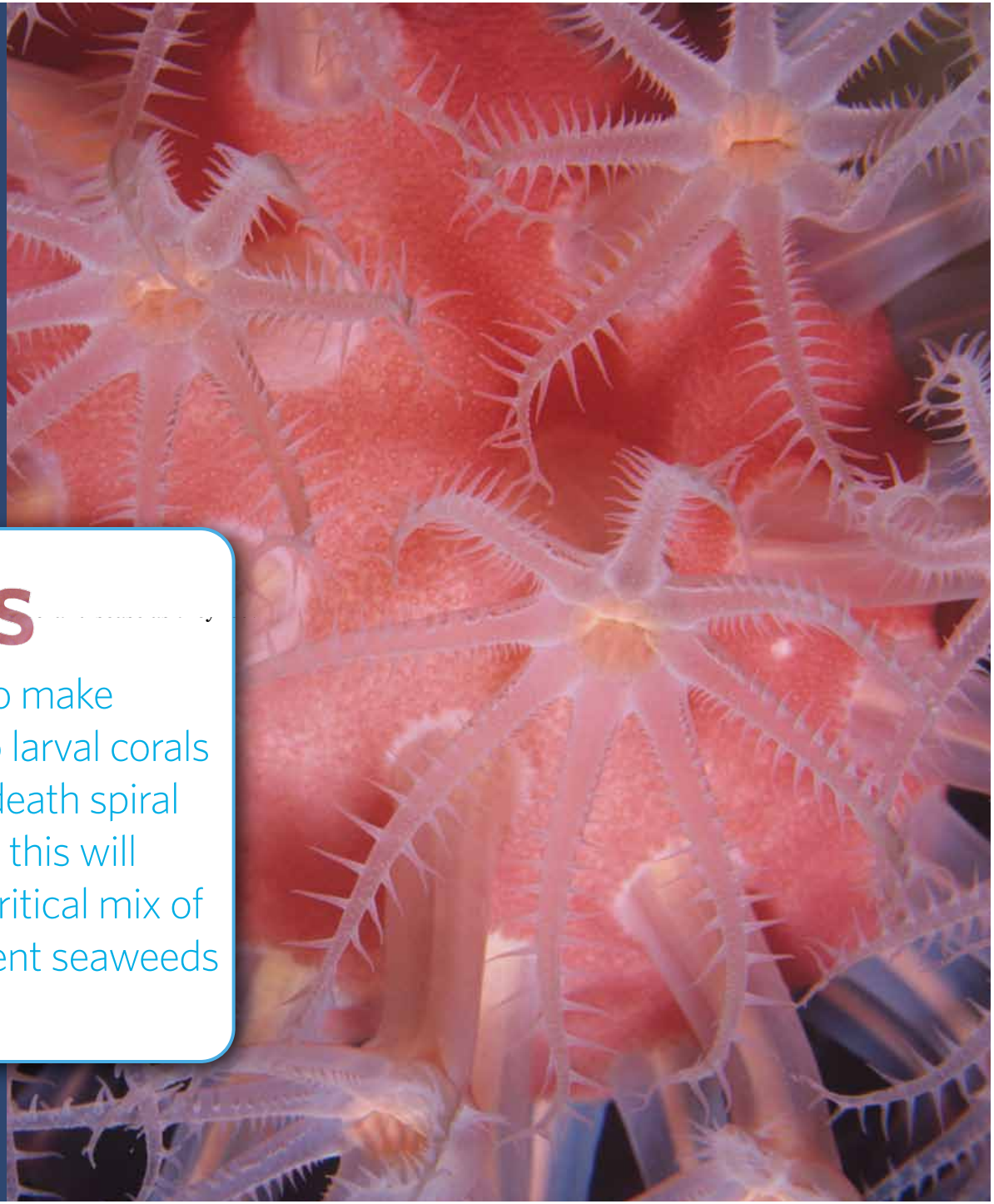
Tropical Corals Ecosystems

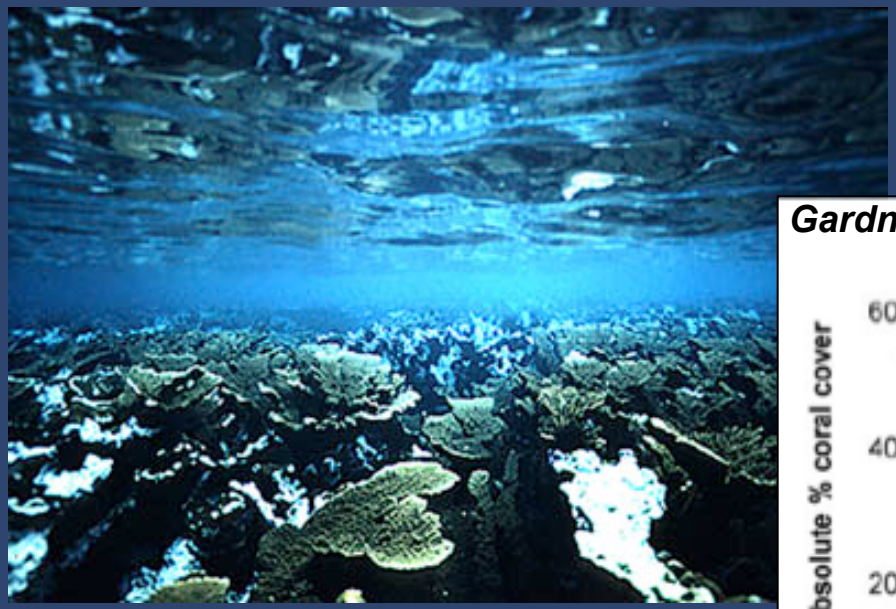


Coral in Crisis

We need to find effective ways to make damaged reefs more receptive to larval corals and thus better able to stop the death spiral that is occurring on today's reefs; this will involve limiting the harvest of a critical mix of reef herbivorous fishes that prevent seaweeds from blooming on coral reefs.

