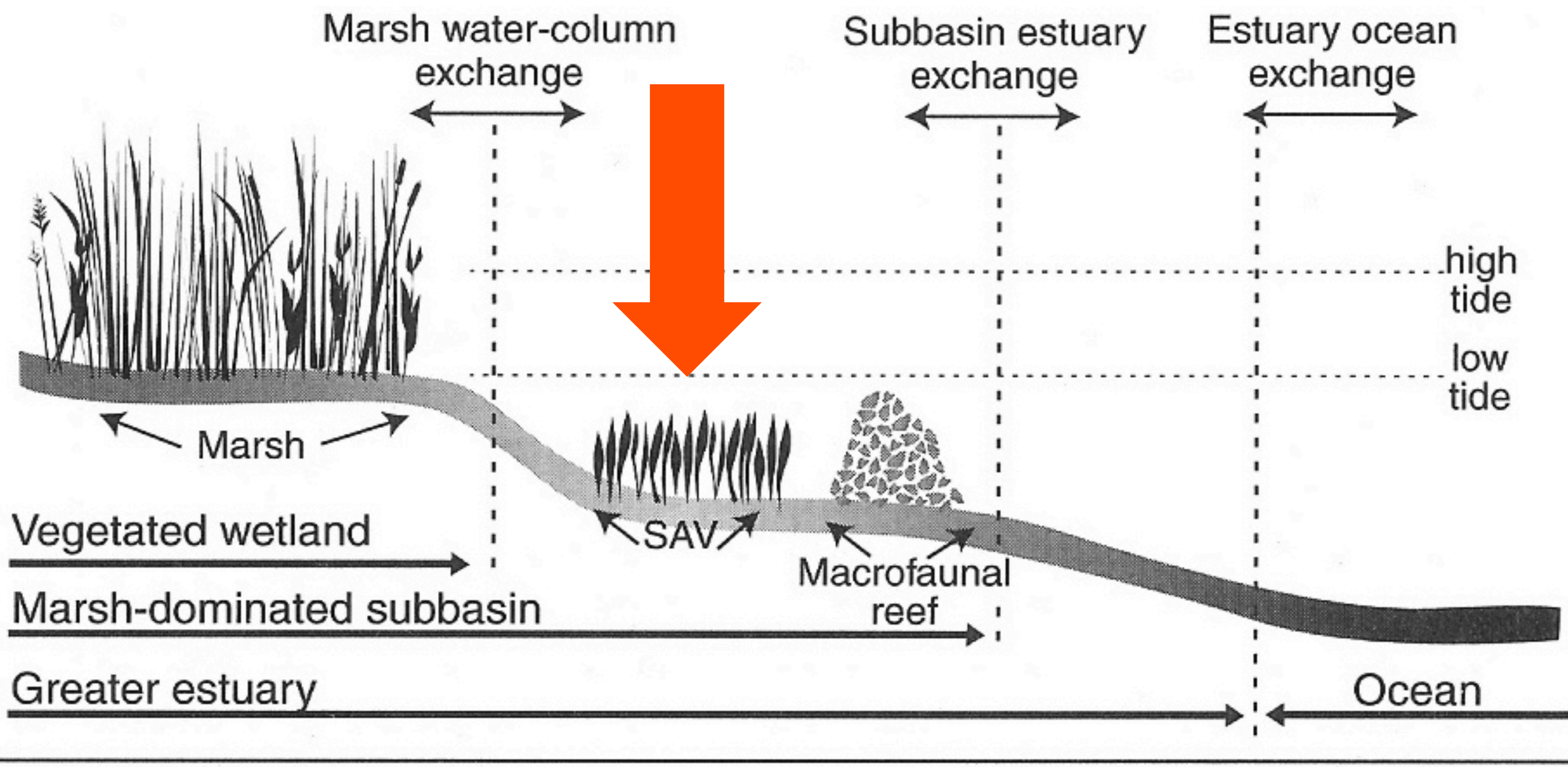
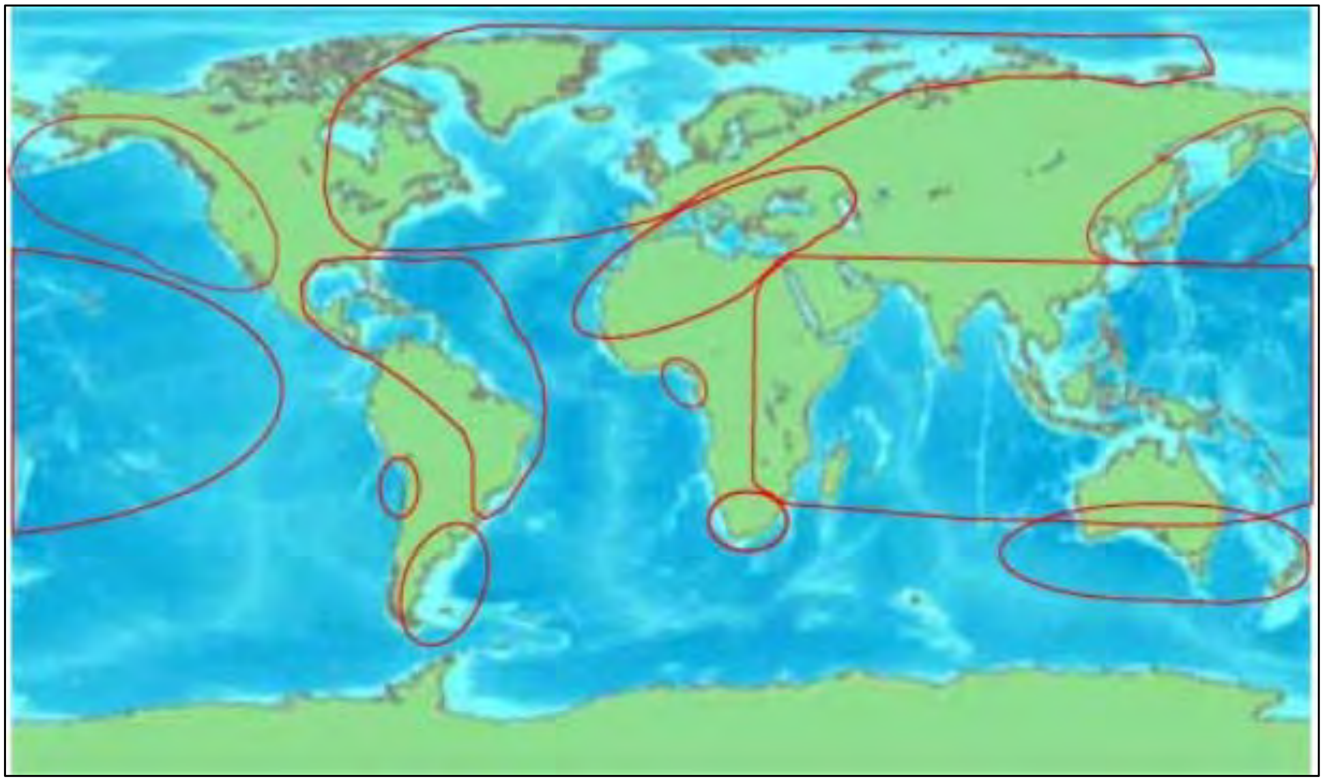
Coastal Ecology and Management: Seagrasses and Coral Reefs

Seagrasses: Formation and development



(Mitsch & Gosselink 2000)

Seagrasses: Formation and development



Temperate - Boreal Regions

- 4 genera
- ~ 28 species

Tropical - Subtropical Region

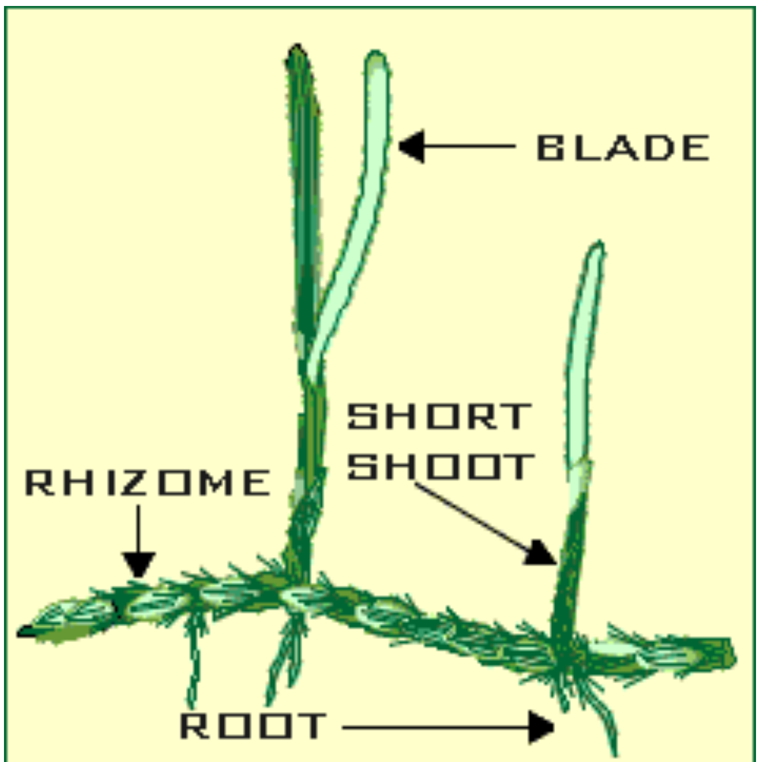
- 7 genera
- ~ 30+ species

Eurythermal

- *Ruppia*
- ~ 2-10 spp.

Seagrasses: Formation and development

Seagrasses: Formation and development



- **Blades** – Photosynthesis, Nutrient uptake
- **Short shoot** = stem
- **Rhizomes** –Anchoring, Propagation, Nutrient absorption, Gas exchange
- **Roots** - Nutrient uptake, Anchoring (binding), Gas exchange

Seagrasses: Formation and development

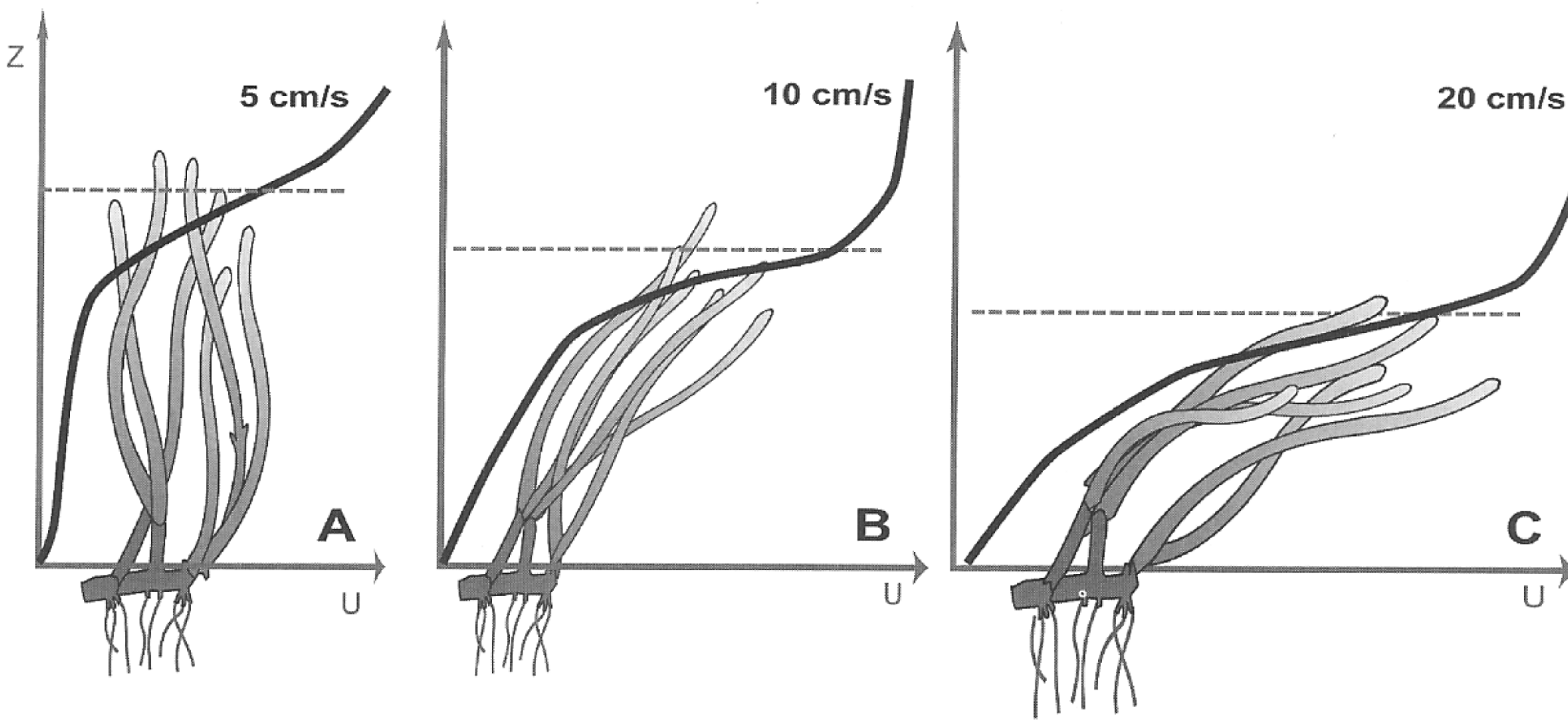
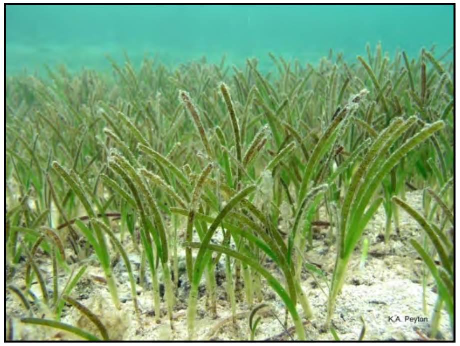


Fig. 5. Vertical velocity (*U*) profiles (thick solid lines) in seagrass canopies exposed to 5 cm s^{-1}(A), 10 cm s^{-1} (B) and 20 cm s^{-1} (C). *Z*, distance above the sediment interface. Note that, as velocity increases, the angle of bending of the canopy increases and the canopy height (dashed horizontal line) decreases. Based on a flume experiment using a short (16 cm) and dense (1,000 shoots m^{-2}) *Zostera marina* canopy (Gambi et al. 1990).


