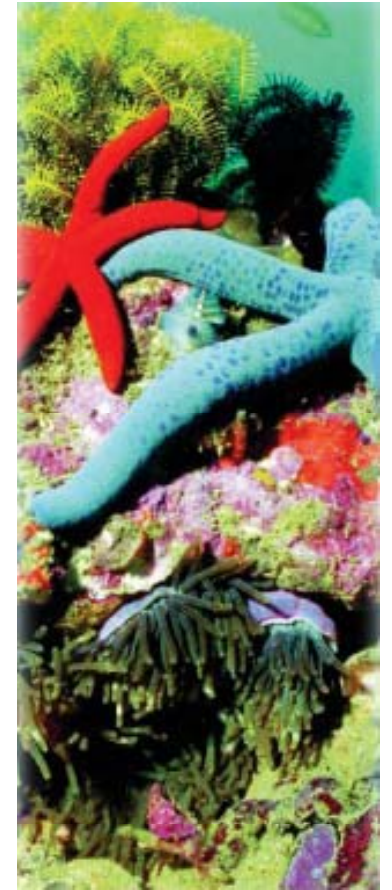
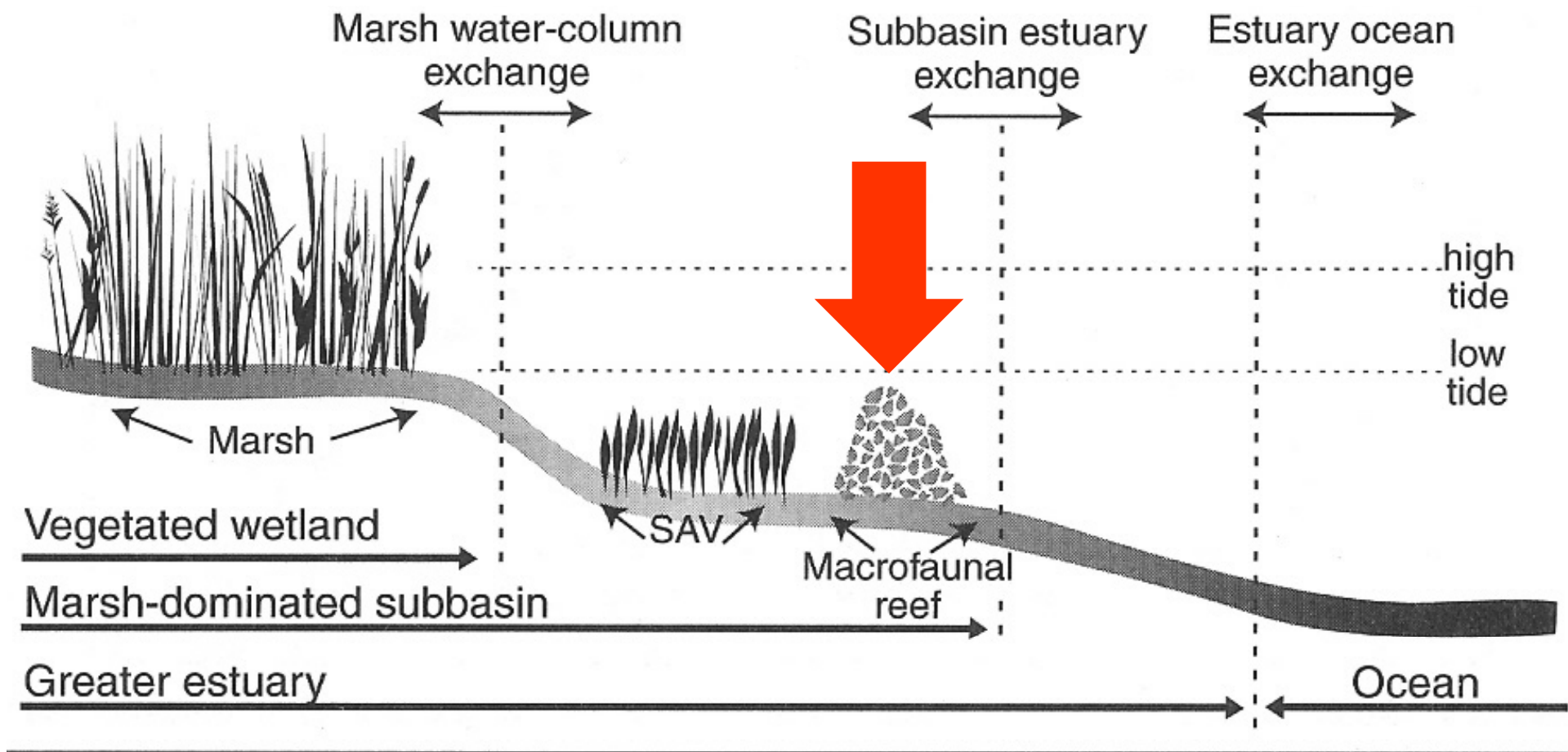