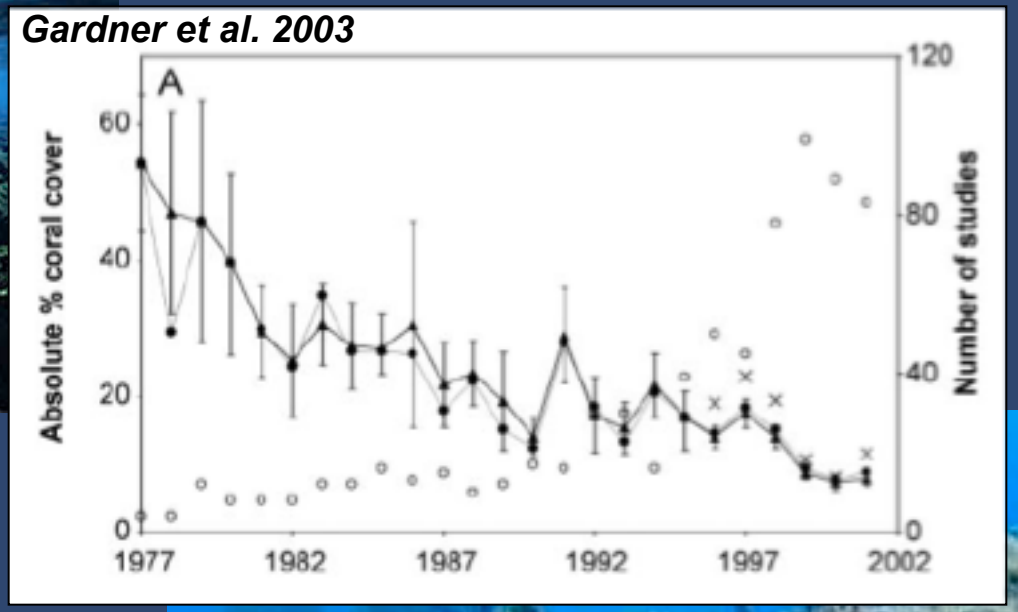
Hay & Rasher 2010

Tropical Corals Ecosystems

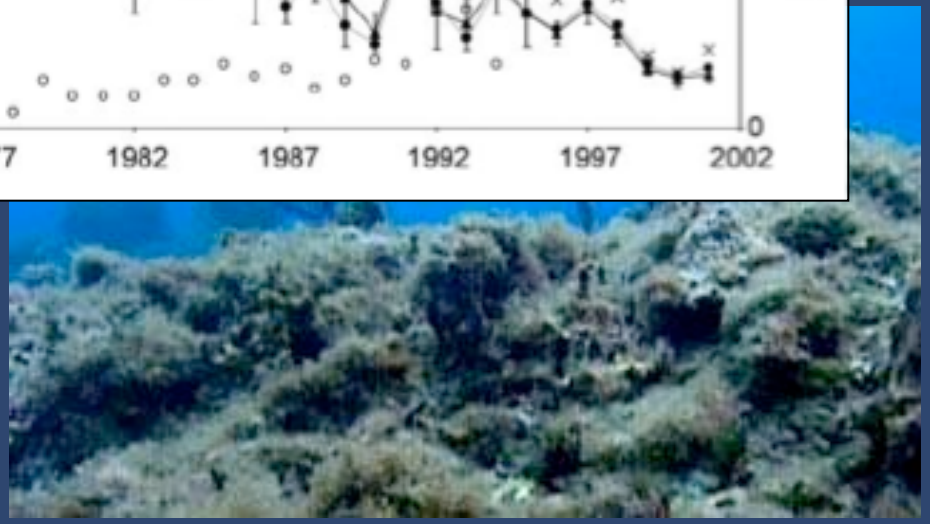


1970's

Dramatic Changes in the Caribbean
("reefs" are now algal-covered meadows)

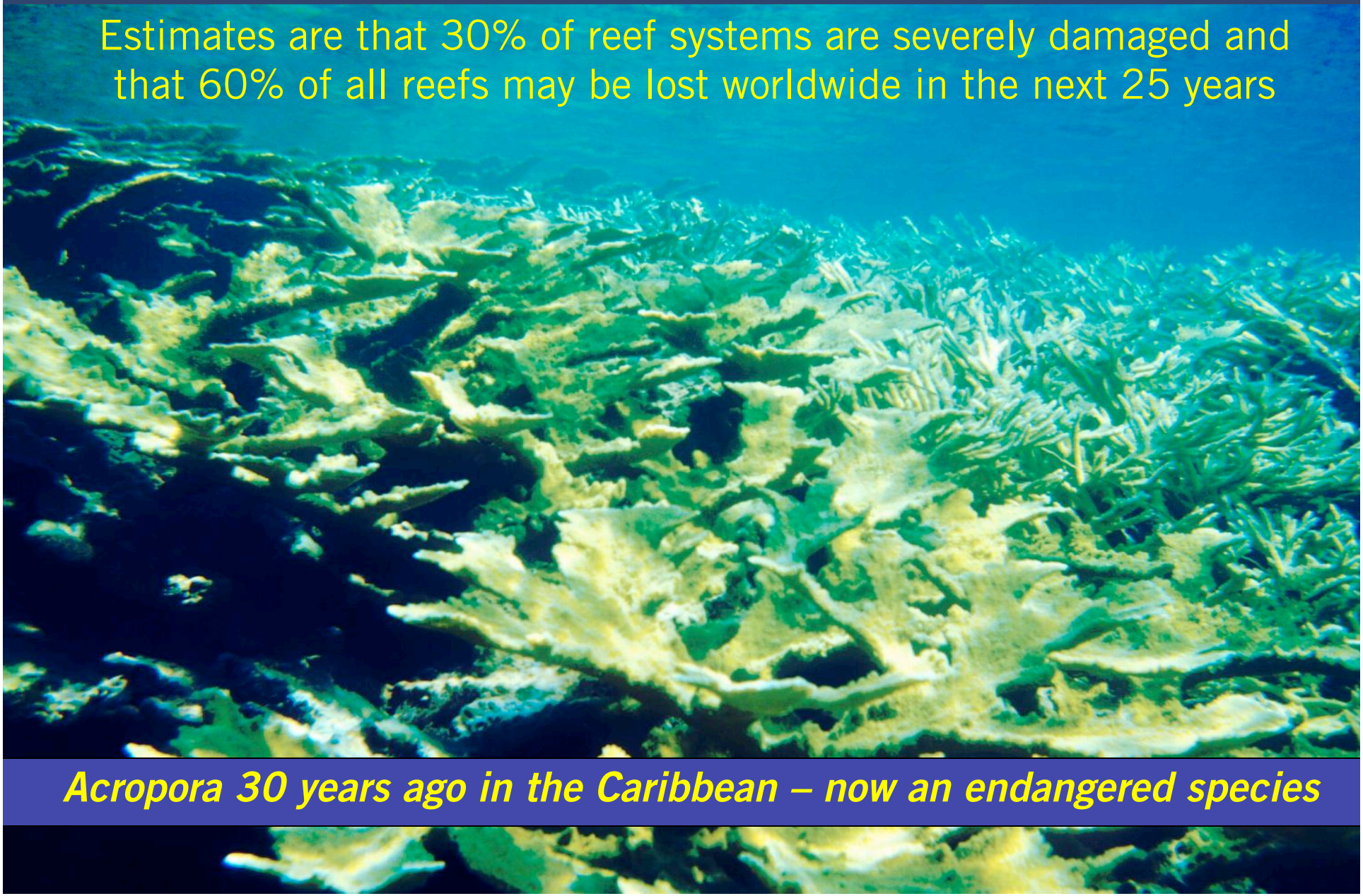


1999



Tropical Corals Ecosystems

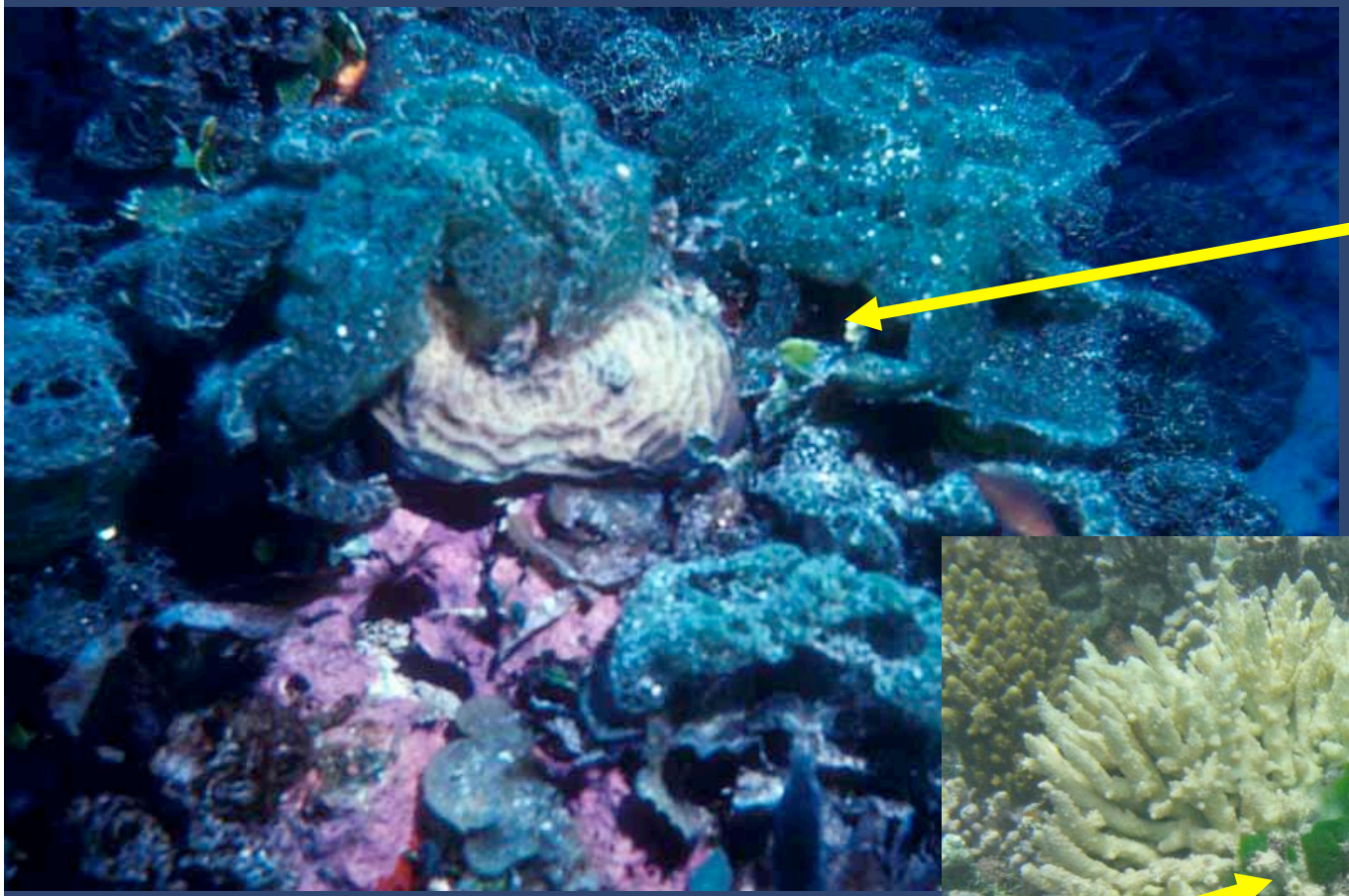
Estimates are that 30% of reef systems are severely damaged and that 60% of all reefs may be lost worldwide in the next 25 years