Seagrasses: Formation and development
K.A. Peyton
SGB 8

Seagrasses: Community dynamics

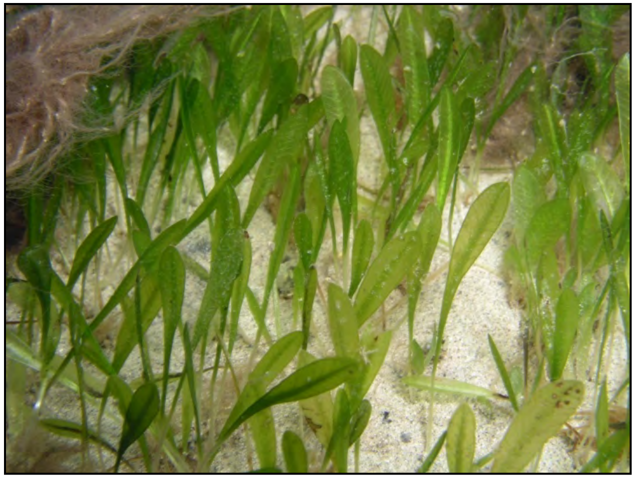


Halodule

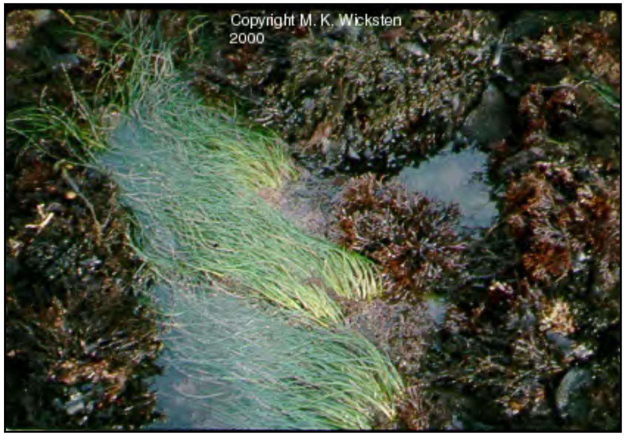
Zostera

Enhalus

Posidonia



Halophila



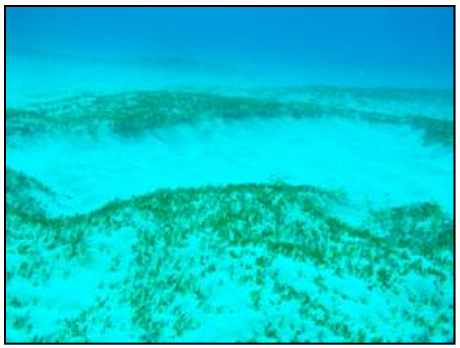
Phyllospadix

(K. Peyton 2007)

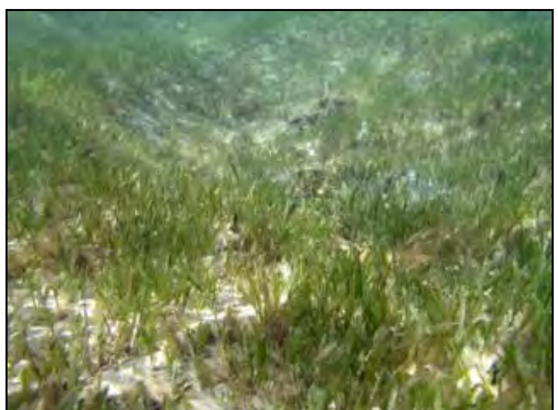
Seagrasses: Community dynamics

Endemic in Hawaii

Halophila decipiens



Halophila hawaiiana



Invasive in Hawaii

Ruppia maritima

(K. Peyton 2007)

Seagrasses: Community dynamics

Endemics: S. shore of Moloka‘i

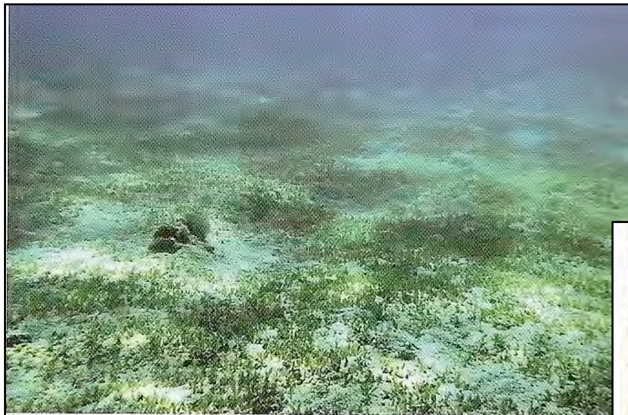


Figure 19. A meadow of the endemic seagrass *Halophila hawaiiana* growing along the south shore of Moloka‘i. Leaves of *Halophila* are usually less than 5 cm (2 in) in height, but meadows can cover several hundred square meters.

(Field et al. 2008)

Figure 20. The common growth form of the endemic Hawaiian seagrass *Halophila hawaiiana* (note the oval or paddle-shaped leaves) growing on the shallow reef flats of south Moloka‘i.

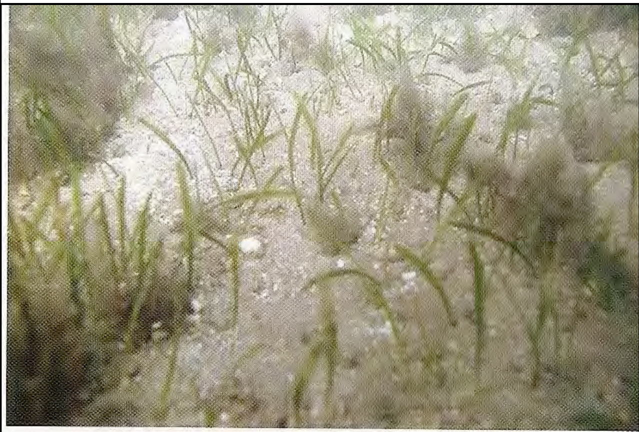
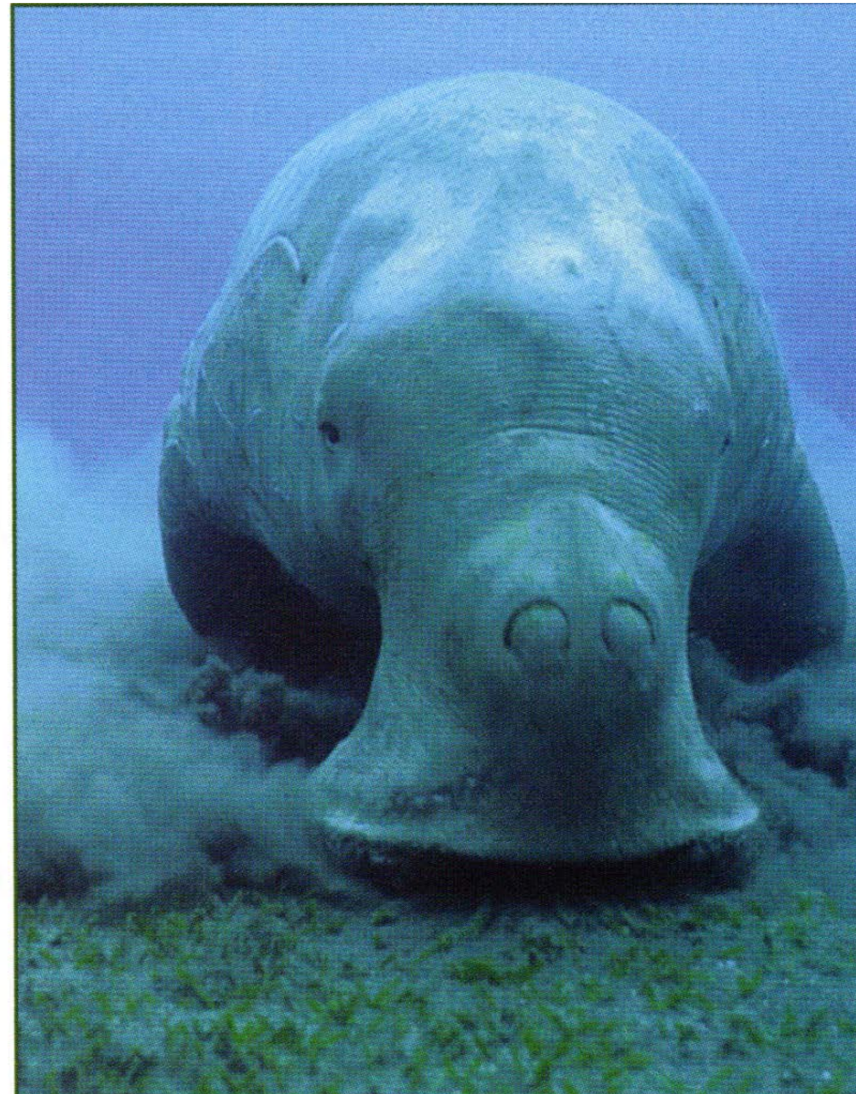


Figure 21. The more elongated and linear-shaped leaves of a different growth form of *Halophila hawaiiana* can also be found growing on the shallow reef flats of Moloka‘i.

Grazers – Sea Cows

A manatee [*Trichechus manatus*], *feixe-boi* in Portugese, over a *Halodule wrightii* bed in Recife, Brazil.

(Green & Short 2003)



