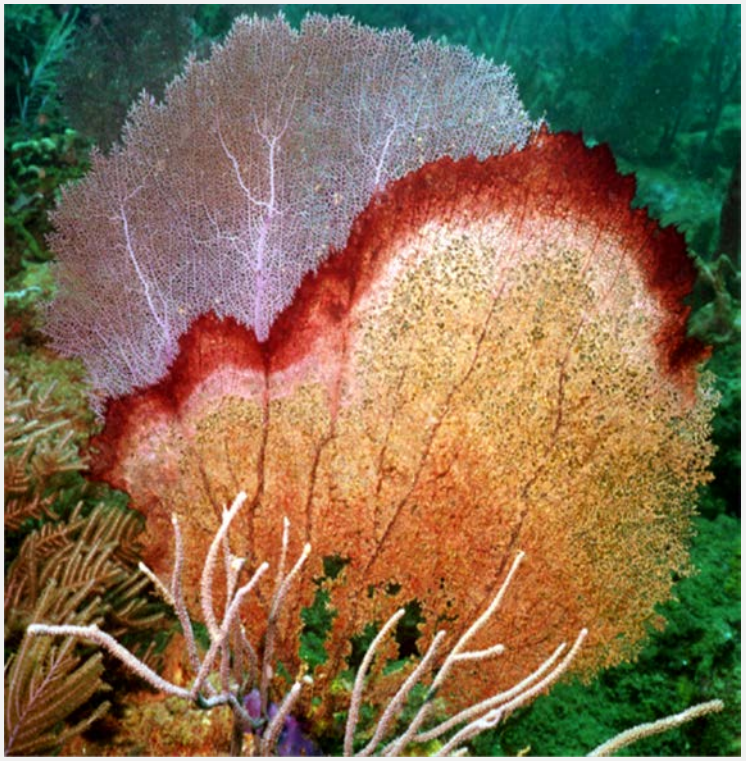
Black band disease (BBD)





- Unlike CCI, band is easily dislodged
- Visible appearance of band highly variable

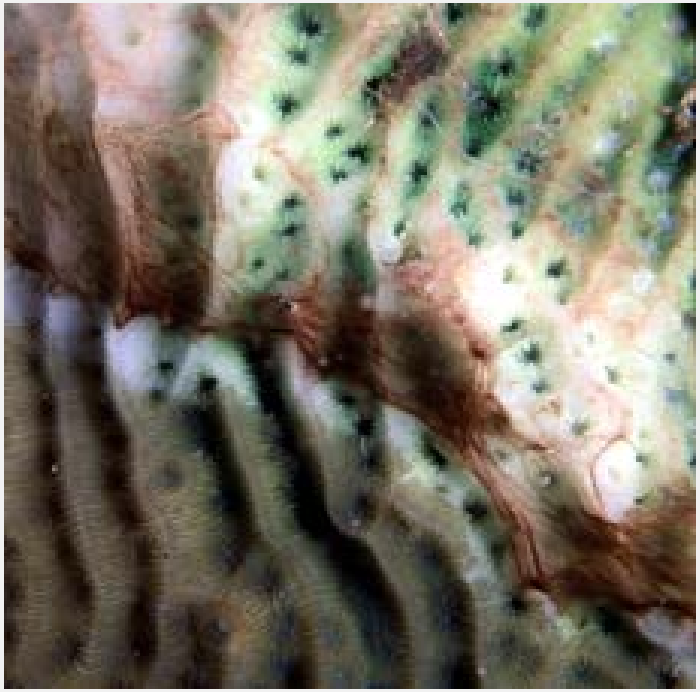
Red band disease



- First reported in 1983 on sea fans; also affects plating/submassive corals
- Type II identified on massive corals from the Bahamas
- Red band separates live tissue from denuded skeleton
- RBD I Similar to BBD, but cyano more loosely organized; lacks *Beggiatoa*

RBD Type I

- A narrow annular, linear or circular band of filamentous cyanobacteria
- Generally lacks white filaments
- More loosely associated with coral than BBD
- Starts at colony edge or focal site of old mortality, slowly advancing out or across the surface of the coral