Acropora 30 years ago in the Caribbean – now an endangered species

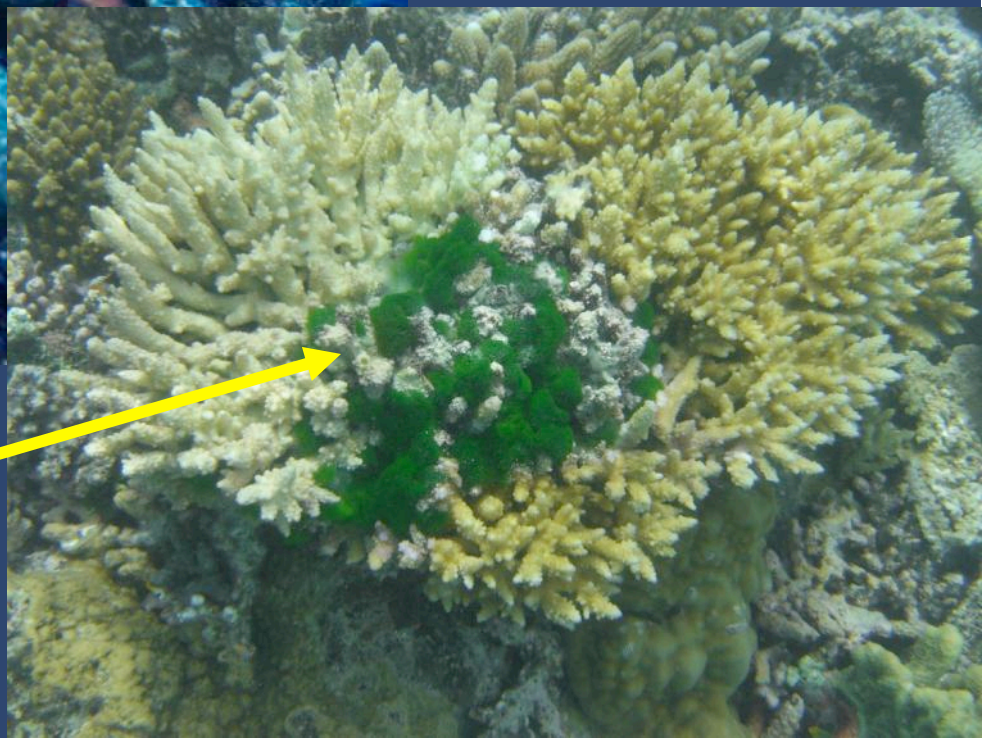
Seaweeds Invasions

Seaweeds Invasions



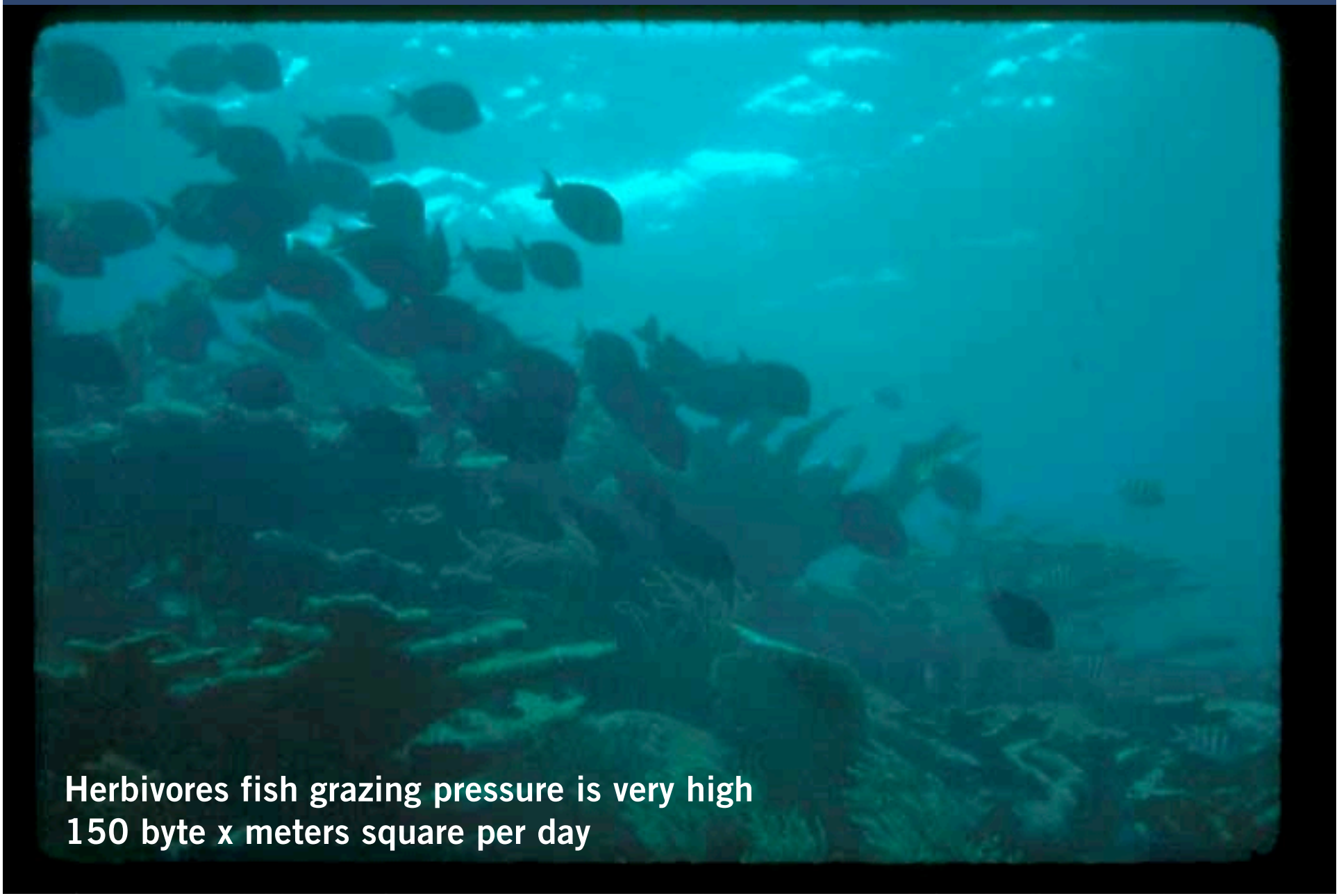
This is not just nutrient pollution

Remote region in the Bahamas 150 miles away from humans



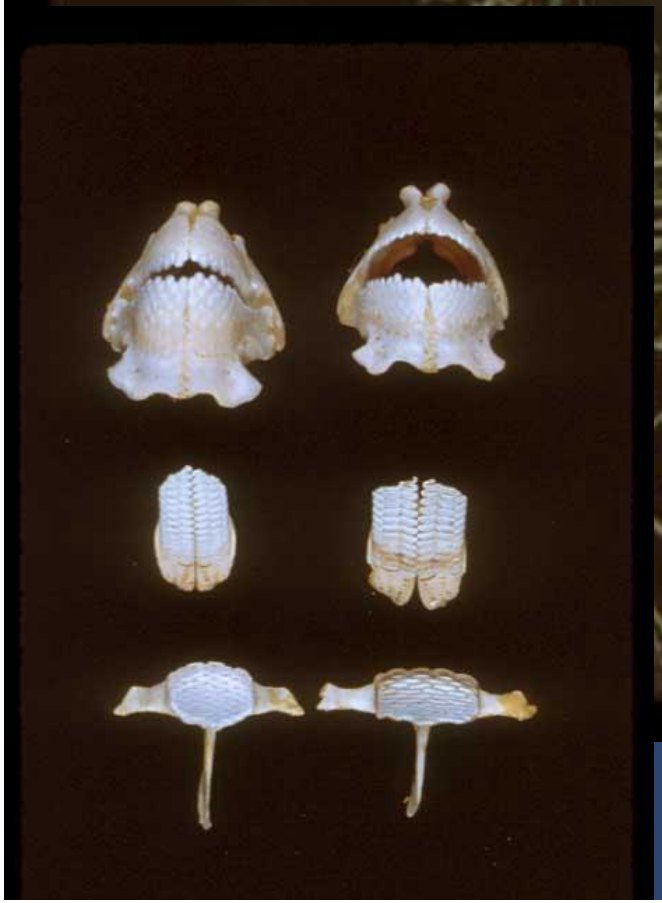
Fiji

Herbivores Suppress Seaweeds



Herbivores fish grazing pressure is very high
150 byte x meters square per day

Tropical Corals Ecosystems

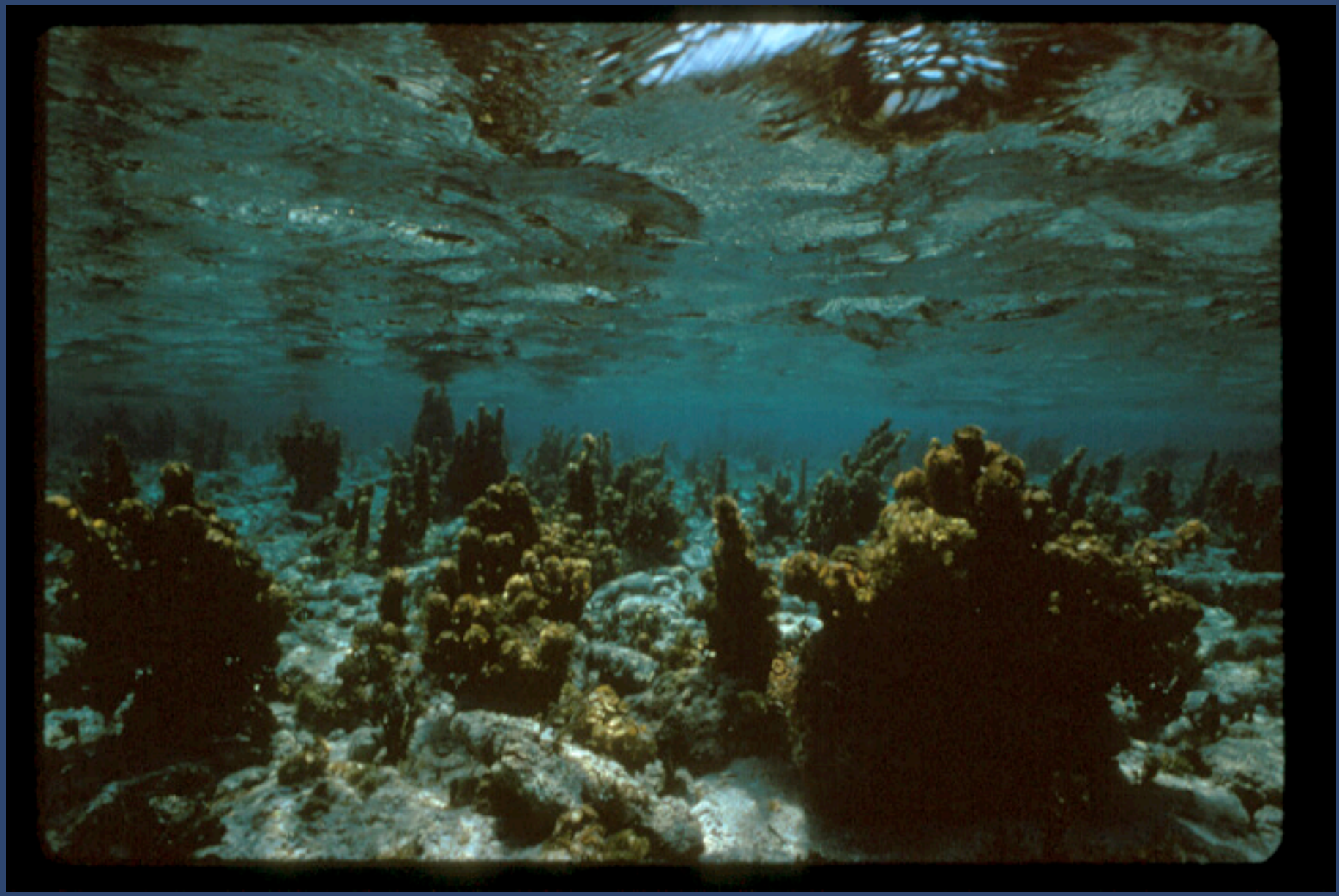


Parrots fish, very effective grazers.
Make 1/2 of the sand in the tropics!