# Coral Reefs NREM 665



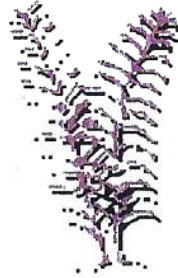




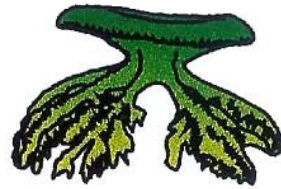
# Phylum CNIDARIA



Portuguese man-of-war



Hydroids



Upside-down Jellies

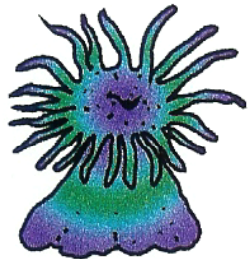


Sea Jellies

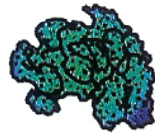


Box Jellies

## Class Hydrozoa

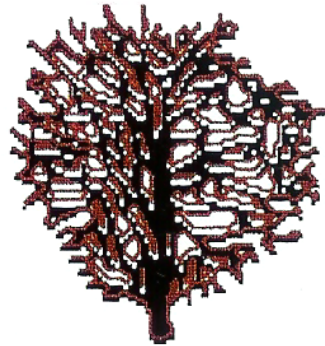


Anemones

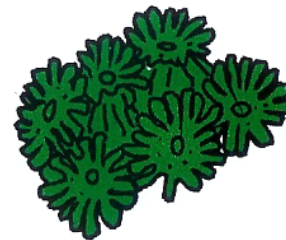


Soft Corals

## Class Scyphozoa

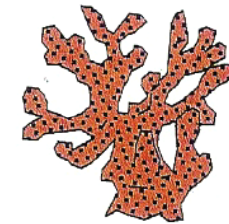


Sea Fans



Zoanthids

## Class Cubozoa



Stony Corals



Precious Corals

## Class Anthozoa

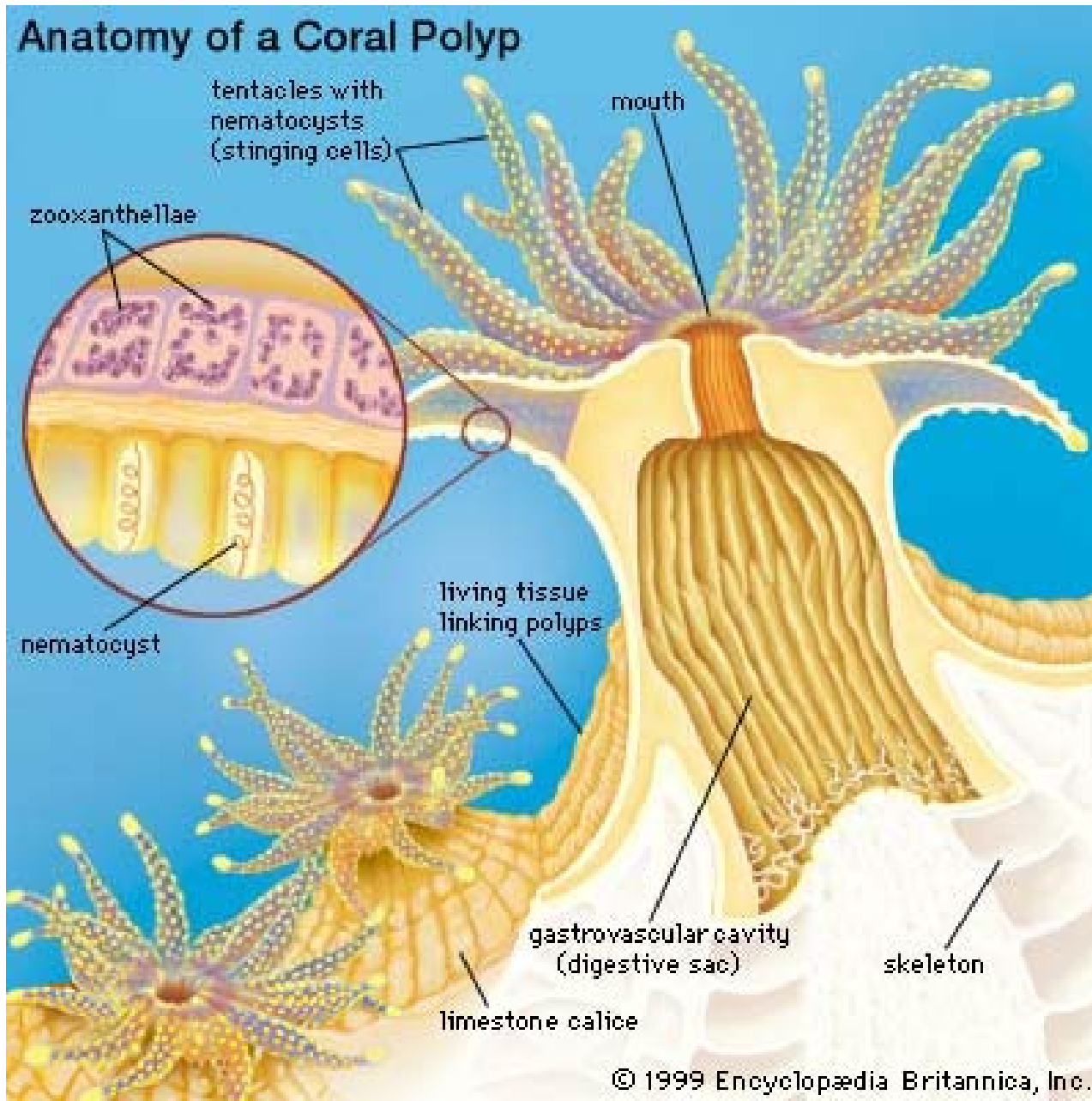
(Gulko 1998)