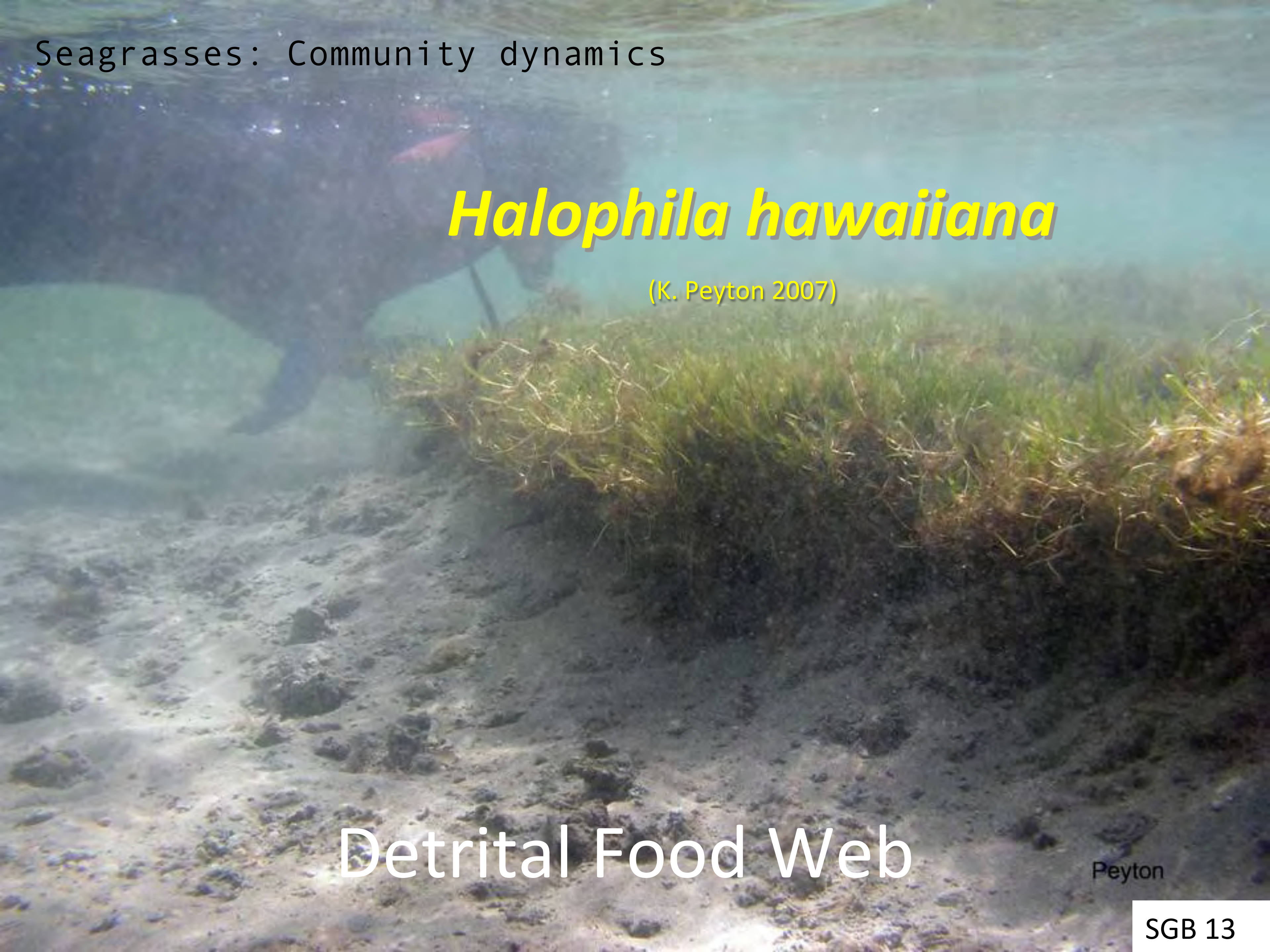
Dugong feeding on *Halophila ovalis*, Vanuatu, western Pacific islands.

Grazers – Turtles and Sea Horses

A sea horse, *Hippocampus whitei*, amongst *Zostera capricorni* in Sydney Harbour, Australia.

Green turtle (*Chelonia mydas)* resting on a bed of *Thalassodendron ciliatum* in Watamu Bay, Kenya

(Green & Short 2003)


Halophila hawaiiana
(K. Peyton 2007)
Detrital Food Web
Peyton

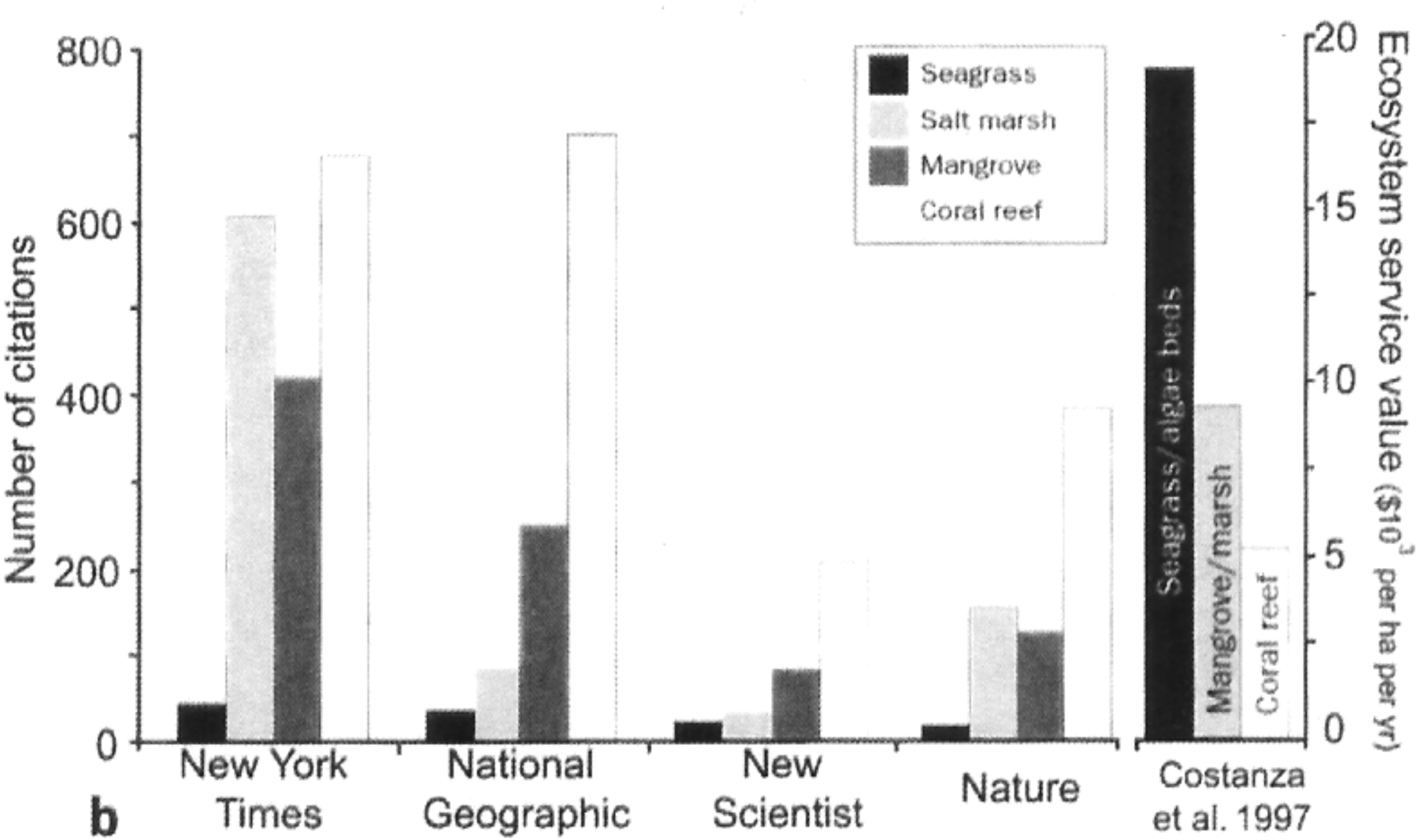
Seagrasses: Community dynamics

Carnivores: Leafy Sea Dragon (*Phycodurus eques*) found in southern & western Australia

Seagrasses: Community dynamics

Carnivores: Weedy Sea Dragon (*Phyllopteryx taeniolatus*)

Seagrasses: Ecosystem services



(Orth et al. 2006)

Seagrasses: Anthropogenic stressors

- Sedimentation
- Sewage discharge
- Non-point pollution
- Algal epiphytes

(K. Peyton 2007)

Invasive Species

Caulerpa taxifolia - cultured strain

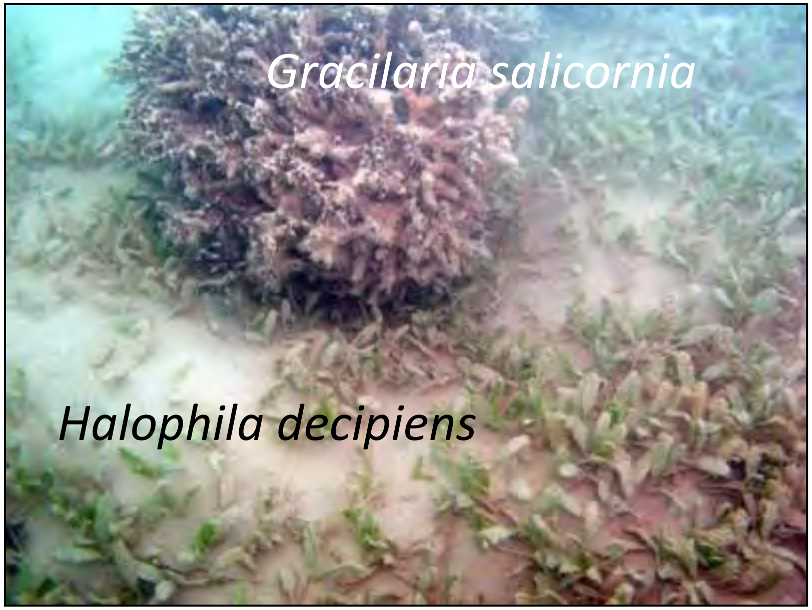
Mediterranean Sea; California; Australia

Posidonia oceanica - endemic seagrass

Aquarium dumping

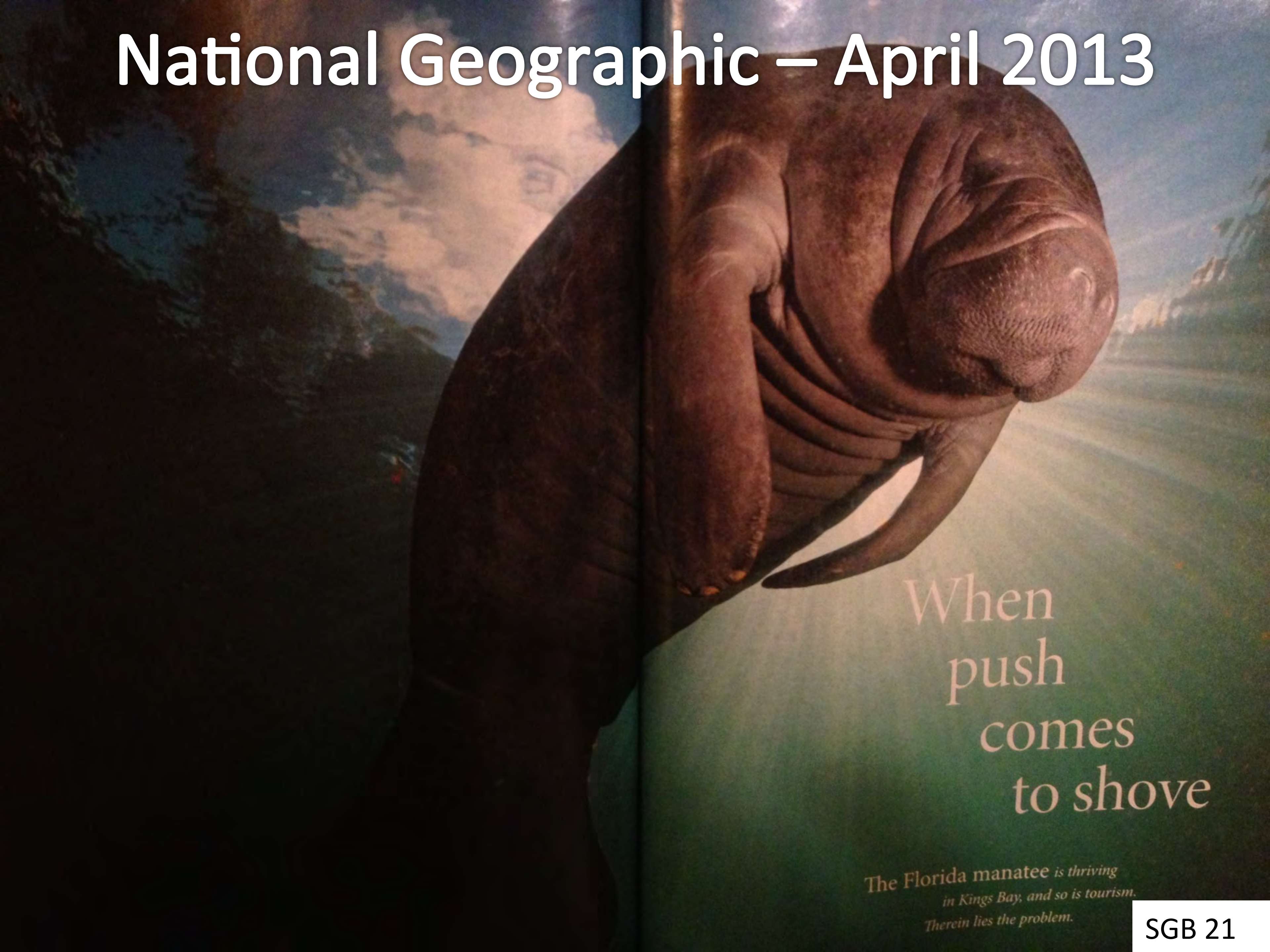
(K. Peyton 2007)

Displacement and Smothering



(K. Peyton 2007)

National Geographic – April 2013



Ecotourism


Kayaks crowd Three Sisters Springs, where people and manatees maintain a controversial coexistence. To reach the warm water they need to survive winter, manatees often must run a gantlet of kayakers and snorkelers eager to interact with the marine mammals.