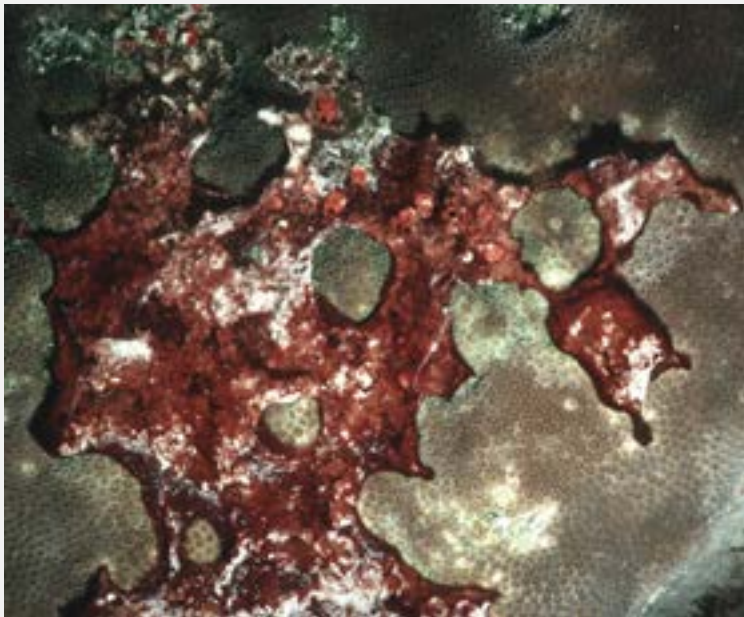
RBD Type I

Affects:

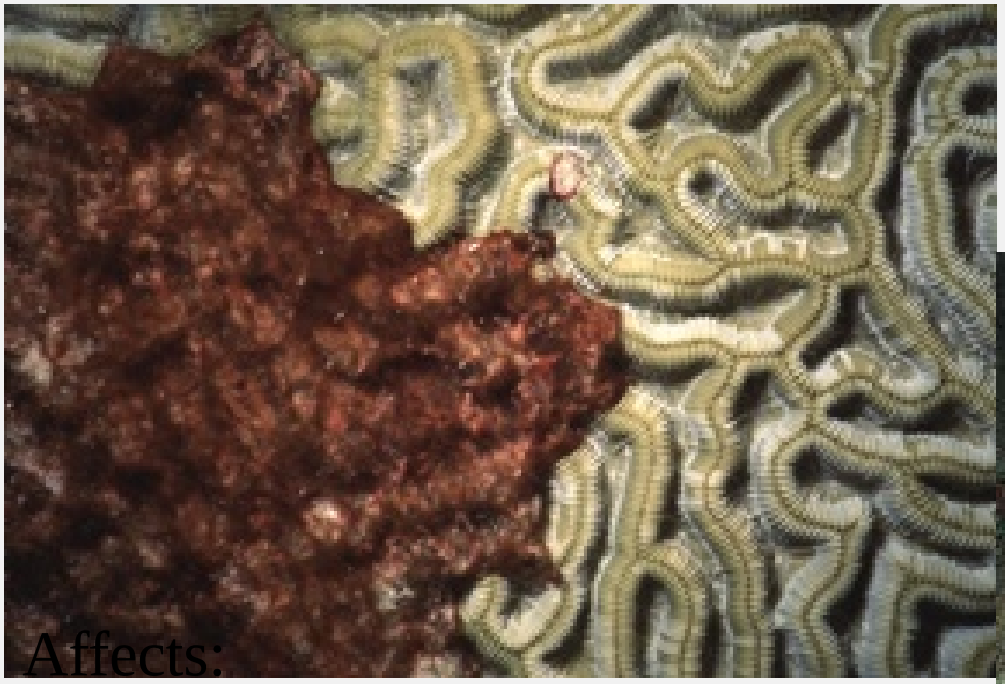
Agaricia*, *Colpophyllia*, *Mycetophyllia*, *Stephanocoenia*, & *Gorgonia ventalina