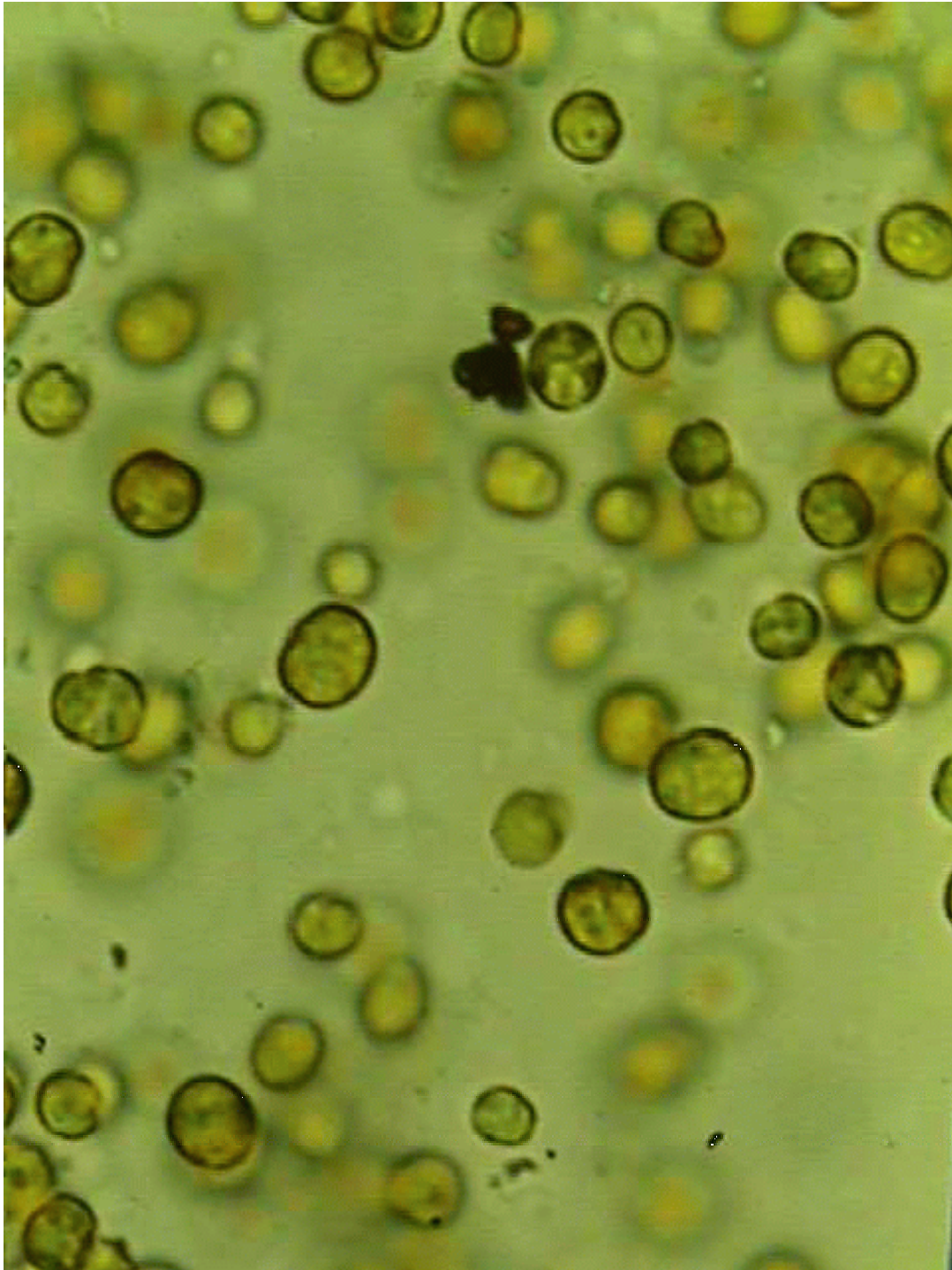
# Coral polyps



# Anatomy of a Coral Polyp







Microscopic view  
of zooxanthellea



# CORAL - ALGAL SYMBIOSIS

WHAT DOES EACH OF THEM GET OUT OF THE RELATIONSHIP?



Light Energy (Visible & UV)

Light is necessary for photosynthesis to occur; but certain wavelengths of light (such as UV) can be harmful.

Some corals have pigments which absorb UV light exciting certain molecules which in turn emit lower frequencies of visible light. Such fluorescence might be used for photosynthesis, in addition to protecting both coral and zooxanthellae from the harmful effects of UV.