Back-reef in Belize in the early 1980s

Lewis 1986

Back-reef in Belize now



Over population by brown algae with no herbivores

Discussions" about Causes (coral necrophilia)

Causes:

- Herbivore loss
- Nutrient addition
- Global change (>SST; <pH)
- Disease
- Etc.

Are seaweeds a cause or a consequence of coral decline

Are all herbivores the same (NO)

Does diversity matter? (YES)

Science Questions (M. Hay Lab)

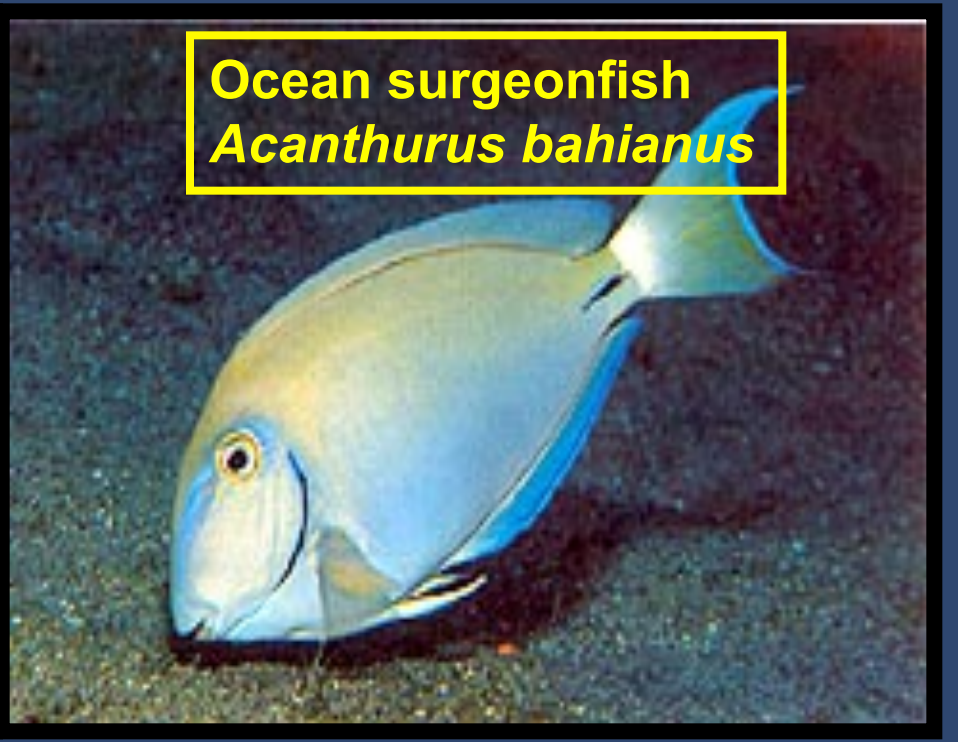
1. How does richness of herbivorous fishes affect macroalgal abundance and species composition?

