CREST HIRES Summer 2016 Research Project

Coral Reefs and Remote Sensing

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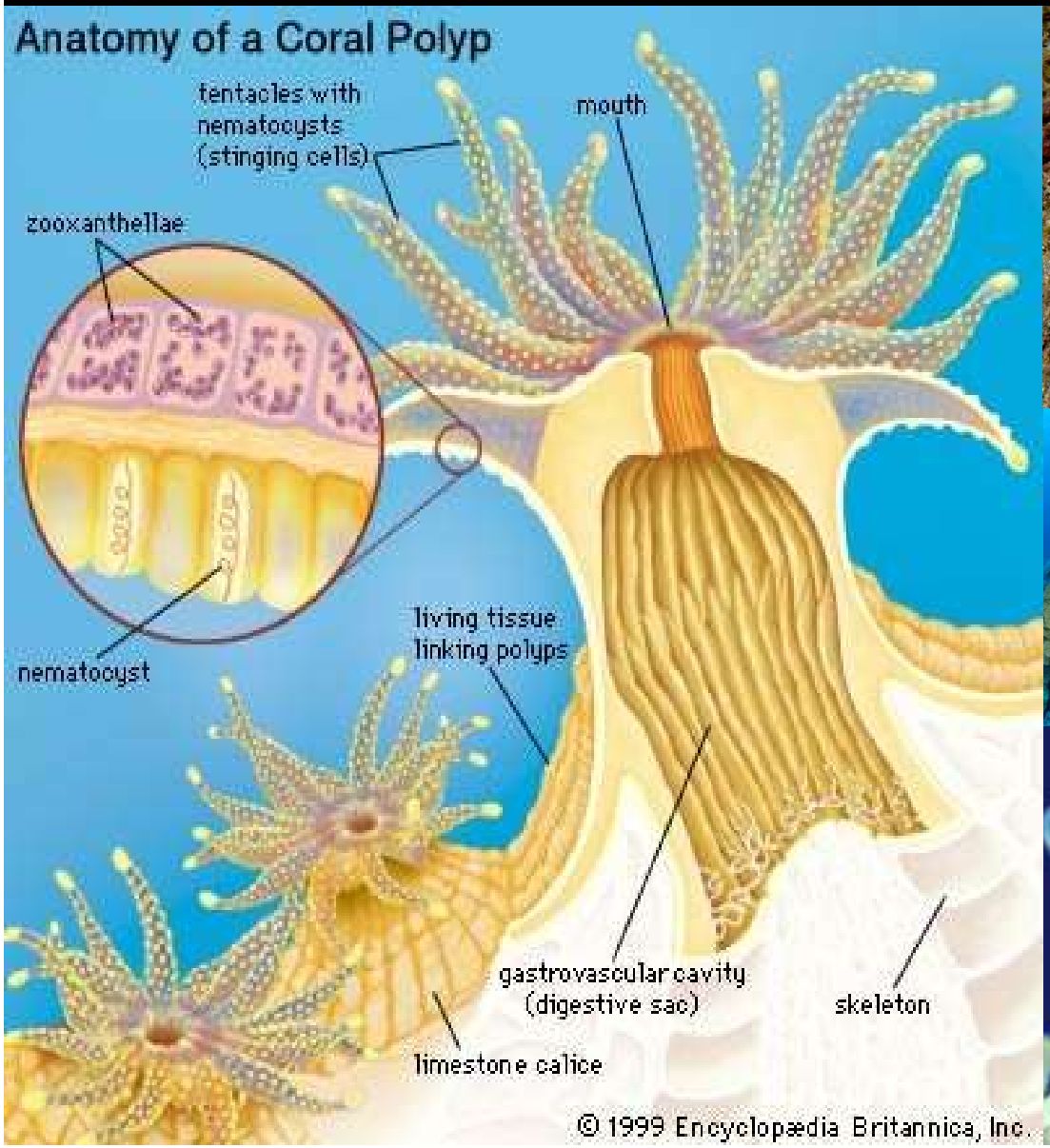
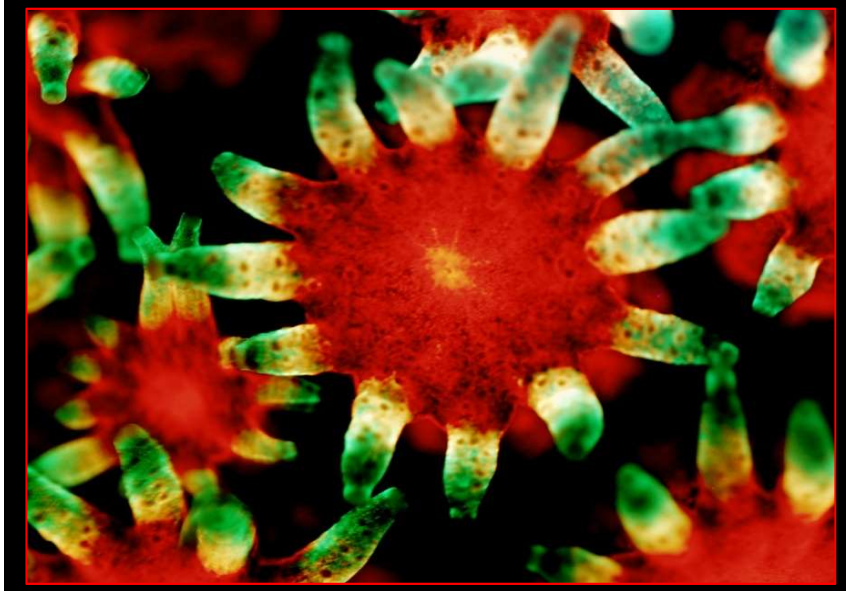
What are Corals?