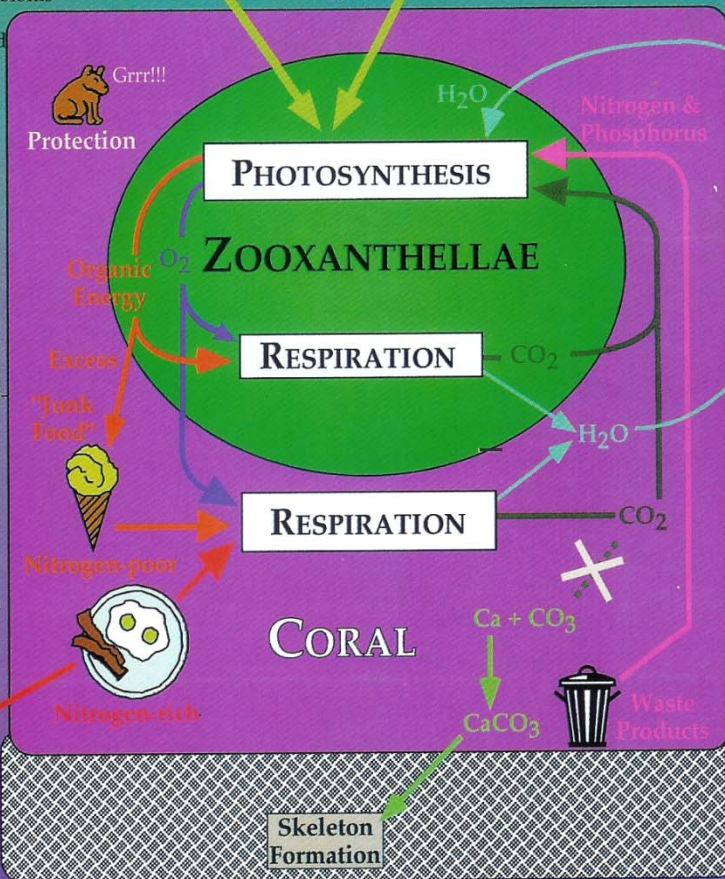


Harmful UV light can be filtered by coral pigments or special UV-absorbing chemicals (Mycosporine-like Amino Acids or MAAs).

Visible Light Energy

Corals provide protection for their endosymbionts through their hard skeletons and stinging cells.

The excess organic energy translocated to the coral host is rich in carbohydrate but low in nitrogen compounds (important building blocks for proteins); most corals supplement this food source by actively feeding on zooplankton or dissolved organic nitrogen (DON).



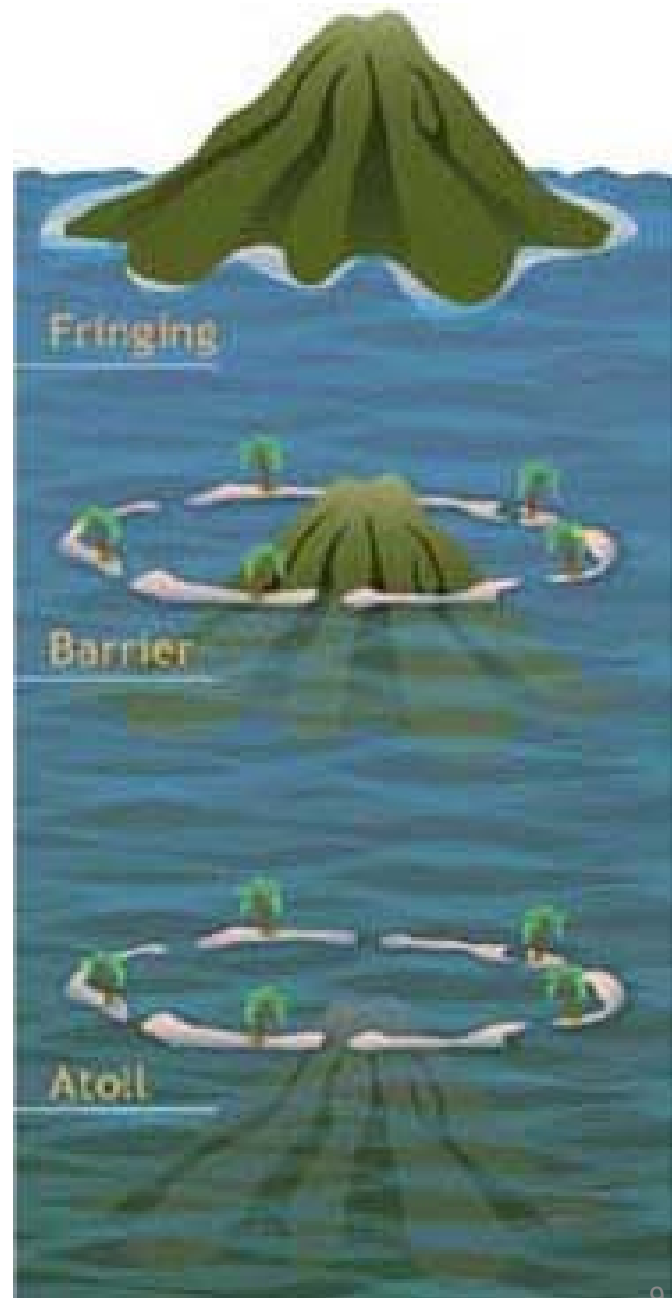
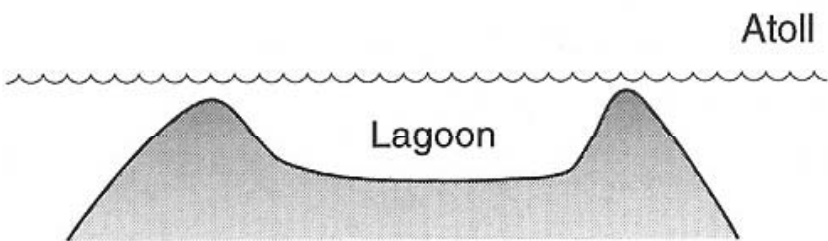
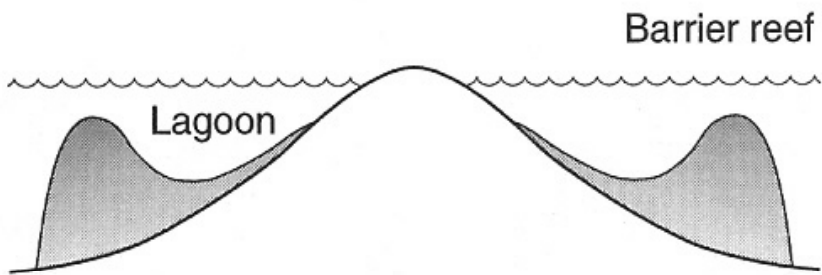
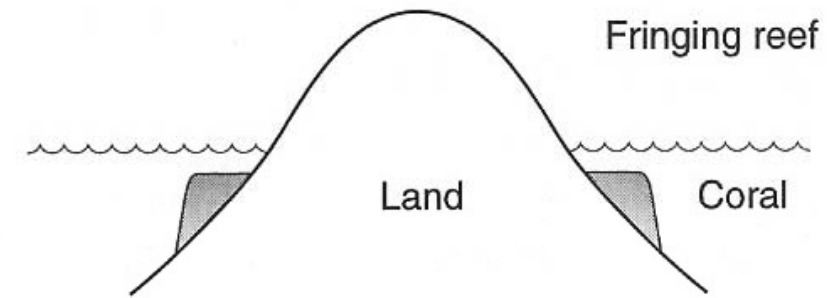
The symbiotic algae also act like a "kidney" for the coral, removing waste materials which are then used to assist the algae in conducting photosynthesis.