(Spalding et al. 2001)

Global Distribution – Coral Reefs

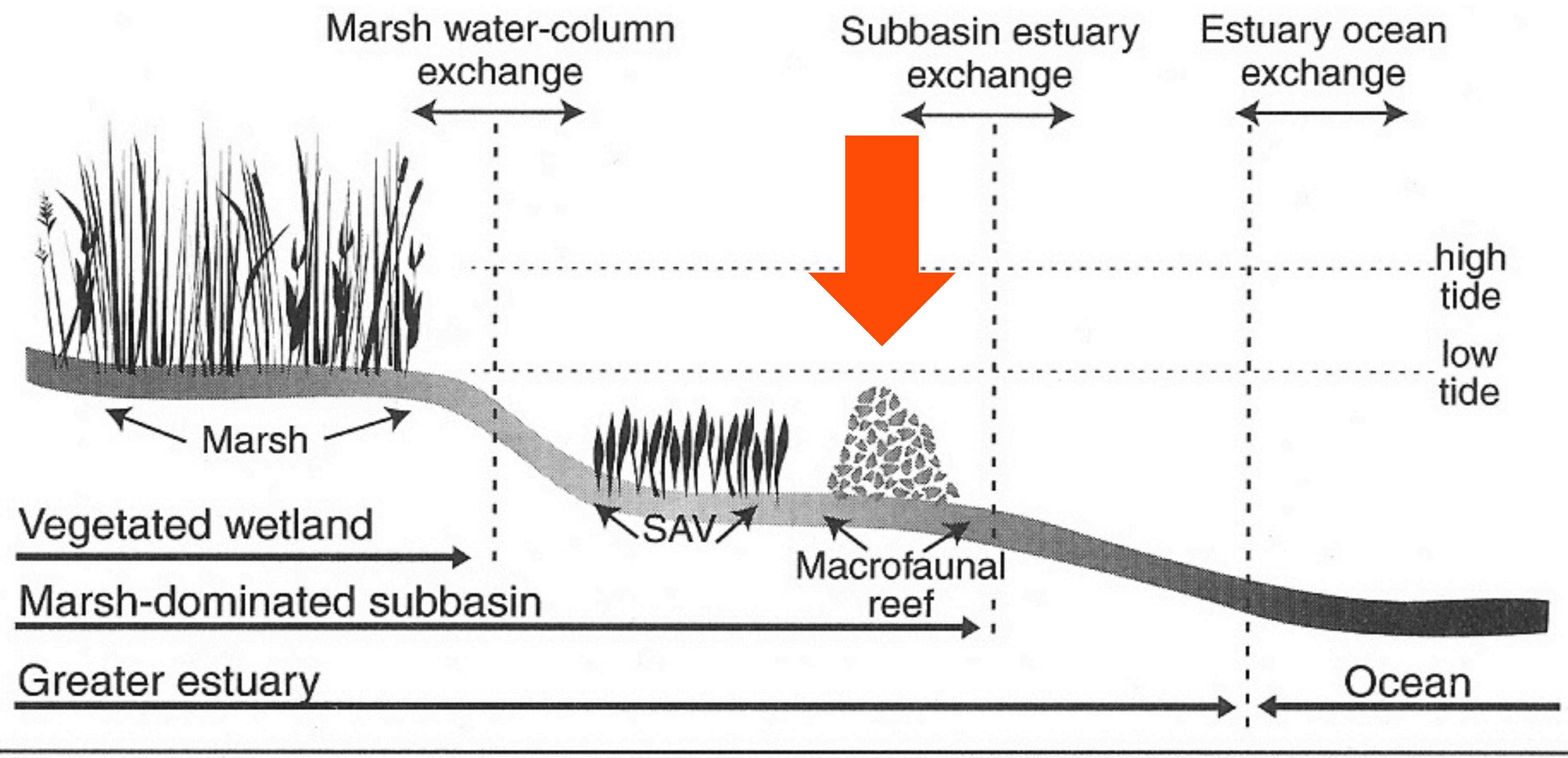
What characteristics do coral reefs require?

-

-

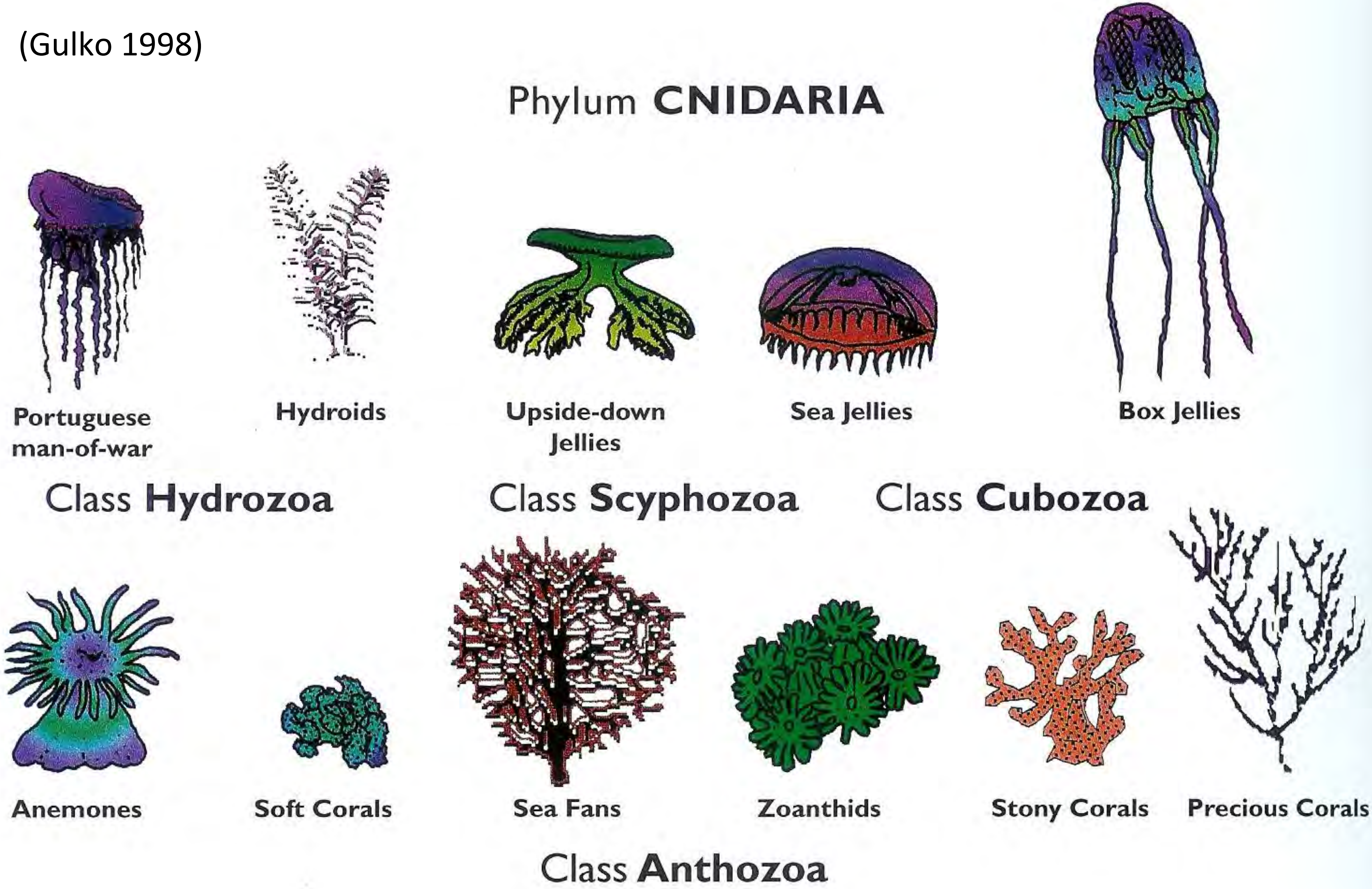
-

Coral Reefs: Formation and Development



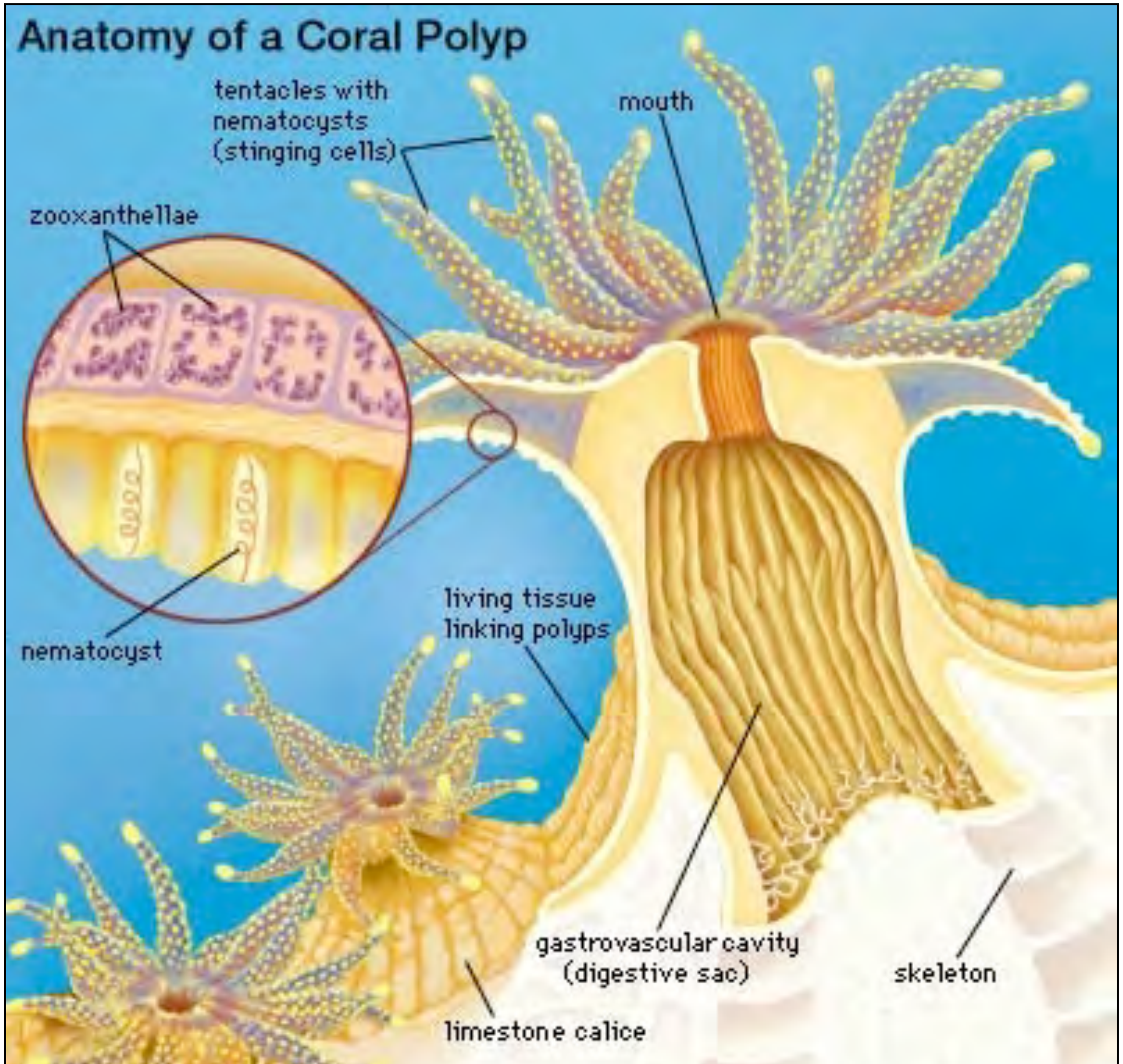
(Mitsch & Gosselink 2000)

(Gulko 1998)