50 - 2,000m depth (4°C)

Coral Fluorescent Proteins



High energy, shorter wavelength → Lower energy, longer wavelength

Two Primary Groups of Flurophores:

1. Photosynthetic pigments from algae (zooxanthellae): emission peaks around 680 nm & 730 nm
2. Fluorescent proteins (FPs): emission peaks between 482 – 609 nm (host)

(Mazel et al. 2003, Palmer et al. 2009)

Function:

1. Photoprotection for algae
2. Enhance photosynthesis for algae

(Johnsen 2012)

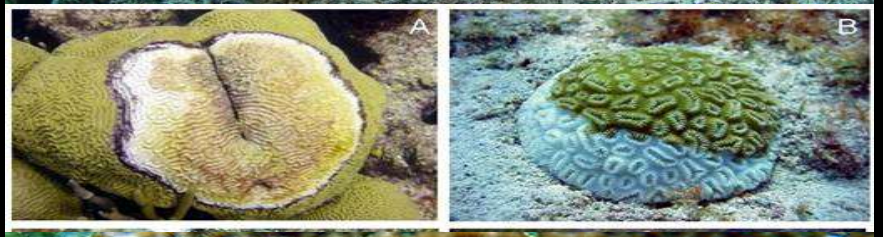
Why Care About Corals?

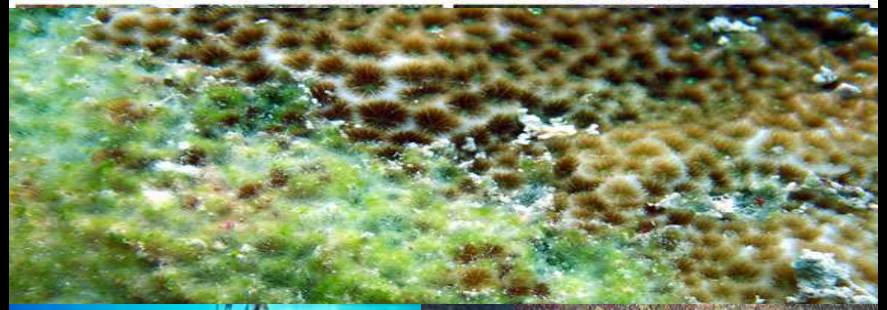
1. Rainforest of the Ocean
    a. Some marine species are only found on coral reefs
2. Economy
    a. Fishing Industry
    b. Tourism: Globally $30 billion (Cesar et al. 2003)
3. Medical
    a. According to NOAA, “Coral reef plants and animals are IMPORTANT sources of NEW medicines being developed to treat cancer, arthritis, human bacterial infections, Alzheimer’s disease, heart disease, viruses, and other diseases.”
4. Coastal protection