(Gulko 1998)

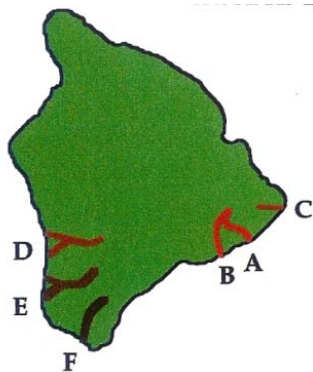
# Subsidence Theory







# Reef Succession Case Study: Hawai'i



**A.** Three month old lava flow. No visible coral colonies present, primarily diatomaceous slime.



**B.** Ten year old lava flow supporting a coral colony roughly ten years old.



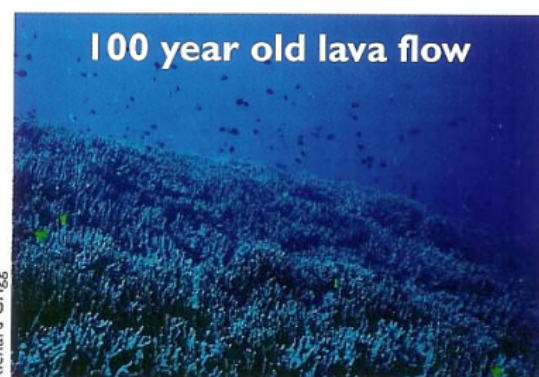
**C.** Fifteen year old lava flow. Coral cover is almost entirely *Pocillopora meandrina*; a fugitive species often found colonizing such flows.