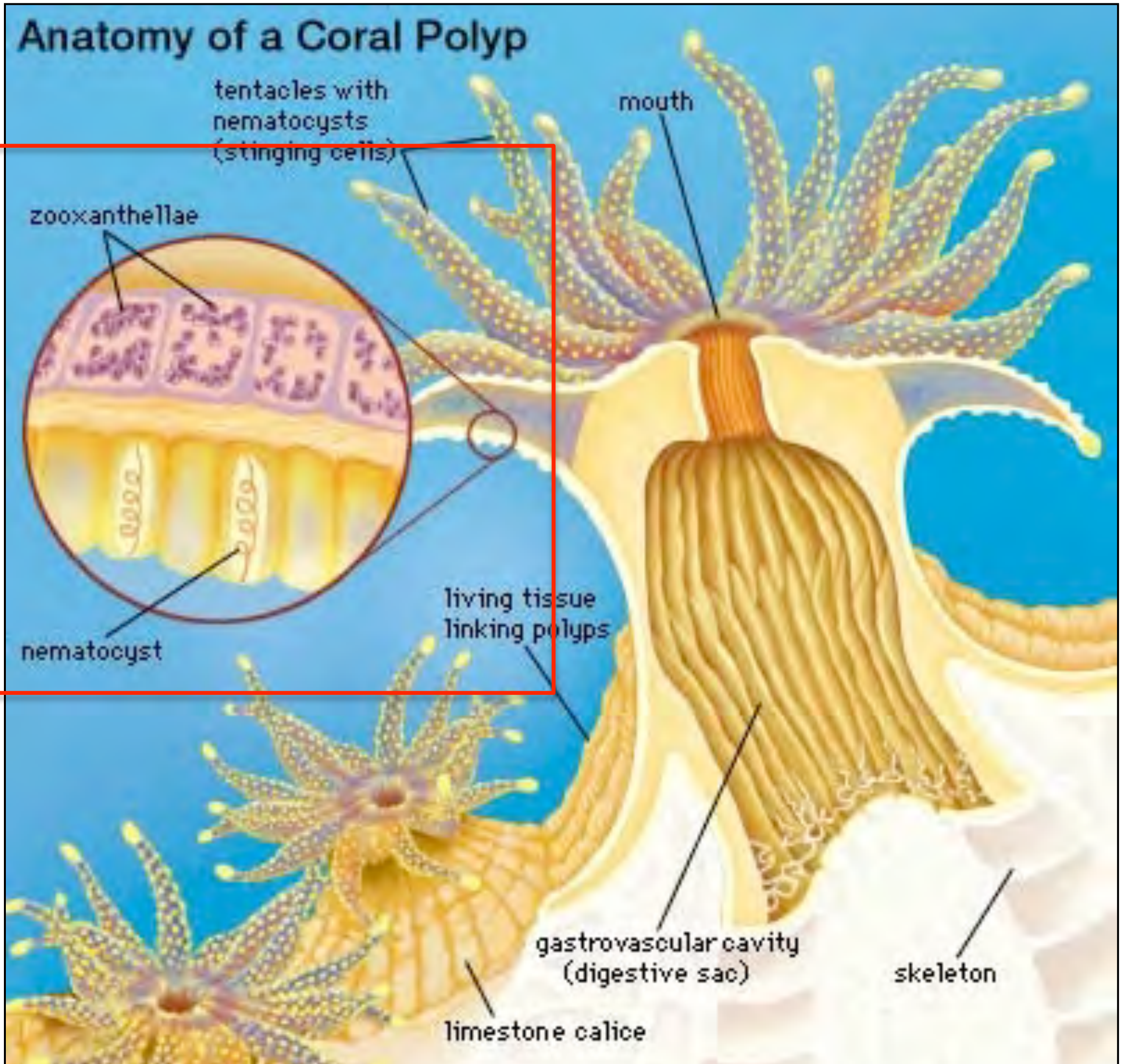
Simple body structure, tentacles, mouth, digestive cavity

Coral polyps



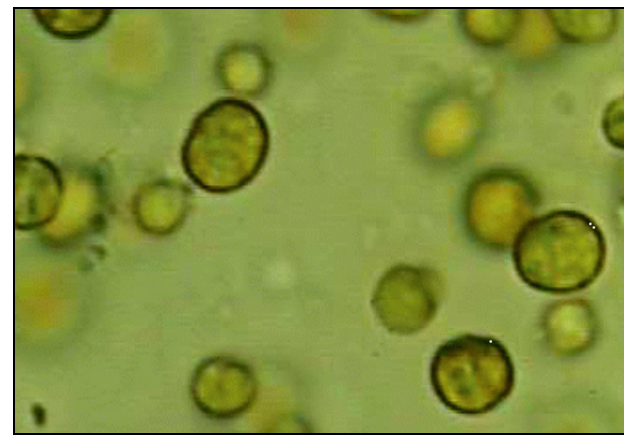
Animal characteristics

Coral polyps



Zooxanthellae

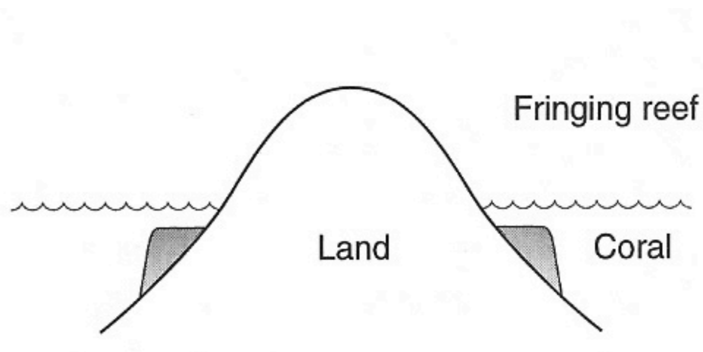
Animal characteristics



Plant characteristics

Coral Reefs: Formation and Development

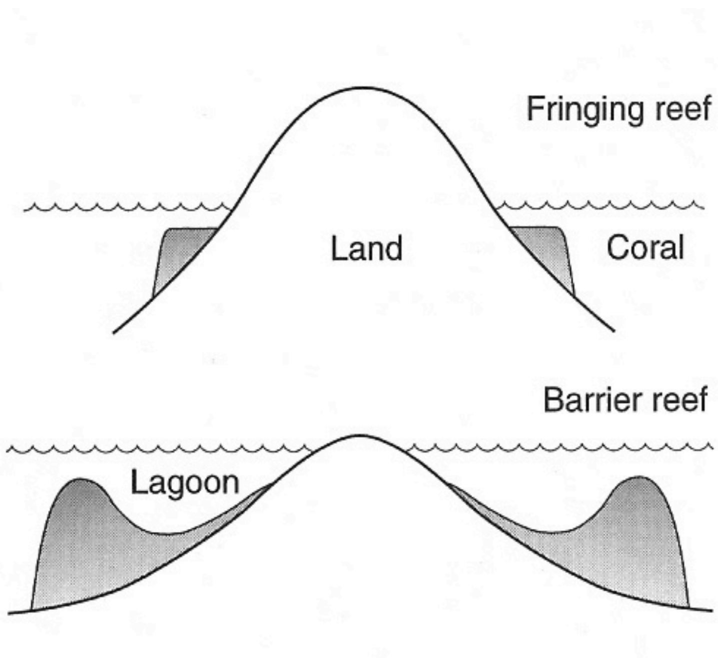
Fringing reef: found growing as fringe attached to land mass

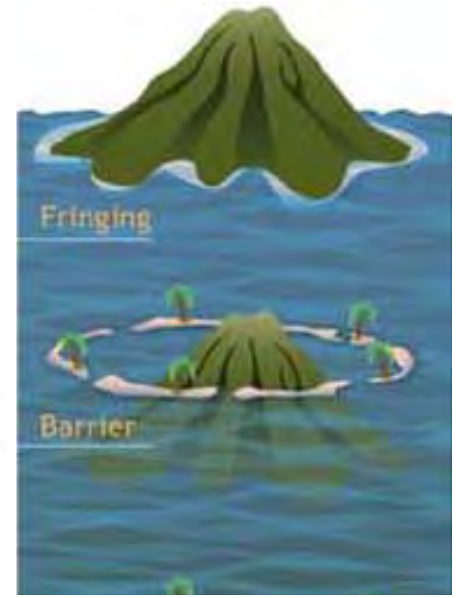


Coral Reefs: Formation and Development

Fringing reef: found growing as fringe attached to land mass

Barrier reef: occur out to sea creating a shallow lagoon b/w reef & land



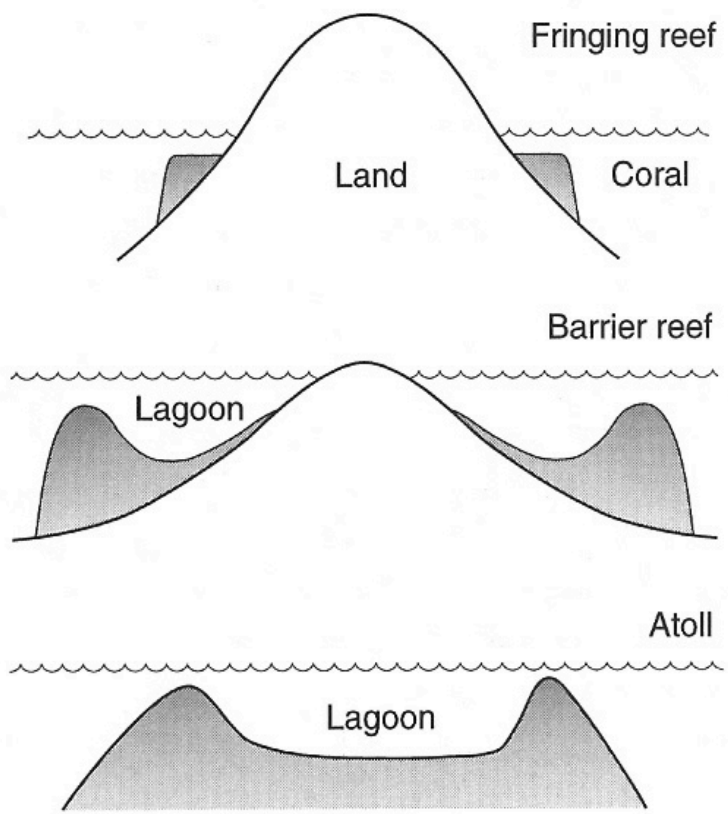


Coral Reefs: Formation and Development

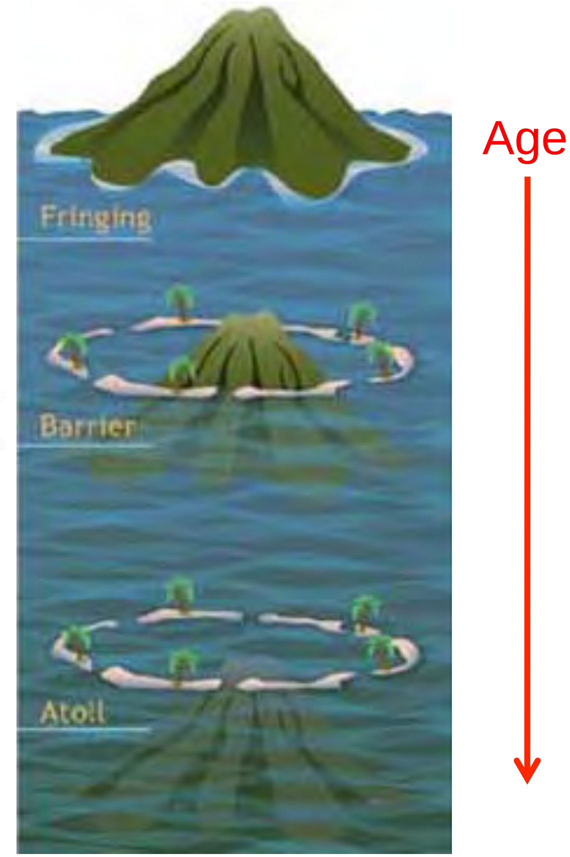
Fringing reef: found growing as fringe attached to land mass

Barrier reef: occur @ some dist. out to sea creating a shallow lagoon b/w reef & land

Atoll: isolated structure surrounded by deep H_2O that forms a ring of coral w/ central lagoon



(Mann 2000)