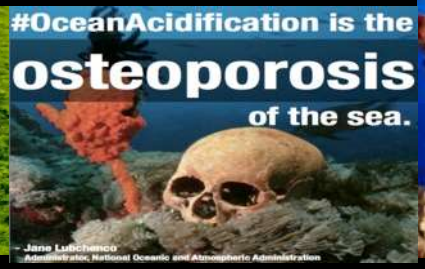
Three Main Problems

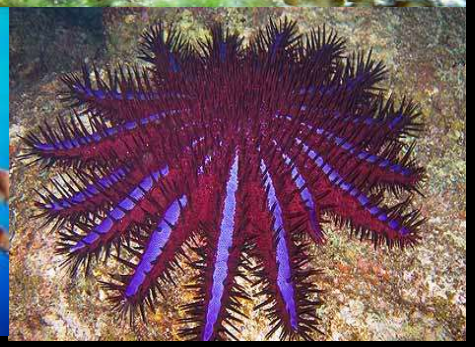
By 2011, 19% of reefs had been lost, and 75% were threatened = due to natural and anthropogenic effects

1. Climate Change
   - ❖ Temperature changes
   - ❖ Ocean Acidification (pH, salinity)
   - ❖ Disease/Bleaching
   - ❖ Invasive species
2. Land-based pollution
   - ❖ Eutrophication
3. Fishing Impacts
   - ❖ Algae dominated ecosystems