**D.** Twenty year old lava flow. Reef is made up of 12 species of corals, almost 100% coral cover.



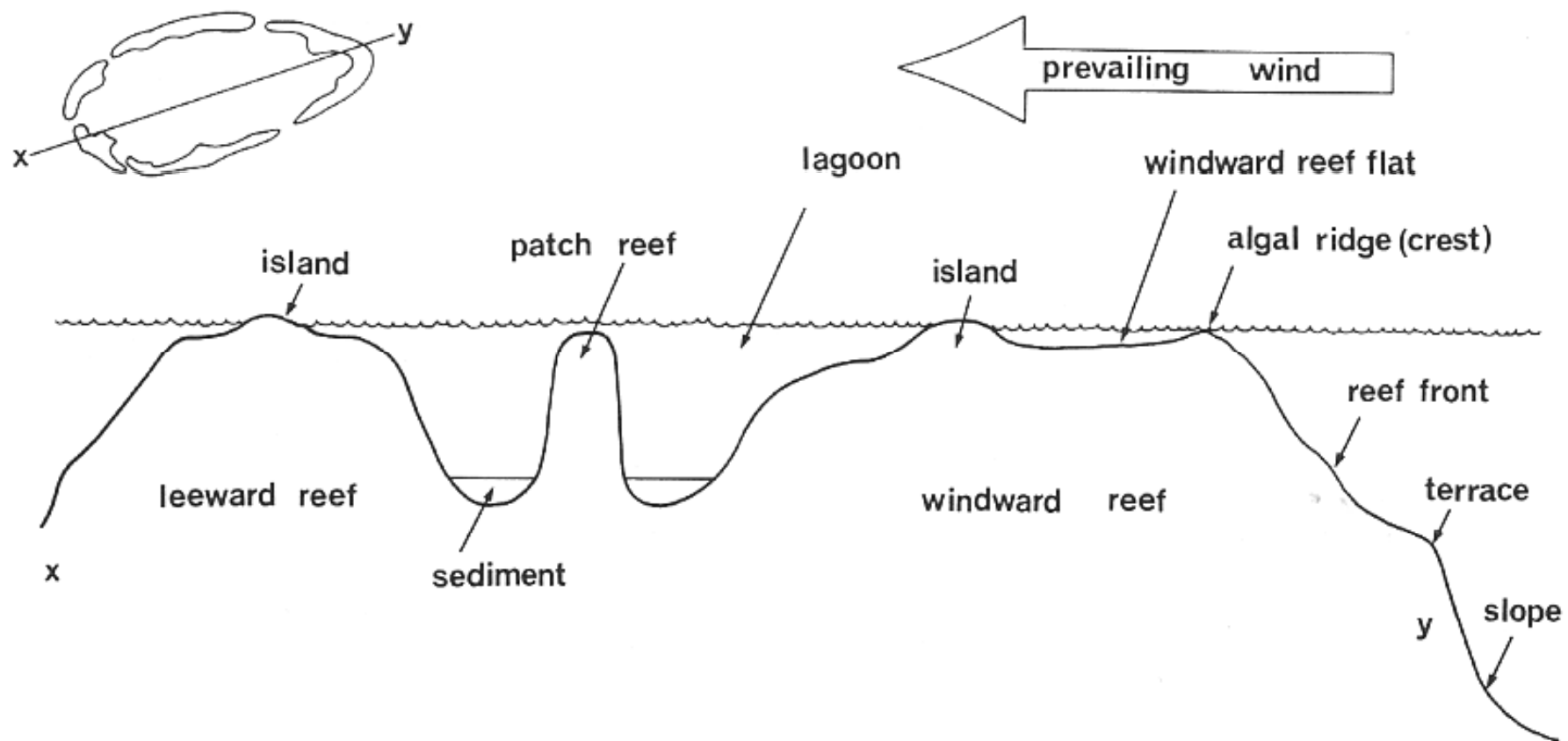
**E.** Forty-four year old lava flow. At this point coverage is primarily *Porites compressa* and *Porites lobata*.



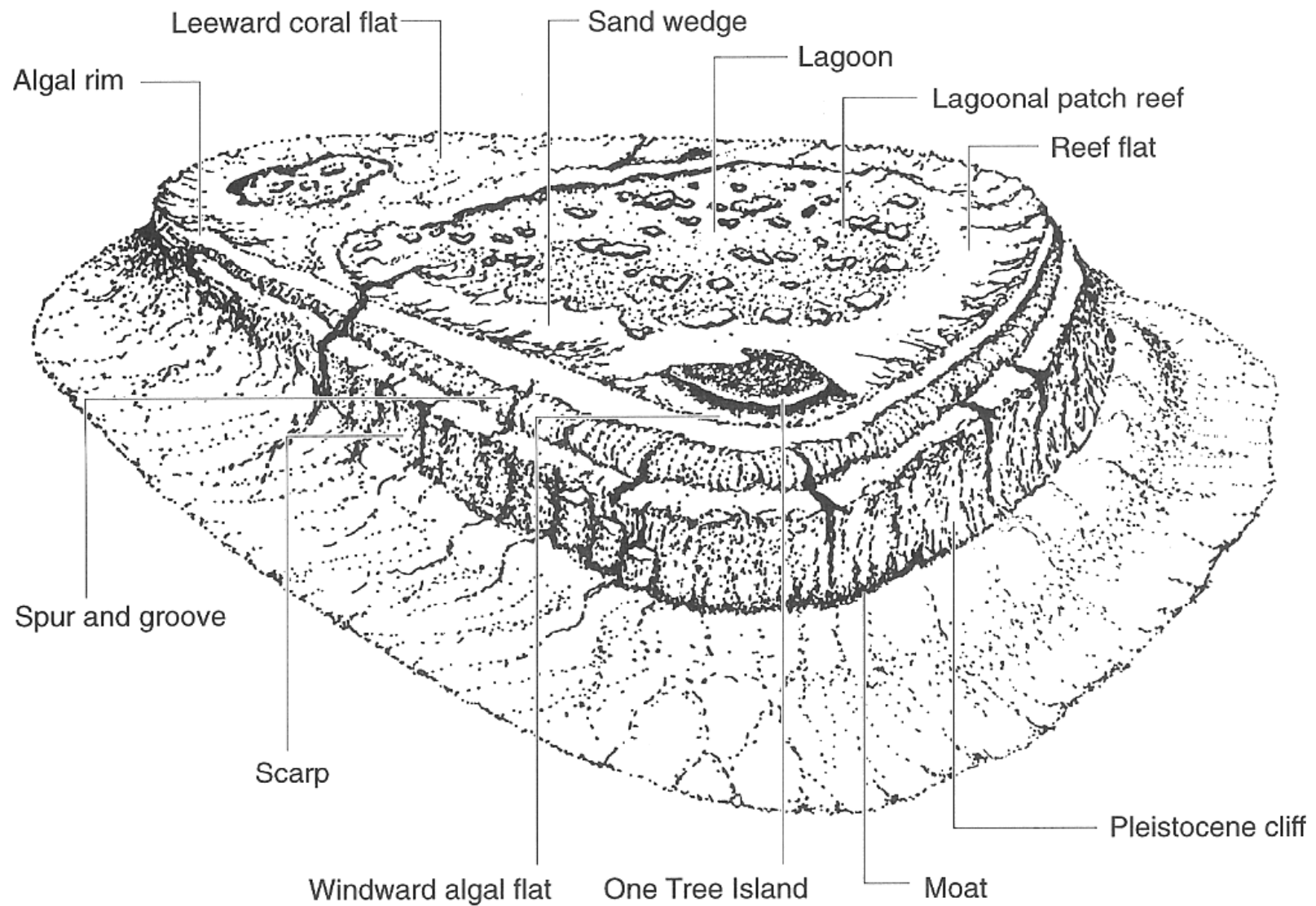
**F.** A hundred year old lava flow in a relatively undisturbed area. This very developed reef is almost 100% *Porites compressa* (finger coral).