2. What are the effects of herbivore richness on coral survivorship/growth?

3. What are the species-specific effects of particular herbivorous fishes on reef communities?

Analysis of Herbivores

- Robust mouthparts
- Grinding pharyngeal mill
- No stomach
- Mechanically breaks algal cells



- Finer mouthparts
- No grinding apparatus
- Acidic stomach
- Chemically lyses algal cells

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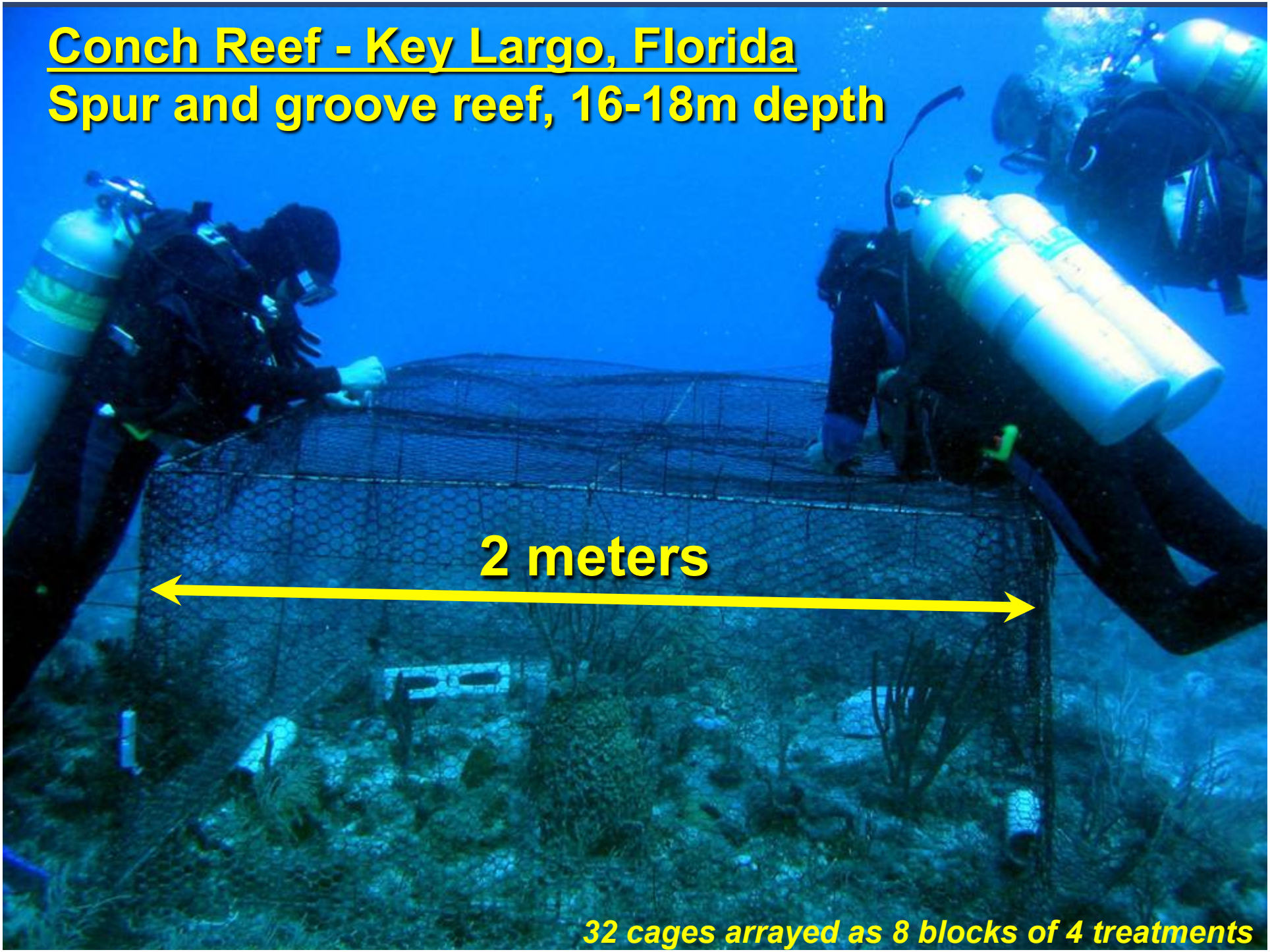
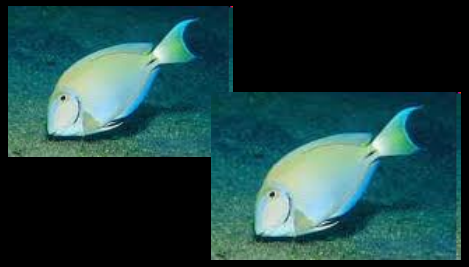
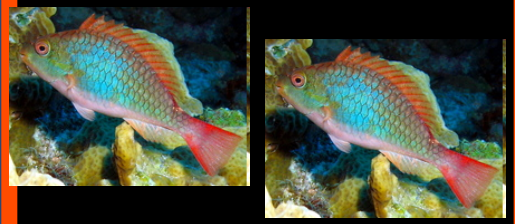

Conch Reef - Key Largo, Florida
Spur and groove reef, 16-18m depth
2 meters
32 cages arrayed as 8 blocks of 4 treatments