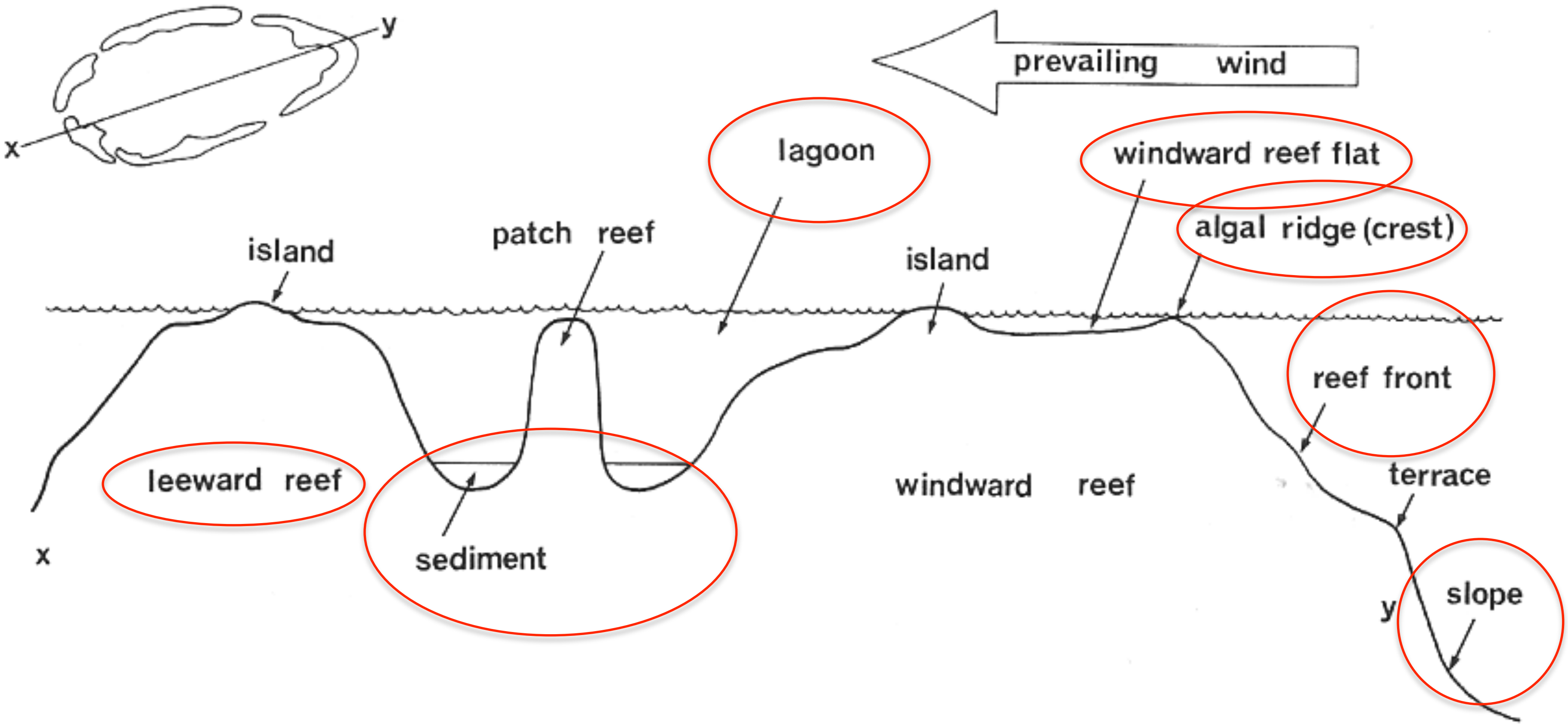
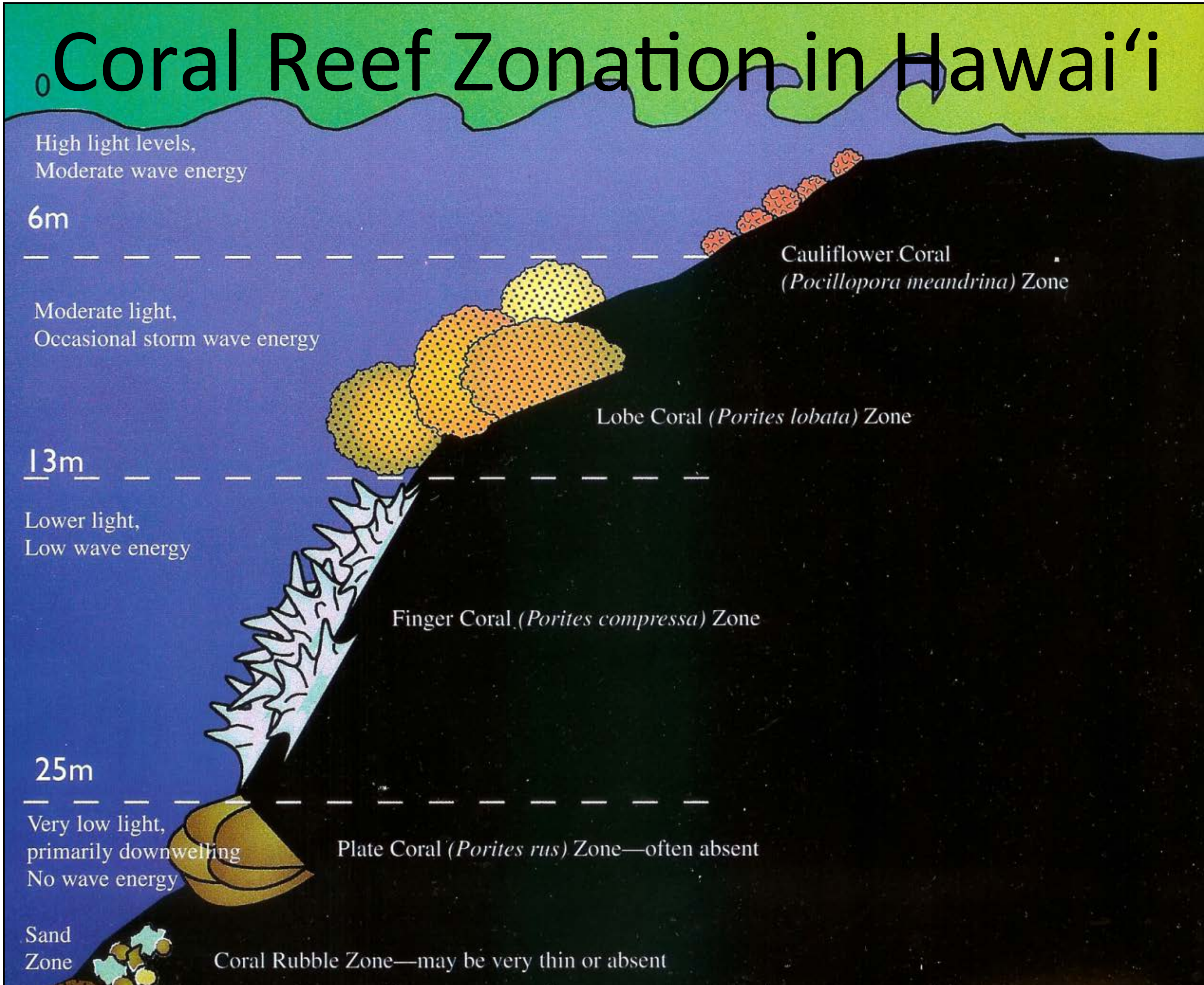


Figure 6.3 Diagrammatic section of a typical atoll showing the major subdivisions of the reef complex.

Reef Functional Zones


Coral Reef Zonation in Hawai'i
0
High light levels,
Moderate wave energy
6m
Cauliflower Coral
(Pocillopora meandrina) Zone
Moderate light,
Occasional storm wave energy
Lobe Coral (Porites lobata) Zone
13m
Lower light,
Low wave energy
Finger Coral (Porites compressa) Zone
25m
Very low light,
primarily downwelling
No wave energy
Plate Coral (Porites rus) Zone—often absent
Sand
Zone
Coral Rubble Zone—may be very thin or absent

(Gulko 1998)

Herbivorous reef fish

Damselfish
Family: Pomacentridae

Fiercely protective

Rabbitfish
Siganidae

Redlip parrotfish, pālukaluka,
Scarus rubroviolaceus

Sexually dimorphic

Surgeonfish
Acanthuridae

Achilles tang, pākuʻikuʻi
Acanthurus achilles

Active, aggressive seaweed grazer

butterflyfish, lauhau

Chaetodon quadrimaculatus

Direct coral grazers

Spotted puffer, ʻoʻopu hue

Arothron meleagris

Produces deadly toxin

Triggerfish

Balistidae

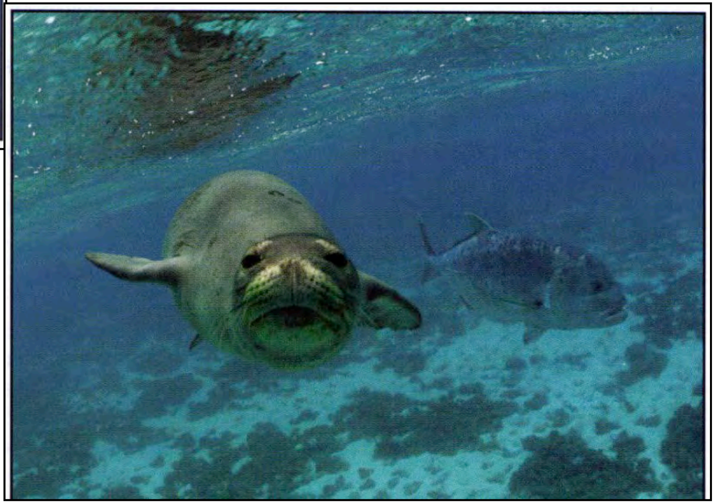
Lagoon triggerfish

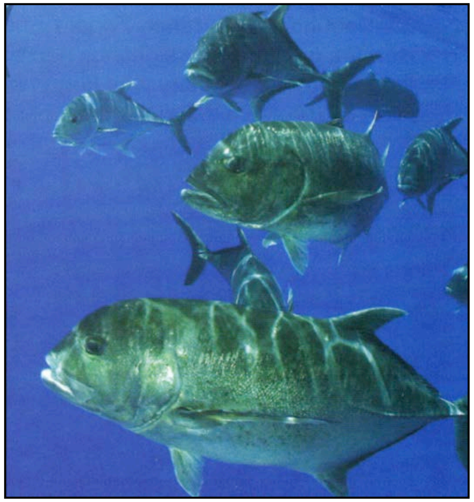
Reef triggerfish, humuhumu-nukunukuāpuaʻā, *Rhinecanthus rectangulus*