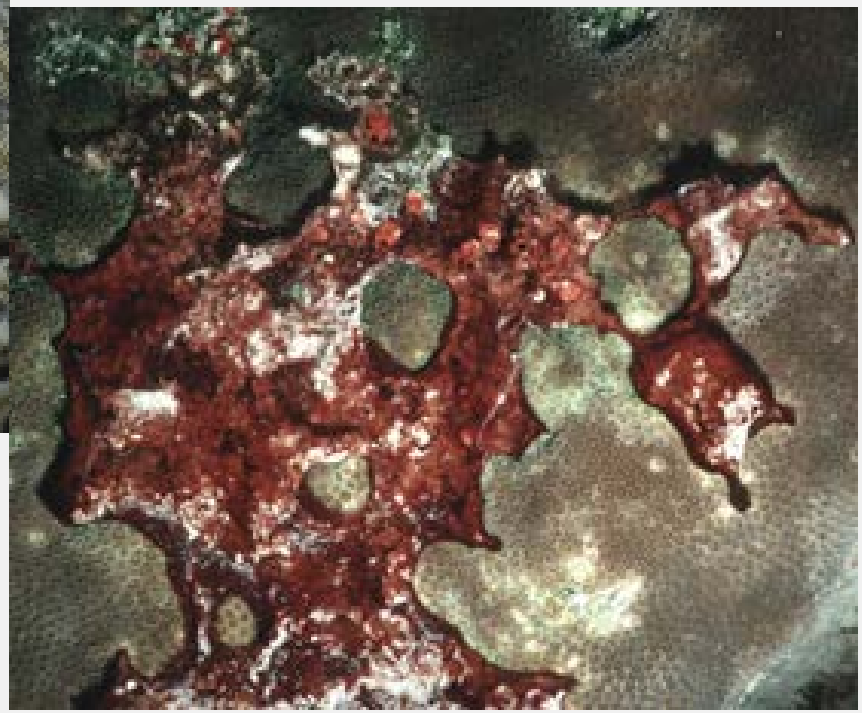
RBD Type II

- Filaments spread out like a net in a diffuse fashion over a colony's surface during daylight
- At night the band forms a compact balled-up mat between live tissue and exposed skeleton



RBD Type II



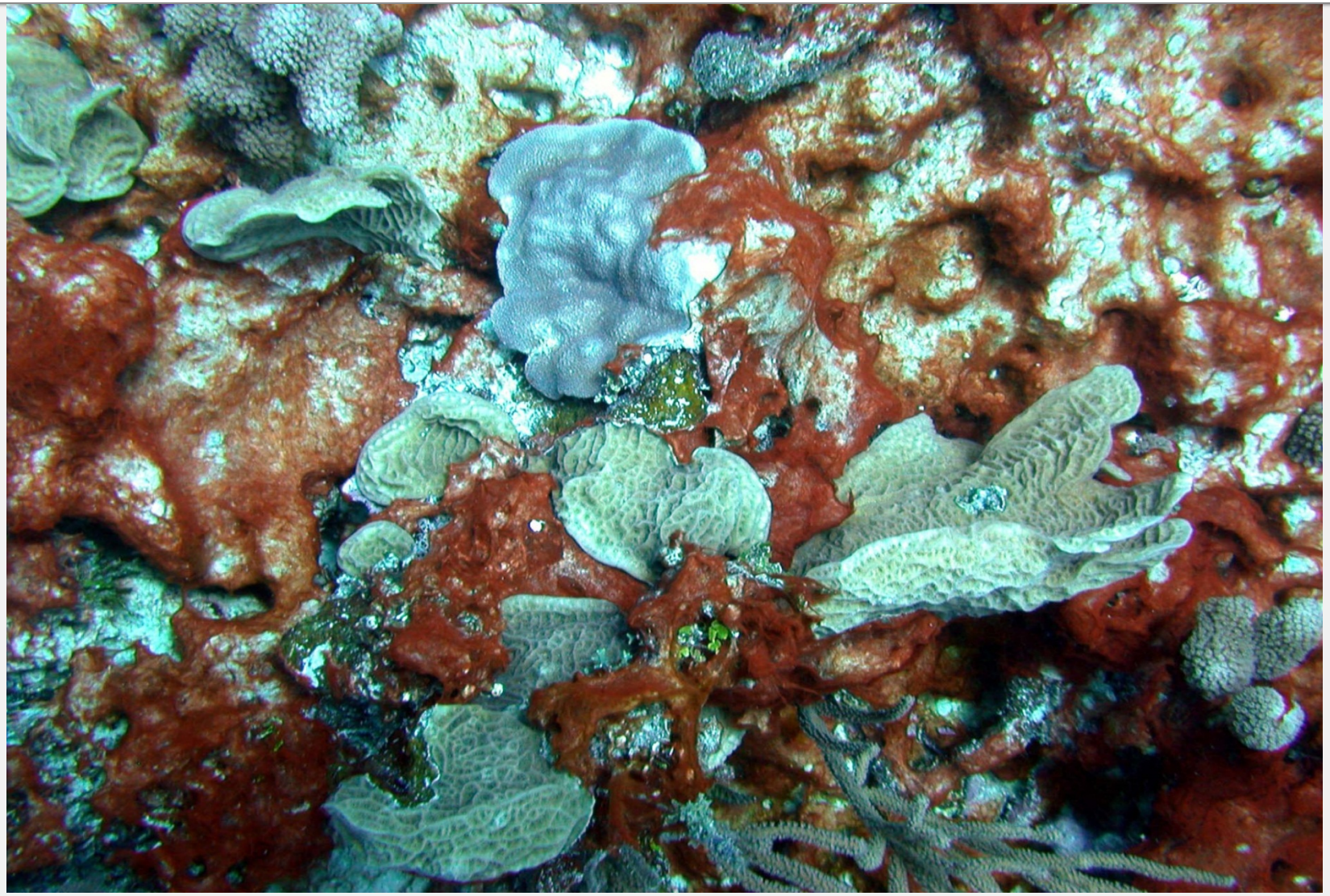


Affects:

D. strigosa, M. annularis, M. cavernosa, Porites astreoides **and** ***Siderastrea radians***

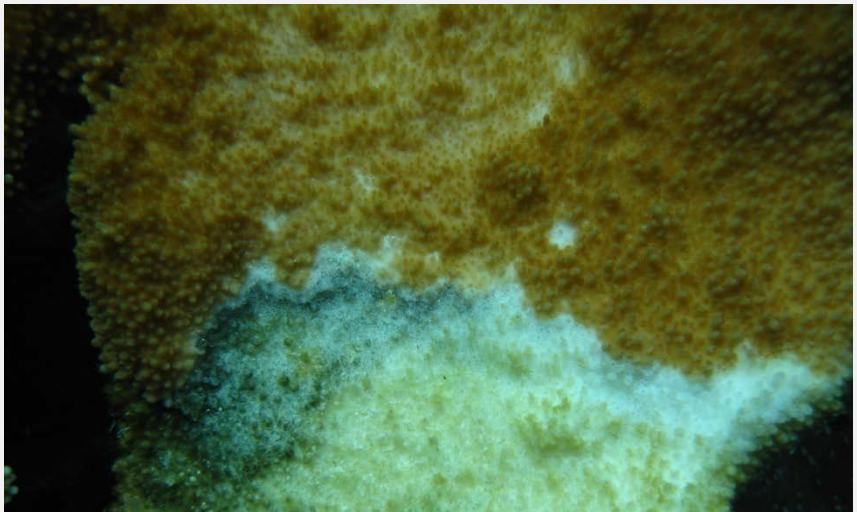
Cyanobacterial overgrowth

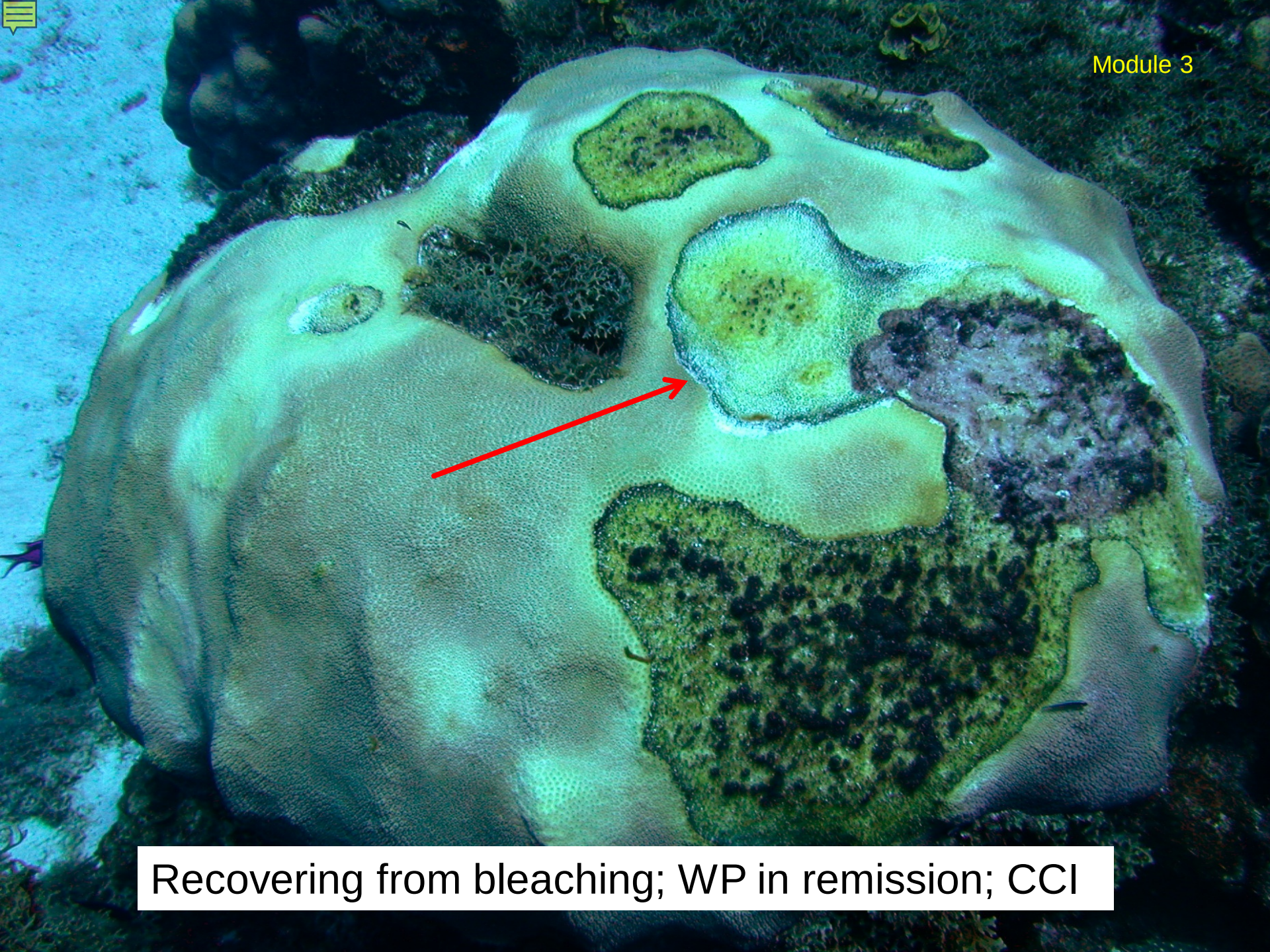
Module 3



Caribbean ciliate infection

- Diffuse black or grey band separating live tissue and exposed skeleton OR a diffuse scattered patch within the colony surface
- Affected area resembles "salt and pepper" associated with ciliate presence
- Ciliates may colonize coral affected by white plague or WBD or other ailment