Herbivores Experimental Treatments

Single-species



Single-species



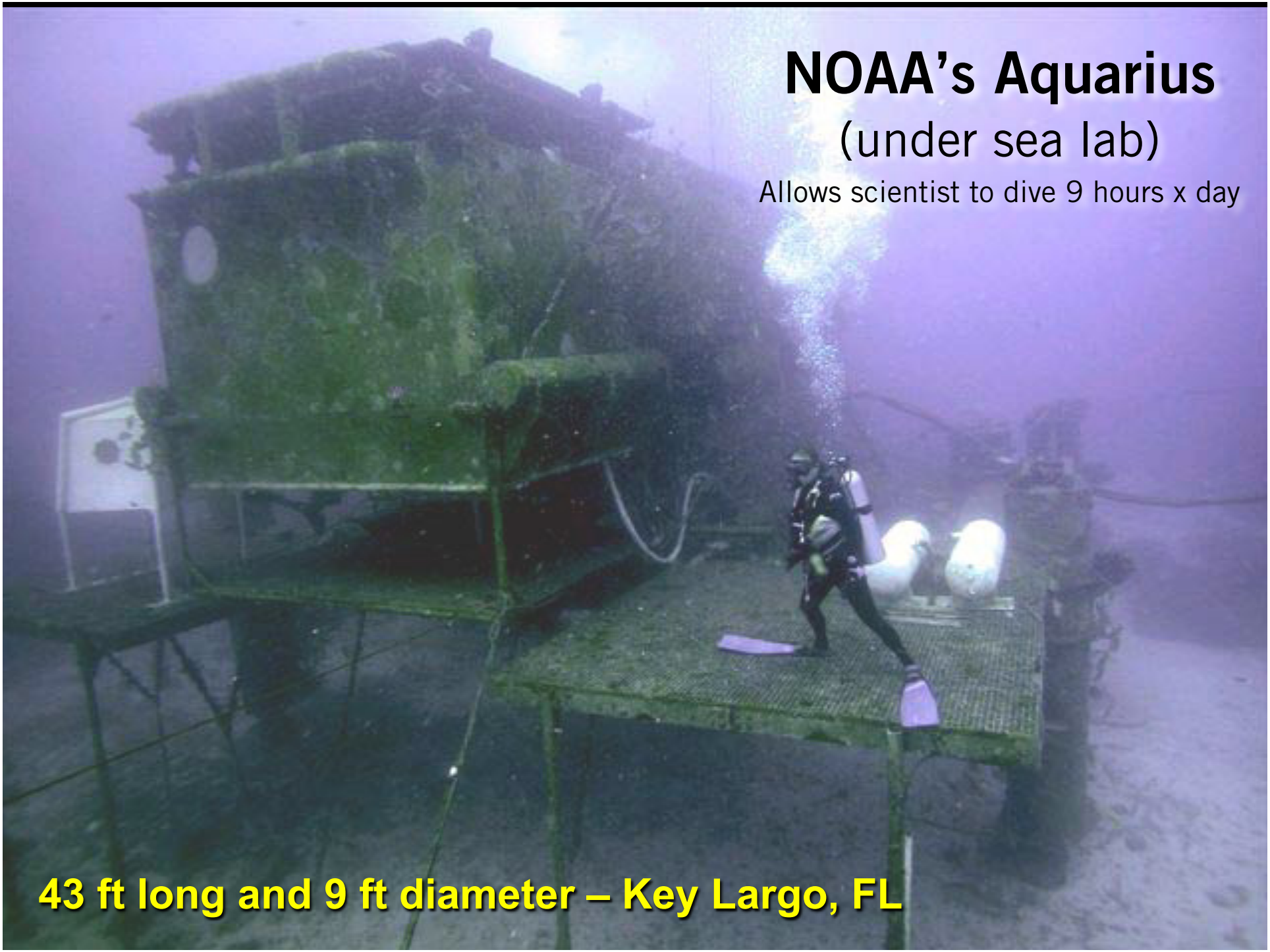
N = 8 per treatment Two-factor ANOVA

Mixed-species

Exclosure

No Fish

Repeated over 4 years with durations of 7-10 months/yr


NOAA's Aquarius
(under sea lab)
Allows scientist to dive 9 hours x day
43 ft long and 9 ft diameter – Key Largo, FL

Herbivores Experimental Treatments

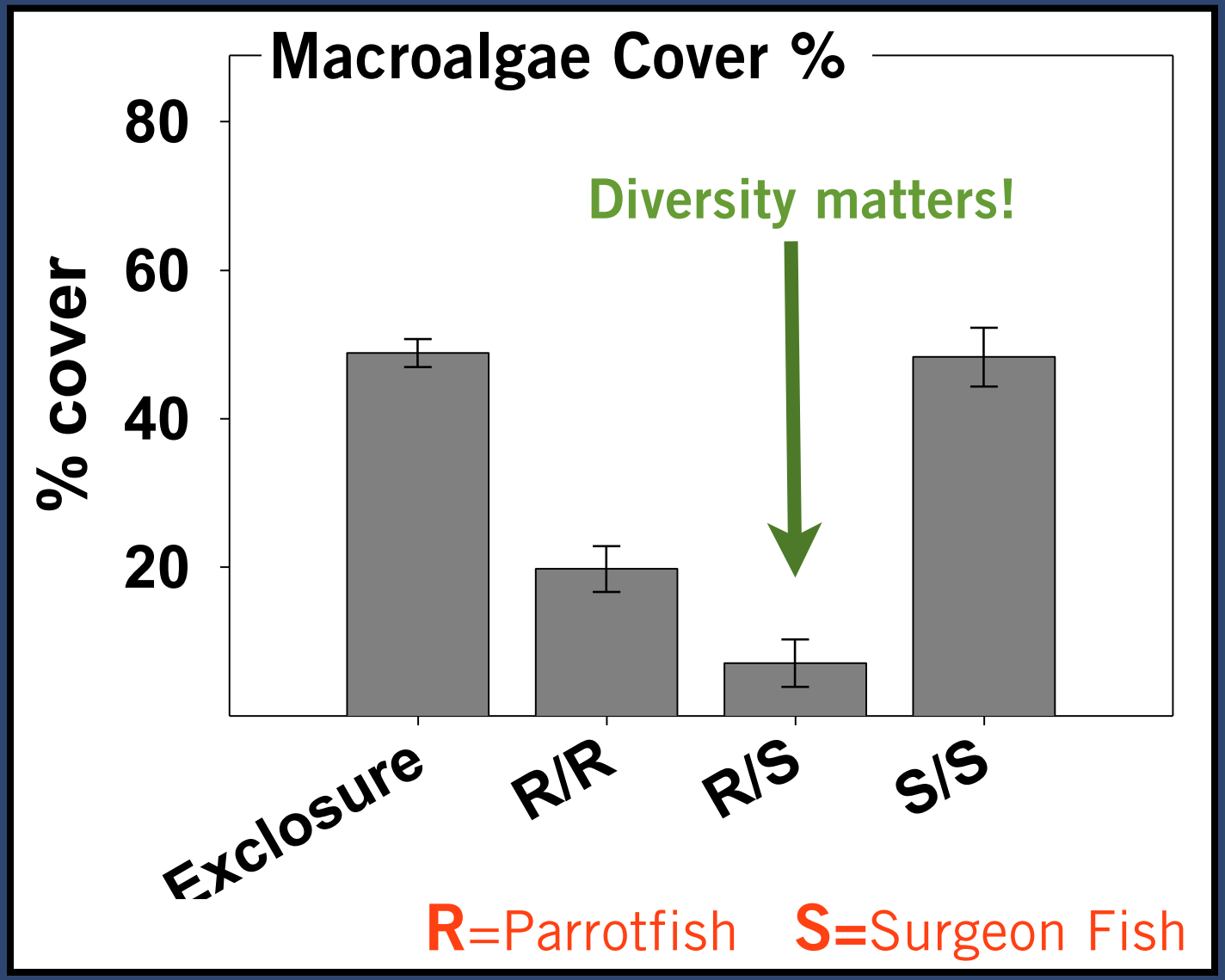
Effects of treatments on:

Seaweed community structure

Herbivore feeding preferences

Coral survivorship and growth

Herbivores Experimental Treatments

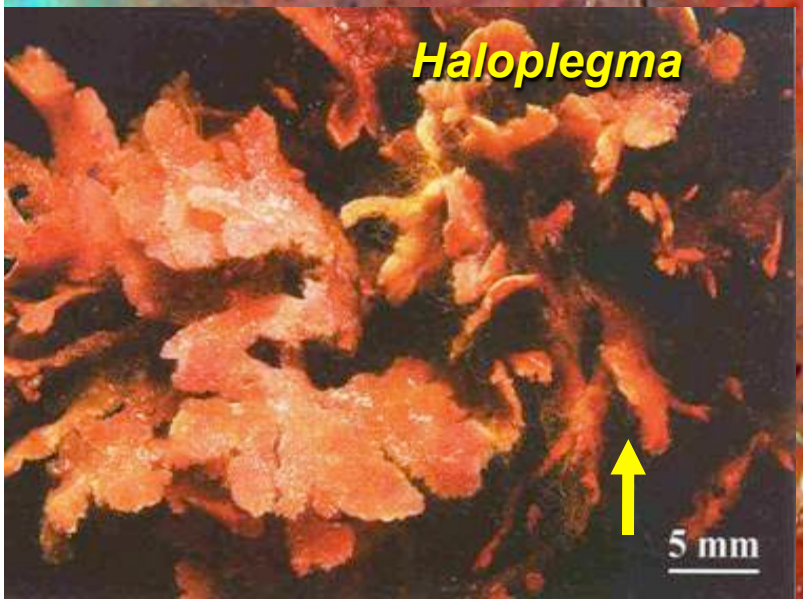


After 10 months in year 1

Redband-only cage

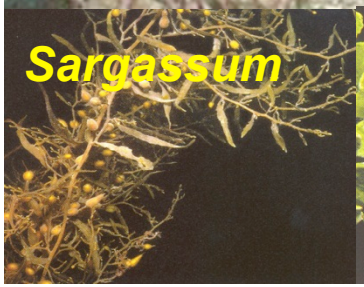
Cage dominated by red algae, very rare to find