(Guilko 1998)





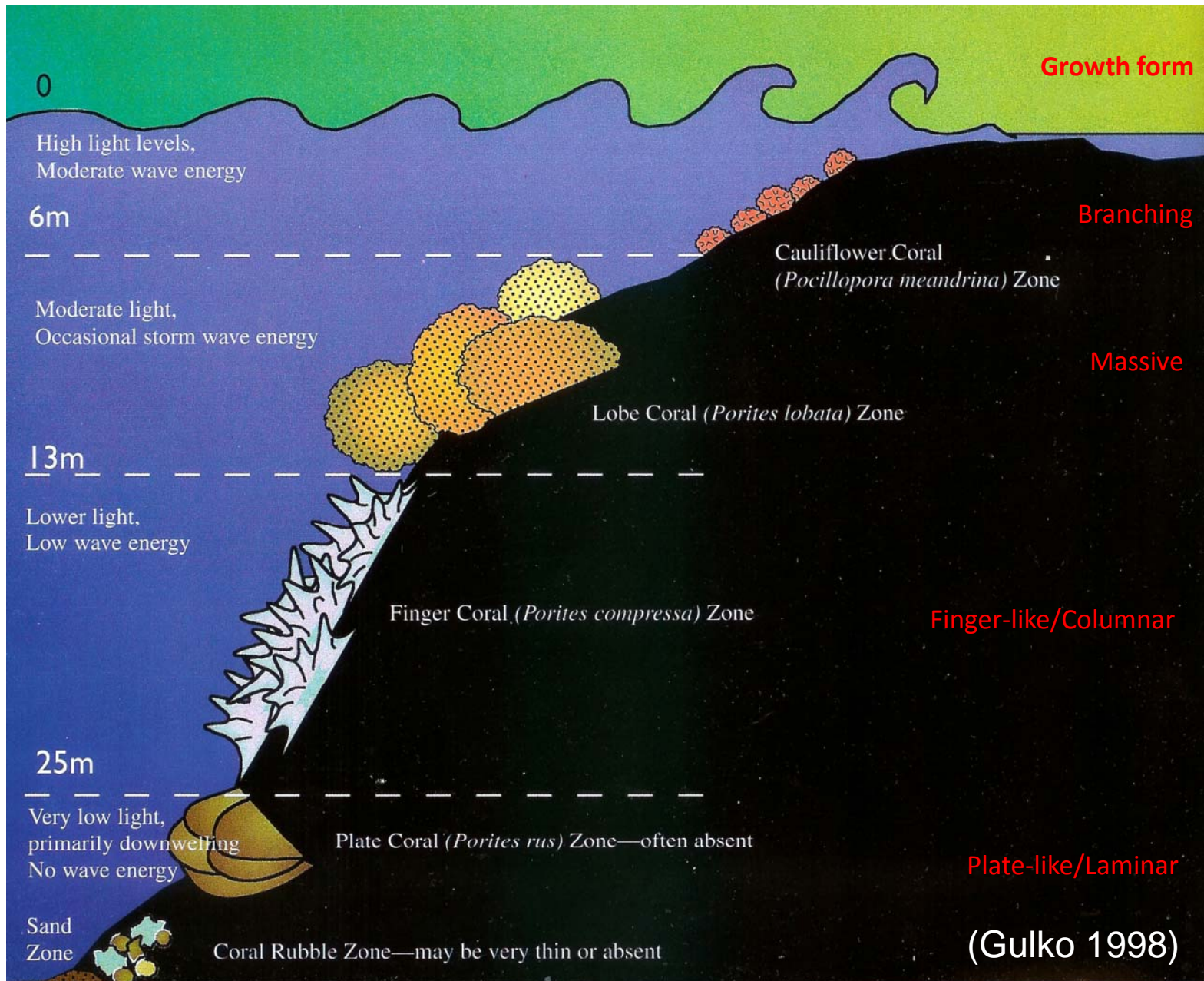
**Figure 6.3** Diagrammatic section of a typical atoll showing the major subdivisions of the reef complex.



**Figure 16.3** A three-dimensional representation of One Tree Reef, part of the Great Barrier Reef. Note that One Tree Island is a very small part of the reef complex. For discussion of the features, see text. Reproduced from Borowitzka and Larkum (1986) by permission.



