Black Band Disease Pathogenesis and Impacts in the Florida Keys

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Regulation of Pathogenesis

1) Invasion of infectious bacteria

2) Change in environment results in increased pathogen virulence

3) Change in environment reduces coral defenses
   A. via changes in coral physiology (zoox?)
   B. via changes in resident bacteria abundance or physiology
Prolonged elevated temperature impacts coral bleaching and disease

- Maximum Degree Heating Weeks (DHW)
RCRP and FKNMS Coral Health Cruise Data: BBD Prevalence among Susceptible Species

DHW
Likelihood of total colony mortality due to BBD

Colpophyllia natans
Siderastrea siderea
Montastraea spp

Colony Experiencing Total Mortality (%)
12%
10%
8%
6%
4%
2%
0%

Years of Recurring Infection
1 2 3 4 5 6
Effect of BBD on Coral Tissue Surface Area

Colpophyllia natans
Siderastrea siderea

Mean Colony S.A. (cm²)

Years from initial BBD observation

0 1 2 3 4 5 6

1 2 3 4 5 6

10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Effect of nutrient enrichment on BBD migration \textit{in situ}

Voss and Richardson 2006, Coral Reefs
Ex-situ experiment: temperature, light, and colony effects on BBD pathogenesis

1) progression rates of BBD
2) composition of the bacterial communities of the host coral mucus and BBD
3) gene expression of coral and zooxanthellae
4) immune activity of coral (Mydlarz)
Raceway A
Raceway B
Raceway C

12.5% (10m)
35% (2m)

Light

Infected

Control

Amb. (27-30 °C)
Elev. (30-33 °C)

Temp

BBD
BBD Progression

Day 1

Elev Temp
35% Light
Colony - A

0 mm

Ambient Temp
35% Light
Colony - A

0 mm

Ambient temp
35% Light
Colony - C

0 mm

Day 4

3 mm

Day 7

13.2 mm

24.2 mm

6.8 mm
BBD progression rates in light and temperature treatments

- **12.5% light, Ambient temp**
- **12.5% light, Elev. temp**
- **35% light, Ambient temp**
- **35% light, Elev. temp**
BBD Progression colony comparison

Average progression (mm/day)

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<th>Colonies</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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Are Corals Tough Enough?

• Not just who…but why

• Are certain areas or coral populations more resistant to disease in the Florida Keys?

• Are particular coral or zooxanthellae genotypes more resistant to disease?

• Do resistant corals harbor different bacterial assemblages than susceptible corals?

• Do any of the above change when environmental conditions are altered?
Summary

• Annual BBD recurrence common (20-55%) in FL
  – increased coral tissue lost and an improved likelihood of total colony mortality
  – excess nutrients exacerbate BBD infections

• Temperature experiment indicates upper threshold to BBD enhancement effects
  – severity vs. prevalence

• Coral disease susceptibility varies among colonies within and between species
  – Are these patterns predictable?
  – How might this impact restoration activities?

• Diagnostics and training to quantify coral health beyond measures of mortality

• Improved techniques to identify susceptible populations or regions
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