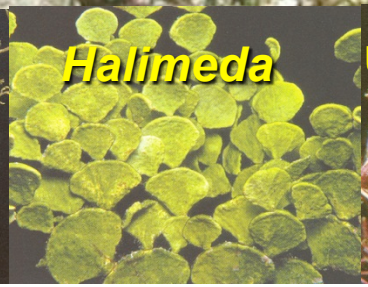
Kallymenia

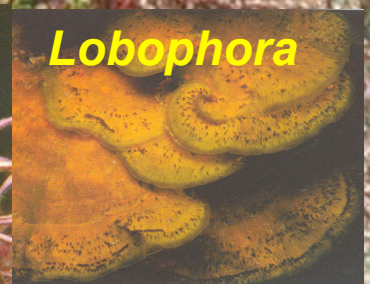


Surgeonfish-only cage

Cage dominated by leathery seaweeds and tough, calcified red and green seaweeds.





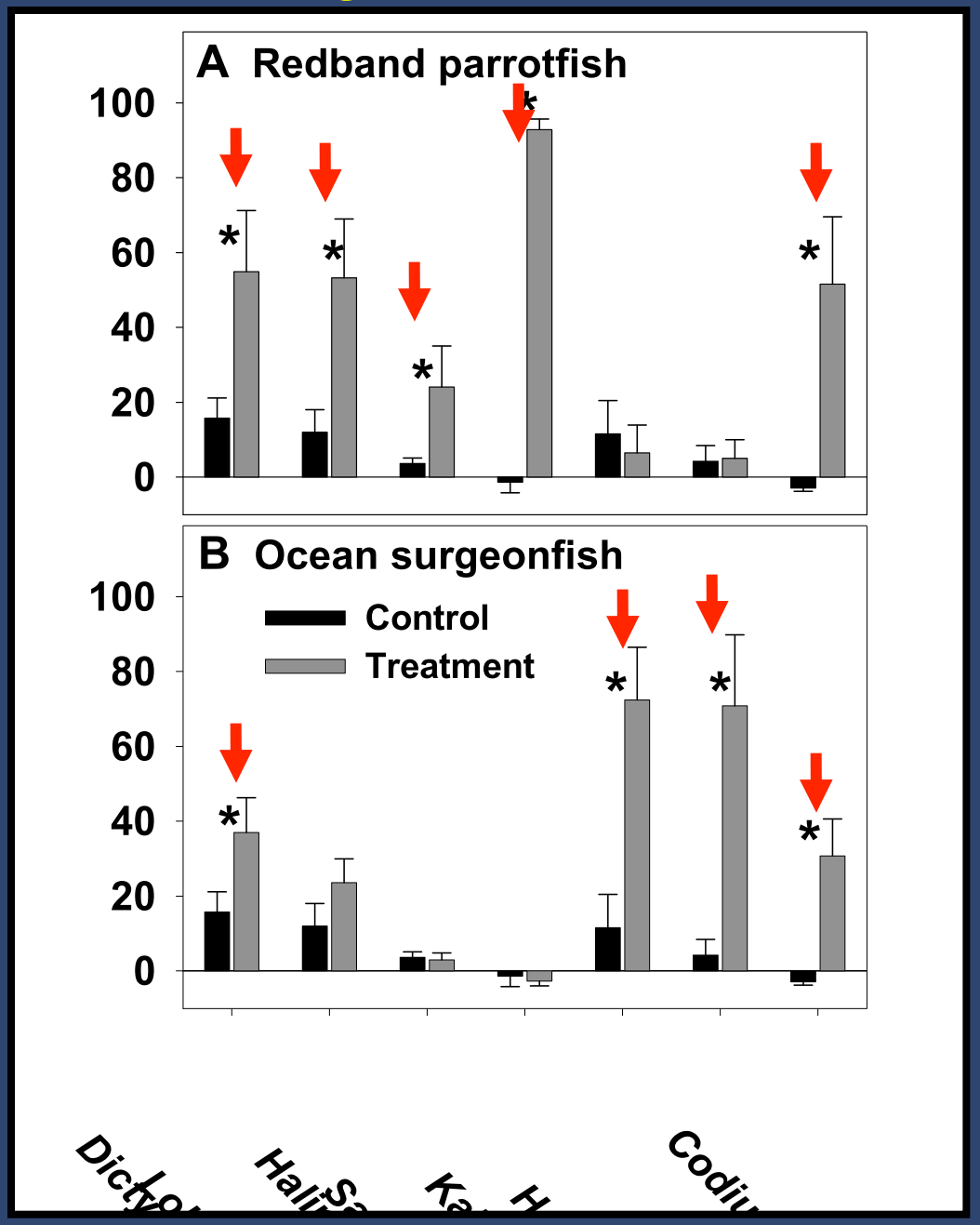


Mixed-species cage

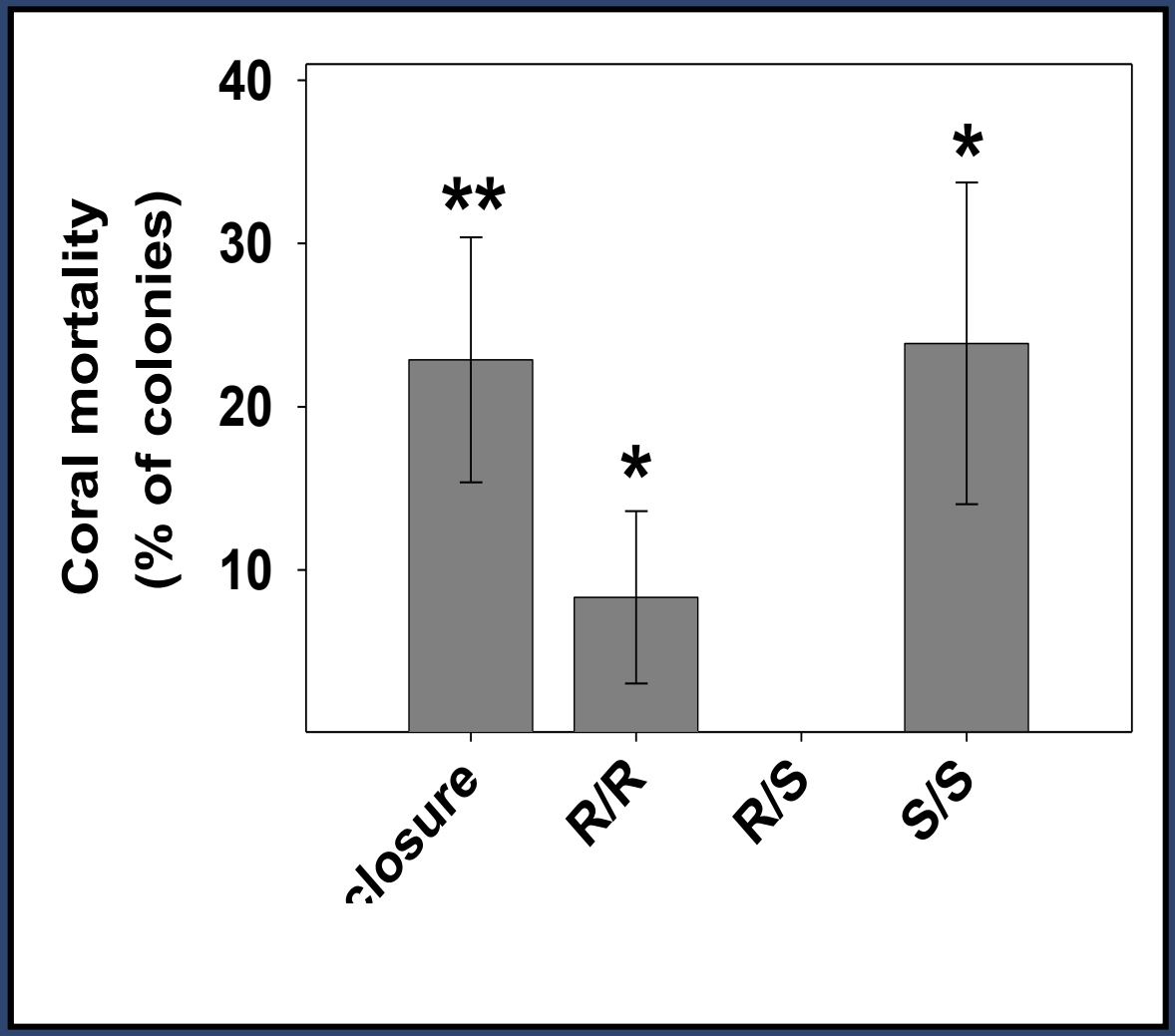
lacked most macroalgae and dominated by community of turf and crustose coralline algae