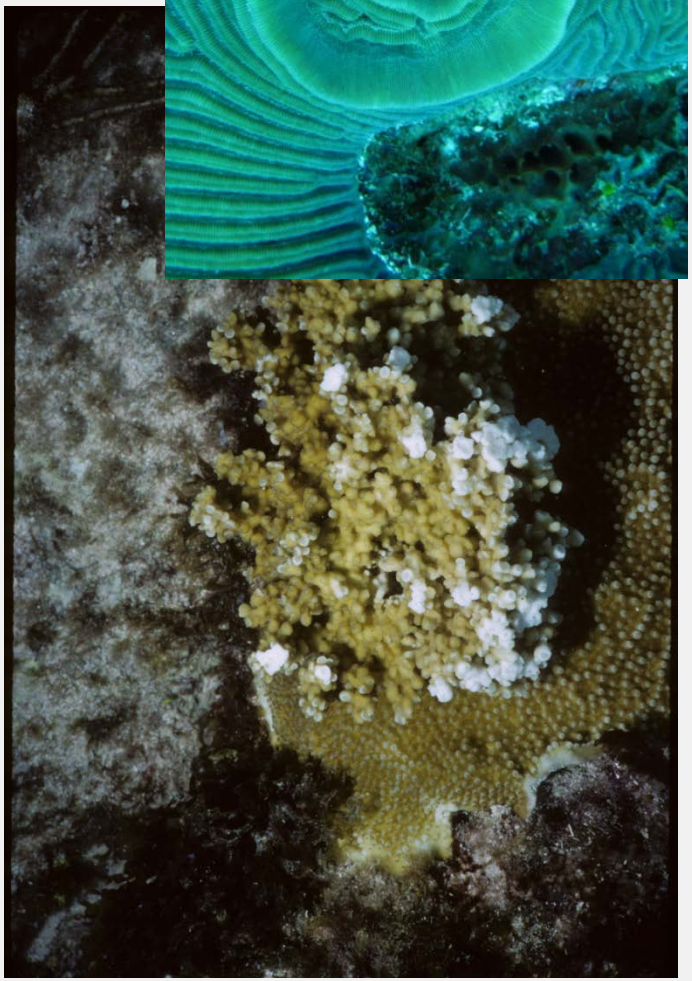




Recovering from bleaching; WP in remission; CCI

Growth Anomalies

Module 3



- Focal, multifocal to coalescing lesions
- Circular or irregular to diffuse shaped
- May have abnormal skeletal elements (corallites, ridges, valleys) larger or smaller than normal
- Corallites may be absent or degenerated, appearing as a white plaque, knob or growth over the colony surface
- Pigmentation normal or lighter
- Tissue loss present or absent

Examples of Growth Anomalies