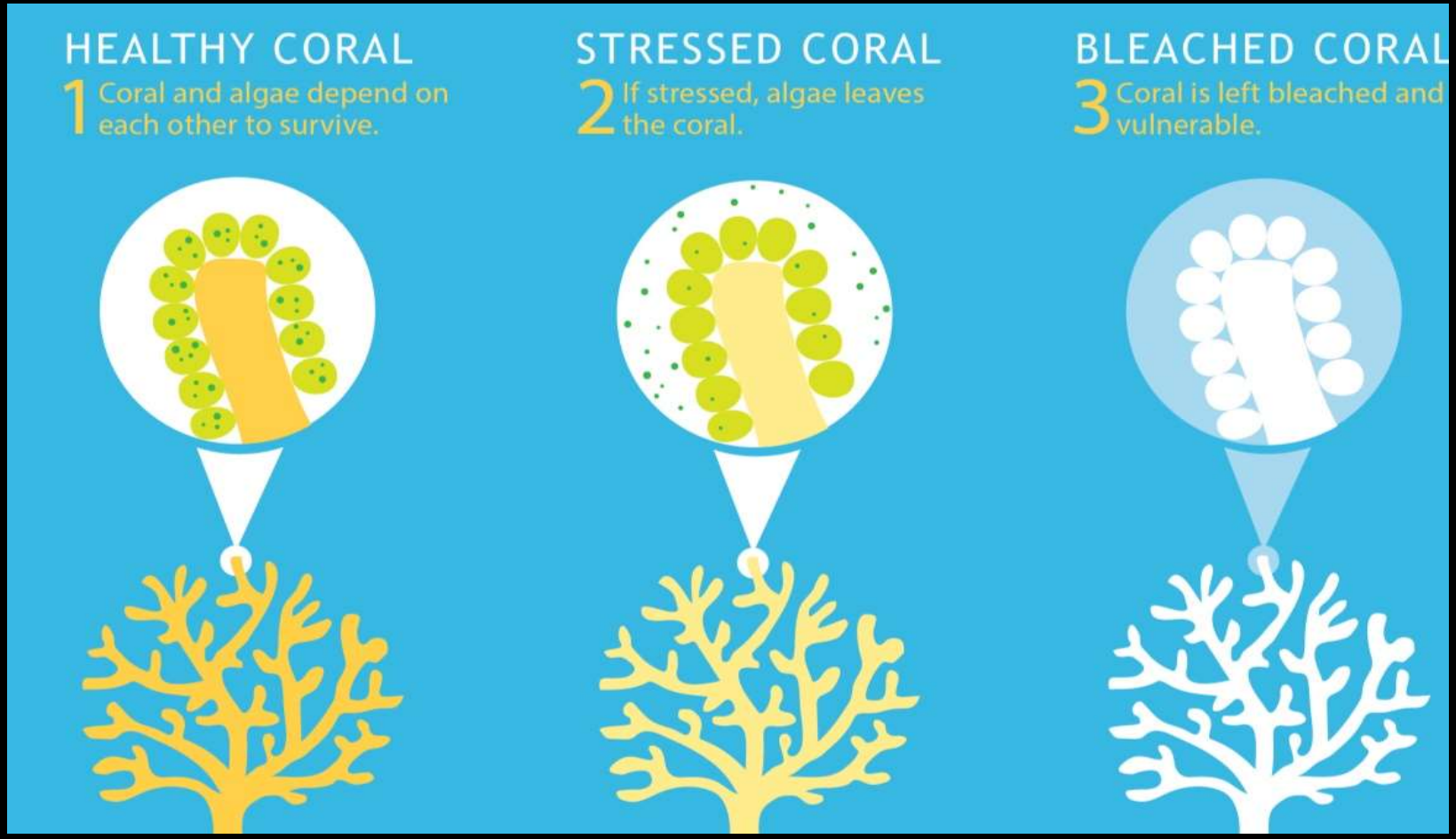


Climate change is the biggest global threat to coral reef ecosystems.

Increasing sea surface temperatures

- Ocean warms, coral bleaching increases (natural phenomenon)

Coral Bleaching



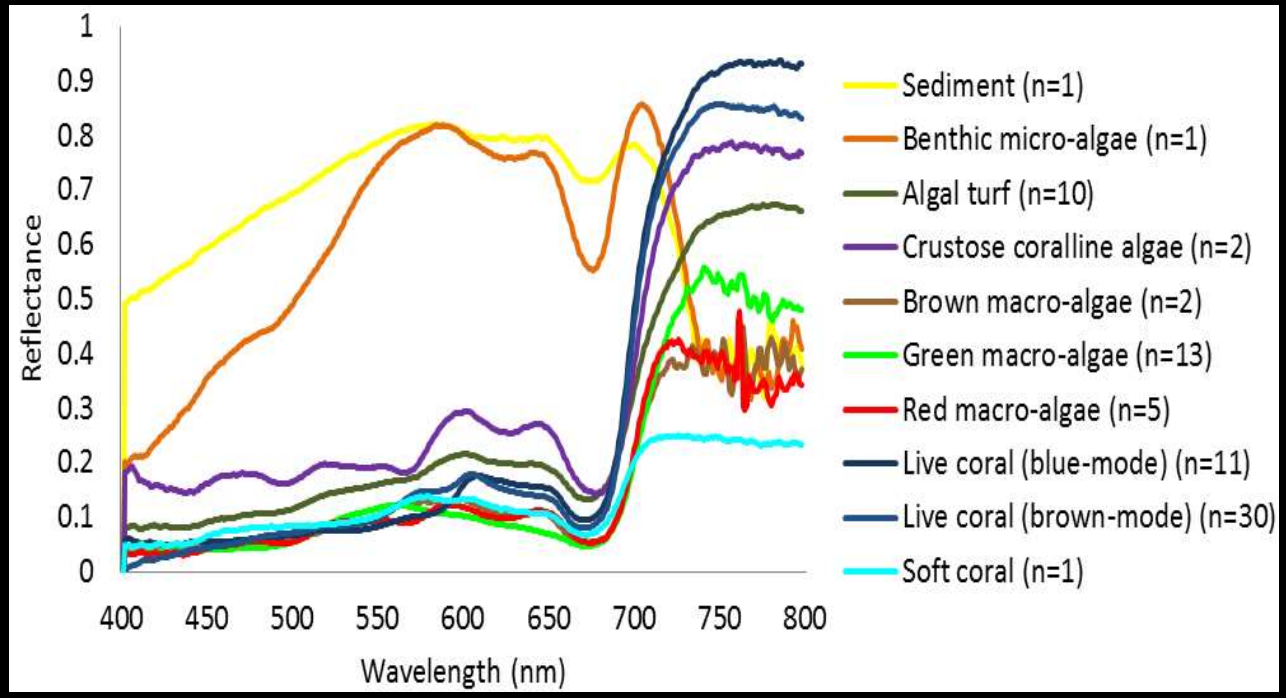
Ultimately depends on the species and location of the coral!