these algae stimulate coral larvae deposition

Feeding Preferences: Year 1



Fish richness promotes coral health



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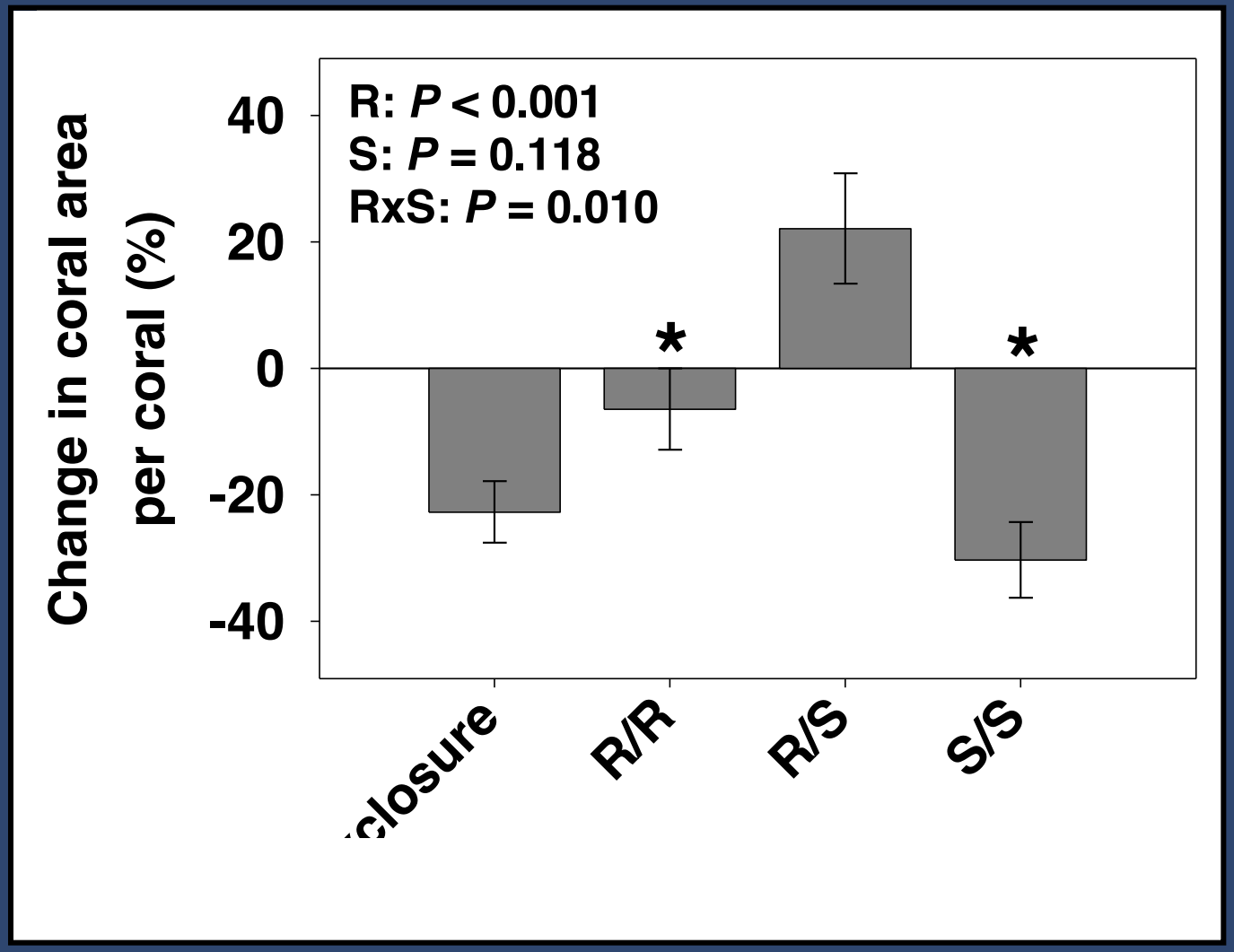
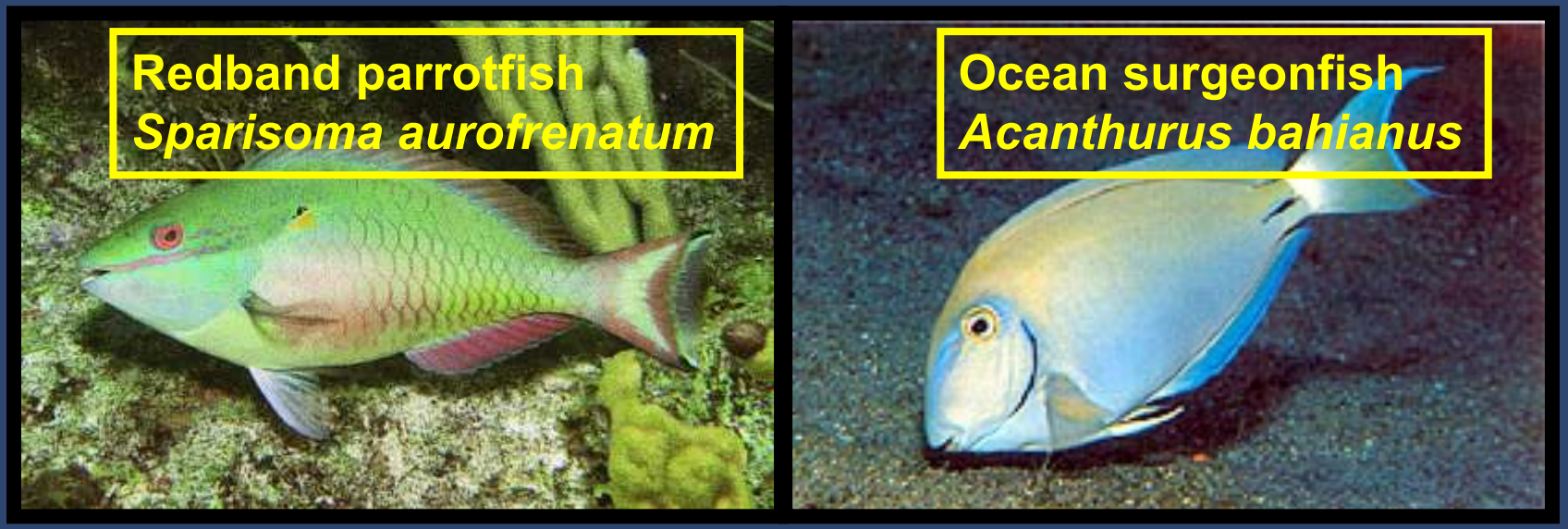


Tropical Corals Ecosystems



- **Complementary feeding on macroalgae**
- **Herbivore richness suppresses macroalgae, facilitates corals**
- **Significant transgressive overyielding**

The biotic death spiral on coral reefs