Spectacled Parrotfish

Chlorurus perspicillatus

Apex Predators

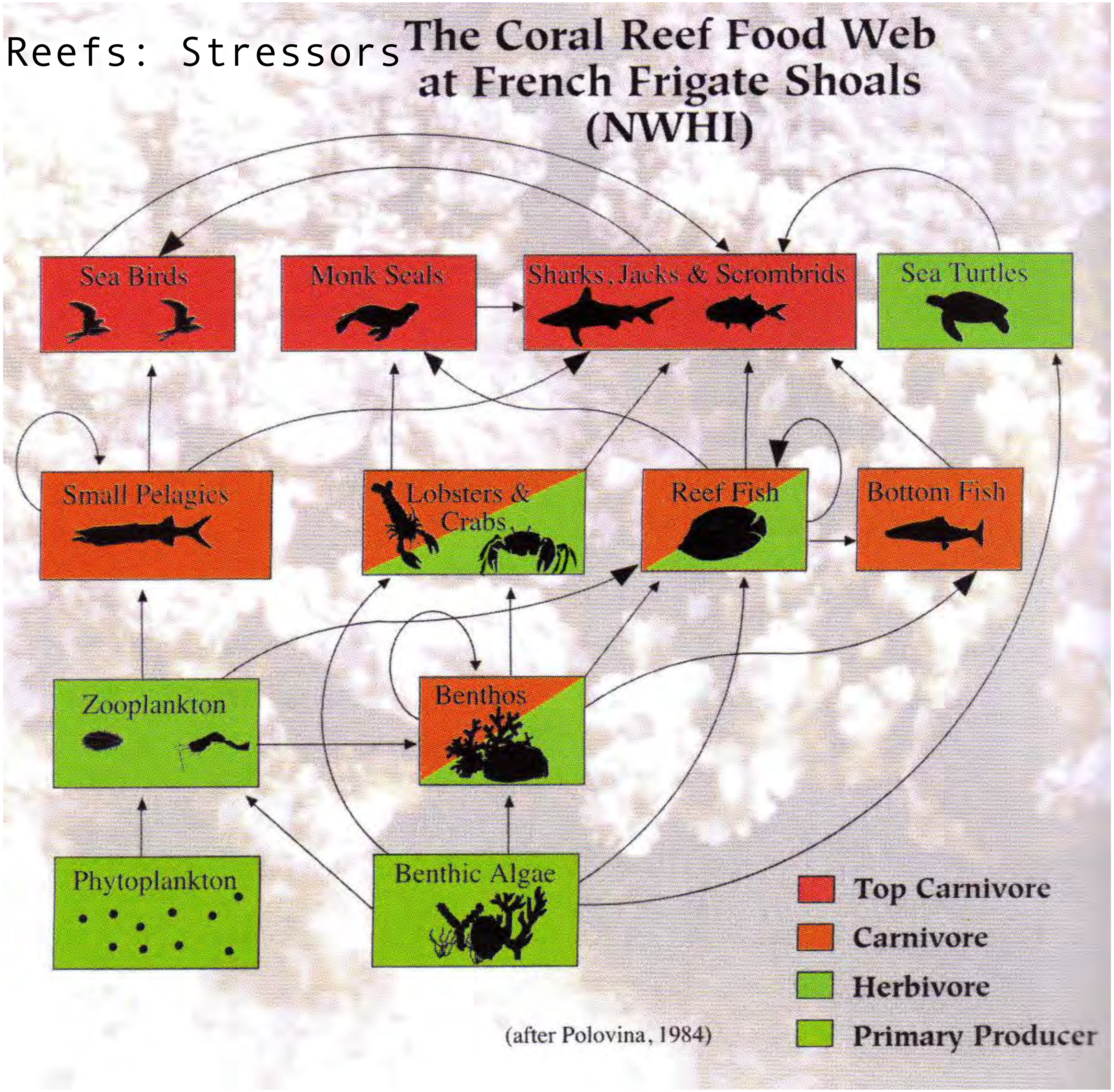


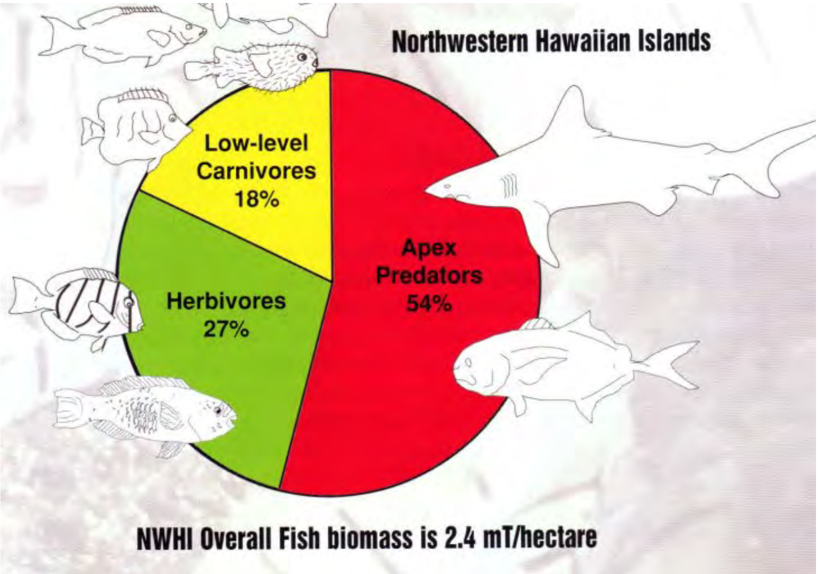


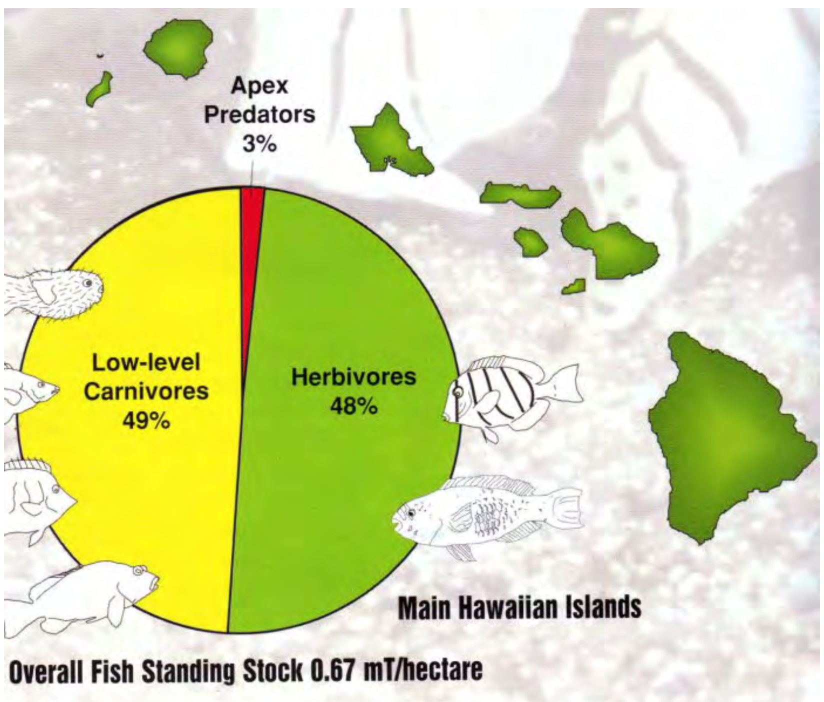
(Waddell 2005)

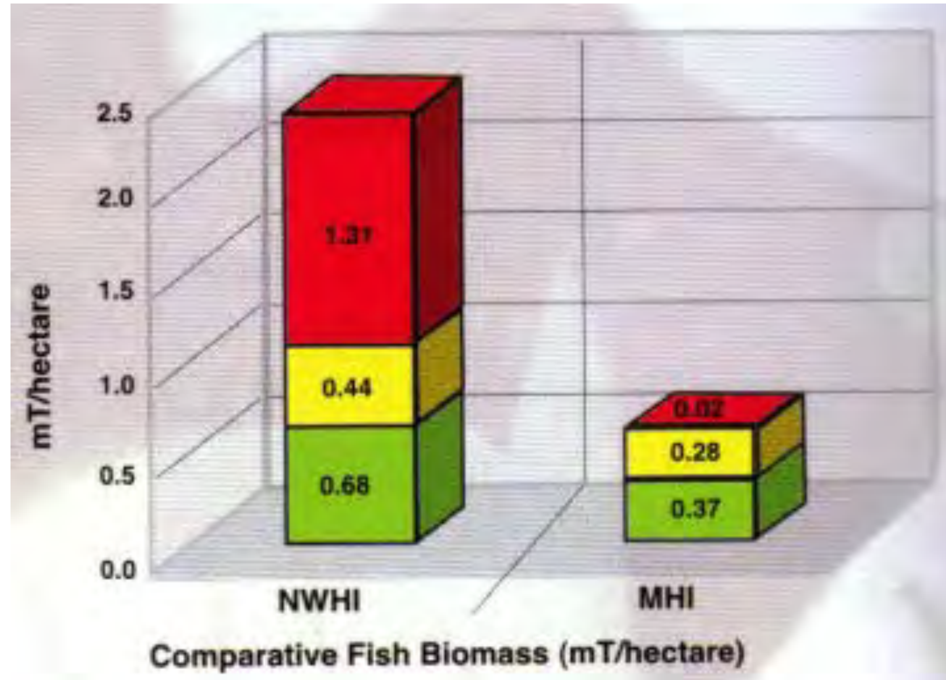
*Absent or reduced numbers and biomass in many systems, but still present in NWHI

Coral Reefs: Stressors





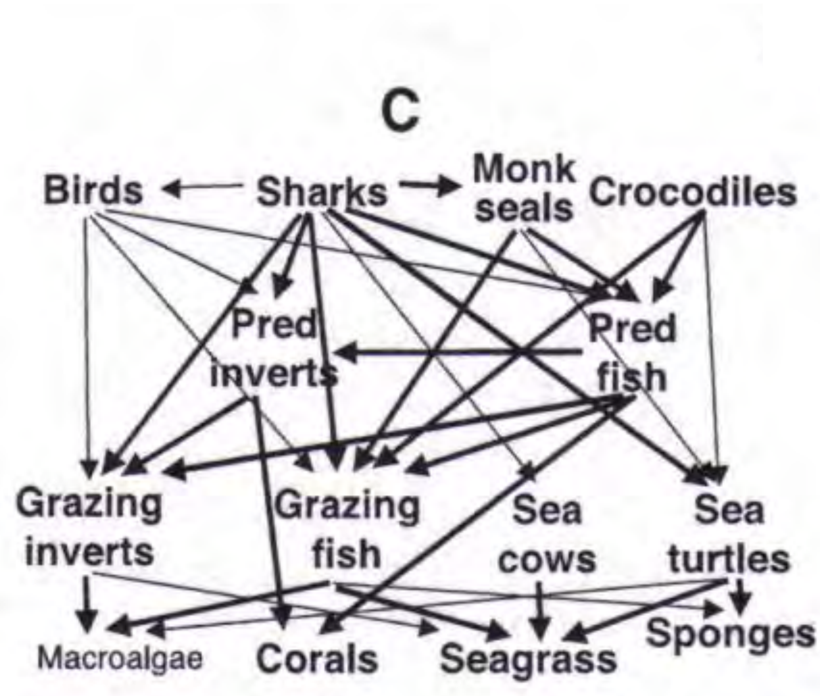


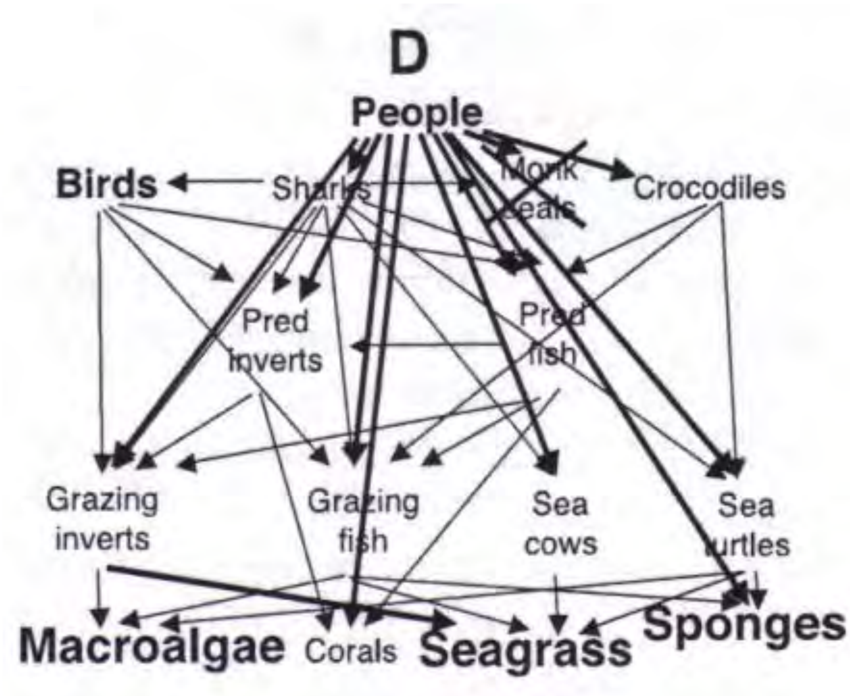


(Maragos & Gulko 2002)

Natural vs human-modified coral reef food web

Before Fishing **After Fishing**





Bold font = abundant

Normal font = rare

(Jackson et al. 2001)