Remote Sensing of Coral Reefs

Idea of a "coral reef"

- Assemblage of different species, that can be represented by their unique spectral signatures

- Dominant spectral reflectance patterns for the coral arise from the pigments of the dinoflagellates living within them

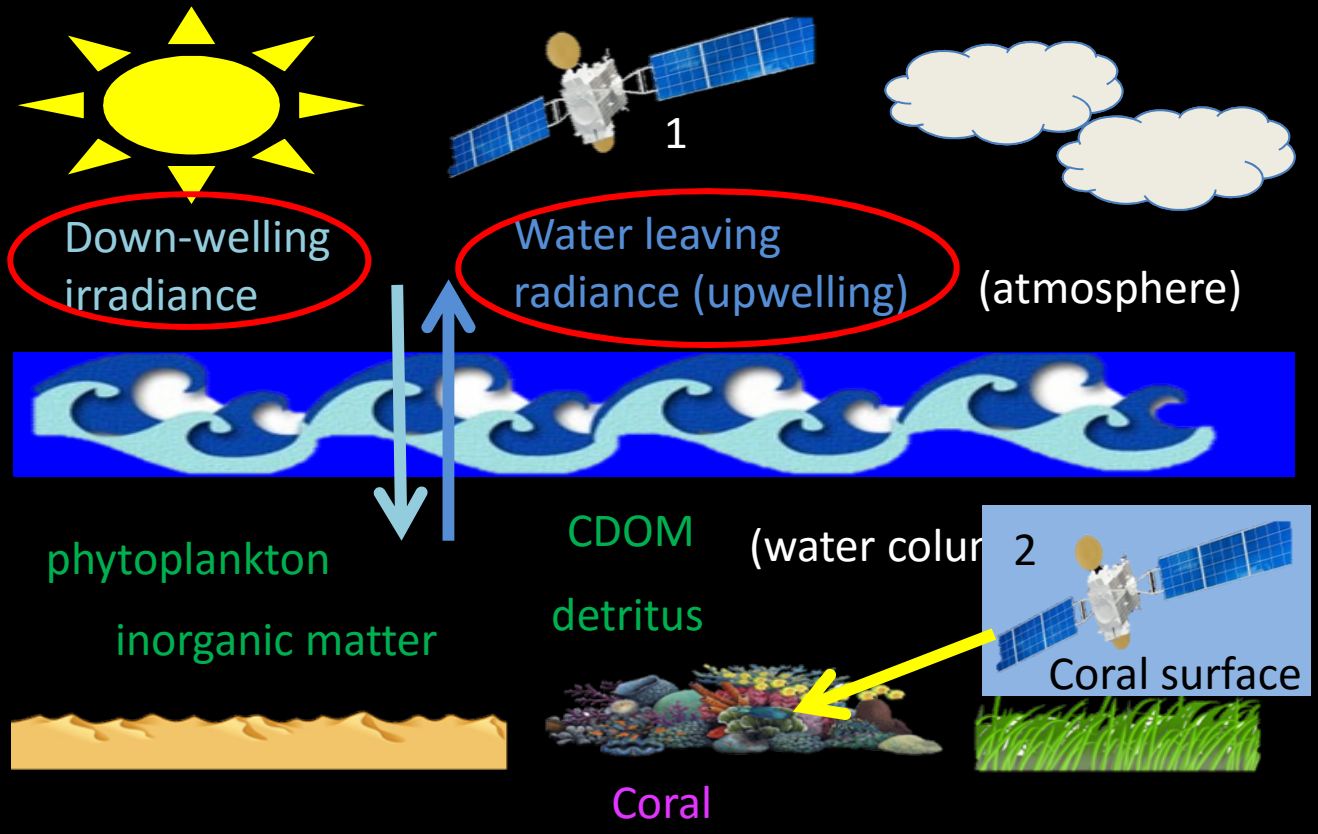


Different benthic substrates = different reflectance's

(Leiper et al. 2014)

How is Reflectance measured?

Two classes of remote sensing tools:



Spectral reflectance signatures can be difficult to obtain underwater, due to atmospheric correction and the water column; also limited by penetration of light

Goal

To investigate the effects of **temperature (heat and cold)** stress on the **fluorescence** and **reflectance** signatures of coral using *in situ* microscopy.

- Does temperature stress affect the fluorescence and reflectance of coral?
- If so, how does it impact them?
- Can this be used as a diagnostic tool to assess coral health?

Student Project

- Learn about coral bleaching, and how remote sensing can be used to help monitor coral health
- Engage in designing and implementing a stress-induced (e.g. temperature, ph) laboratory experiment using the Caribbean coral *Porites furcata*
- Ocean Optics USB2000+ spectrometer to take fluorescence and reflectance measurements
- Coral husbandry
- Data analysis (R and Matlab)
- MR 923

Thank you!

Questions???