Land-based threats to coral reefs

<u>Sedimentation</u>

Hawaii Kai

<u>Eutrophication</u>

Results in algal blooms

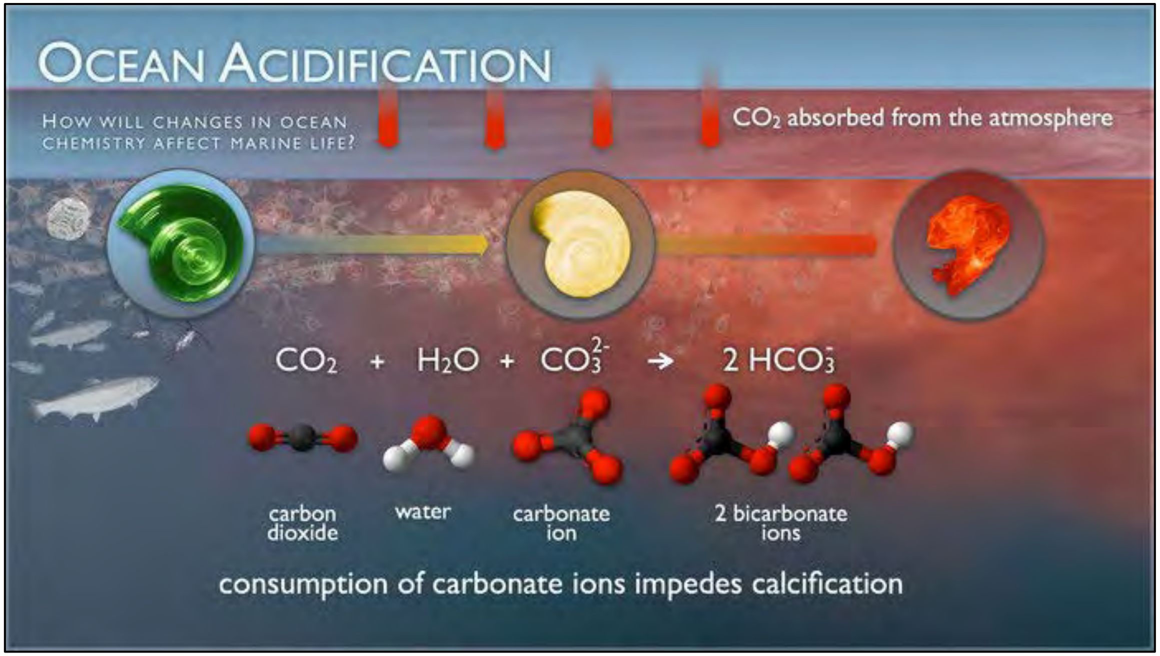
Other threats to Coral Reefs

Coral Mining, Shell Industry

Destructive Fishing Practices

E.g., Indonesia – explosives and cyanide to stun fish

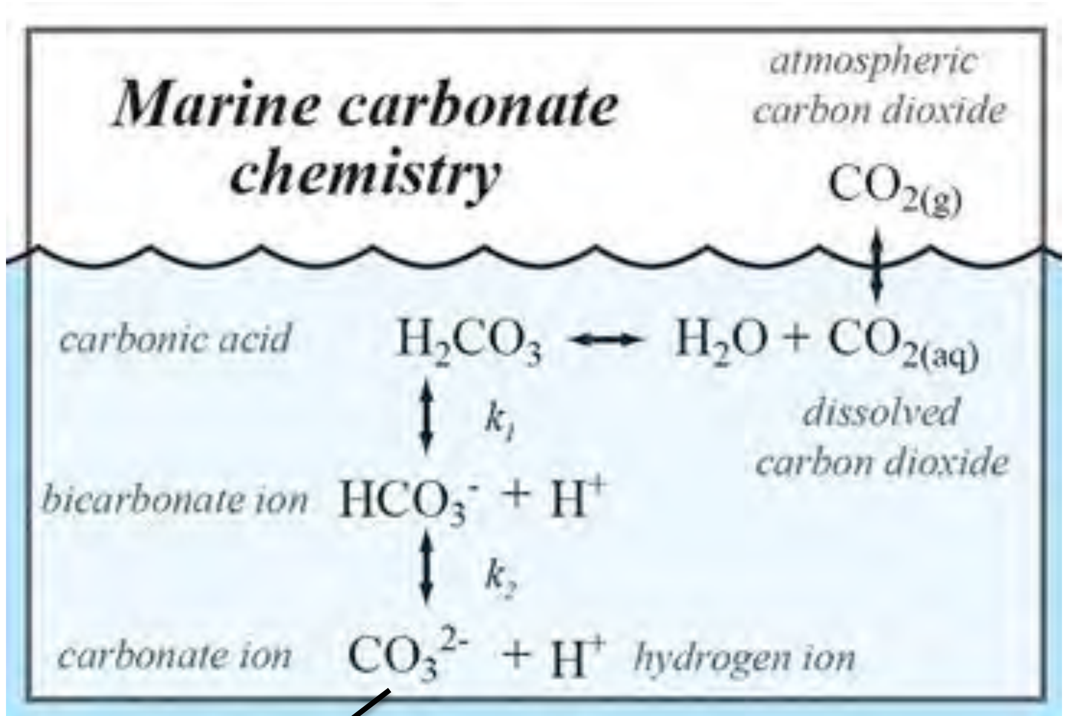
Other threats to Coral Reefs



Acidification

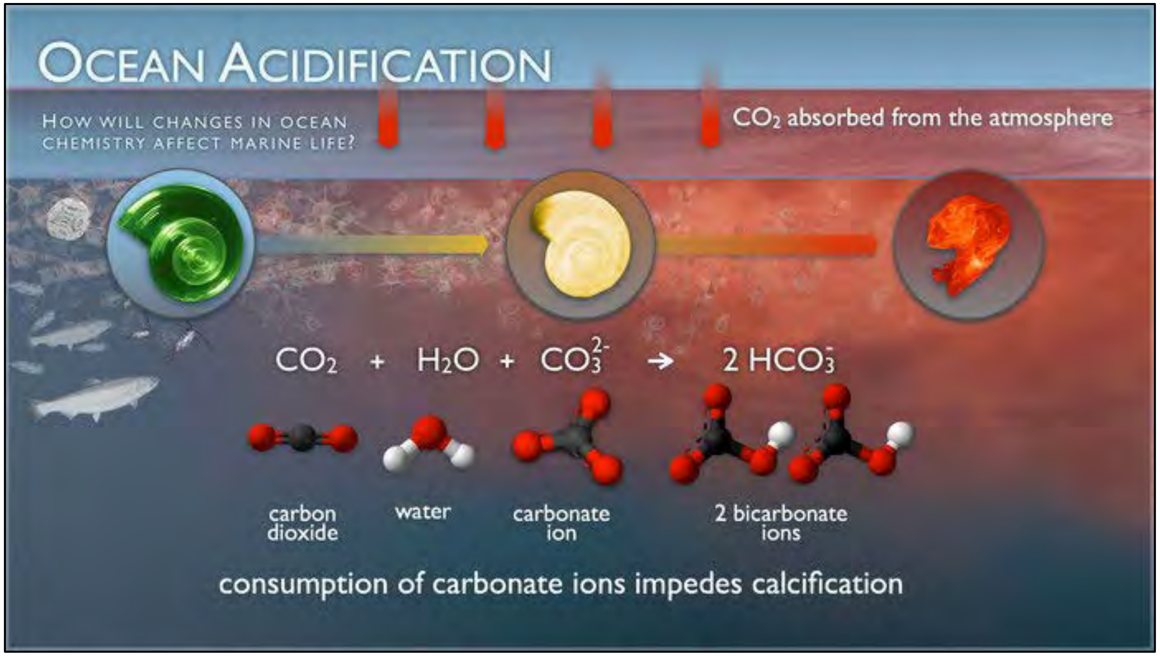
Makes biogenic $CaCO_3$ creation more difficult.

$CaCO_3$



$$Ca^{2+} + CO_3^{2-} \leftarrow\rightarrow CaCO_3$$

Other threats to Coral Reefs



<u>Acidification</u>

Makes biogenic $CaCO_3$ creation more difficult.

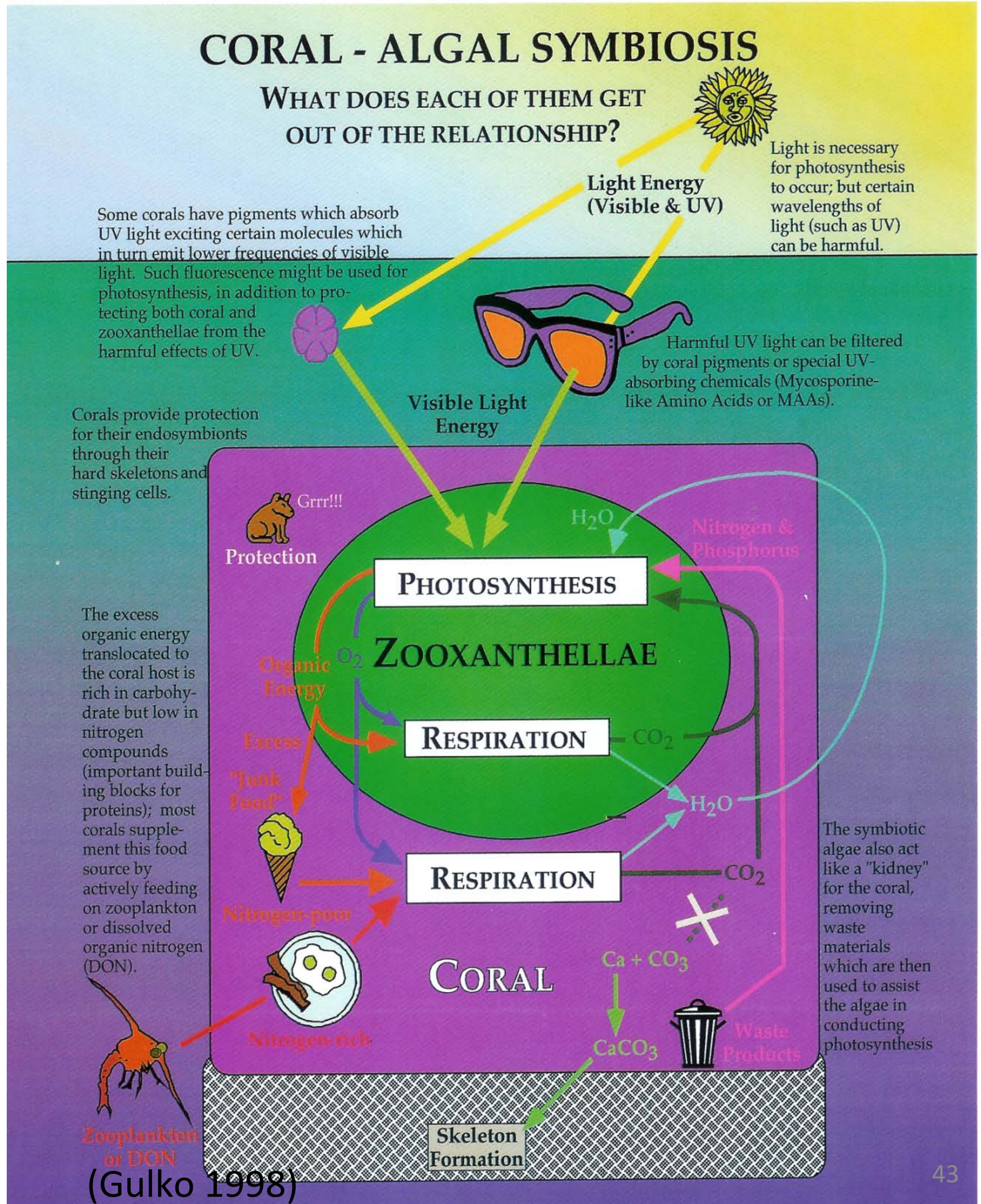
<u>Bleaching</u>

Extremes in temperature, salinity, UV cause expulsion of zooxanthellae – short duration or low intensity, can recover; long duration or high intensity causes death.

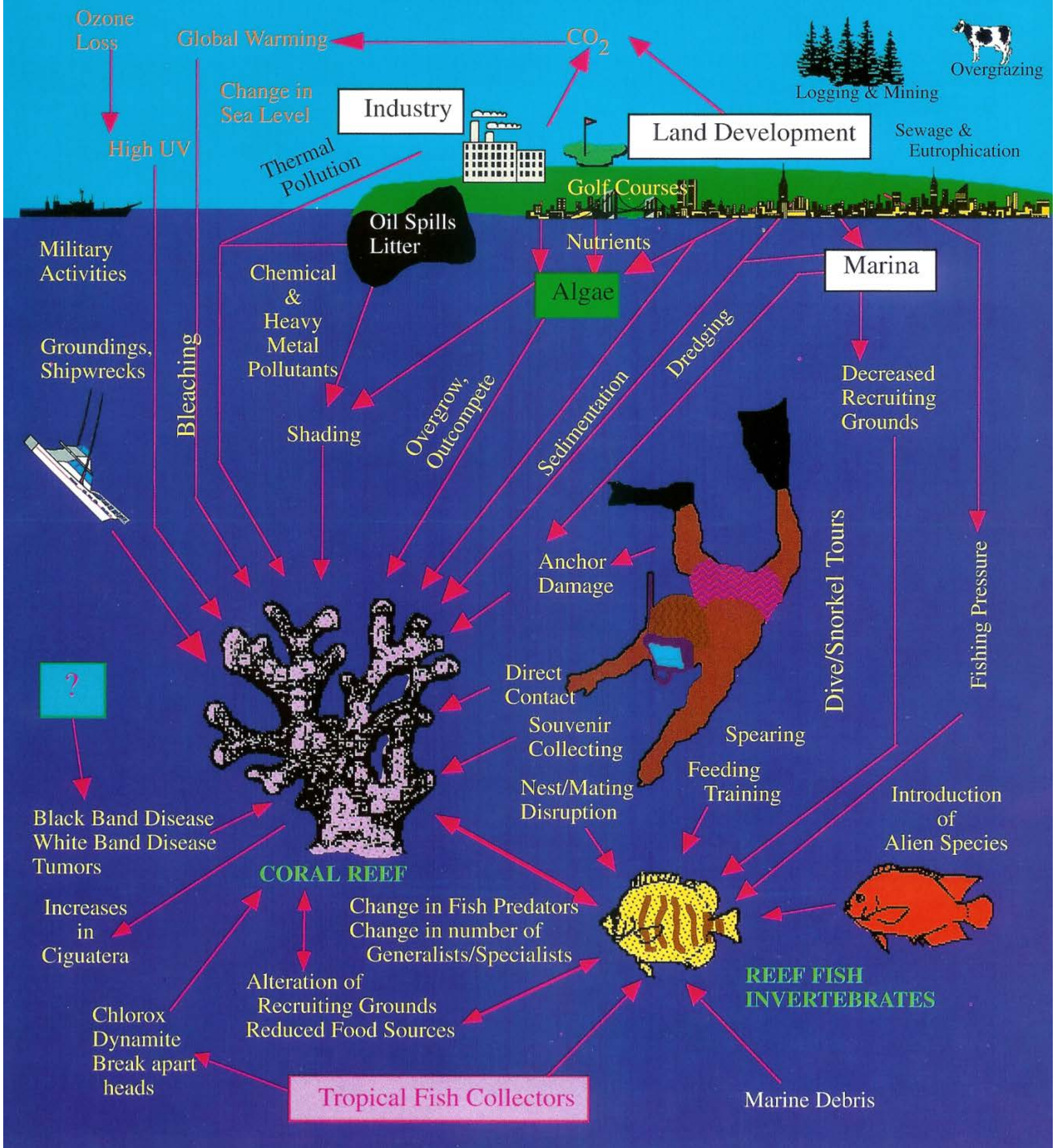
Coral Reefs: Stressors

Instability within mutualism:
High temperature or low salinity, polyps expel zooxanthellae.

Without the algae, cannot form large reefs and corals bleach and die.



(Gulko 1998)



Various Human Impacts on Coral Reefs

(Gulko 1998)

State of the Oceans

http://www.ted.com/talks/jeremy_jackson.html

Dr. Jeremy Jackson, Scripps Institution of Oceanography
A leader in the study of the ecology and evolution of marine organisms, Jeremy Jackson is known for his deep understanding of geological time