# Coral Reef Zonation in Hawai'i







*Porites rus*  
Plate coral



*Porites compressa*  
Finger coral, Pohaku puna



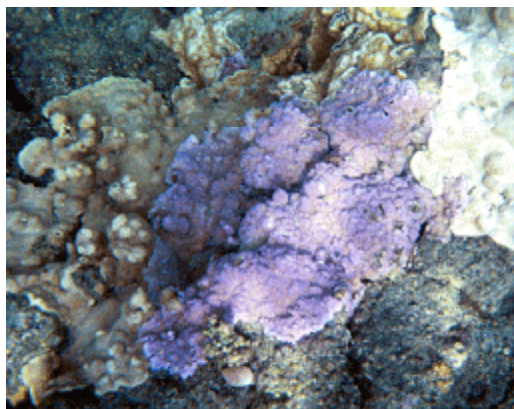
*Porites lobata*  
Lobe coral, Pohaku puna



© Keoki Stender  
*Acropora cytherea*  
Table coral



*Pocillopora meandrina*  
Cauliflower coral, Ko'a



*Montipora flabellata*  
Blue rice coral  
Encrusting



© Keoki Stender  
*Montipora patula*  
Blue rice coral



© John P. Hoover  
*Montipora capitata*  
Rice coral



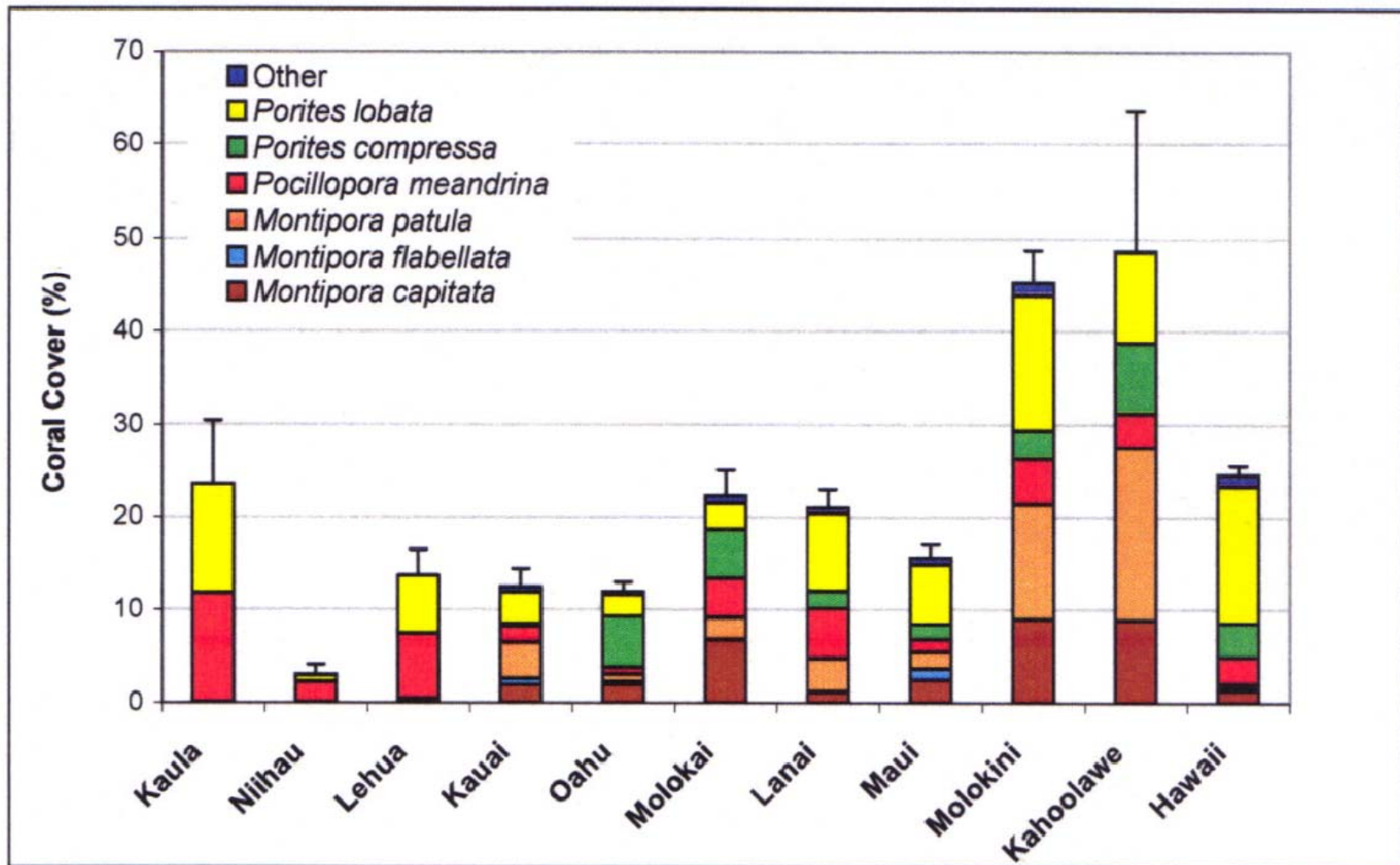
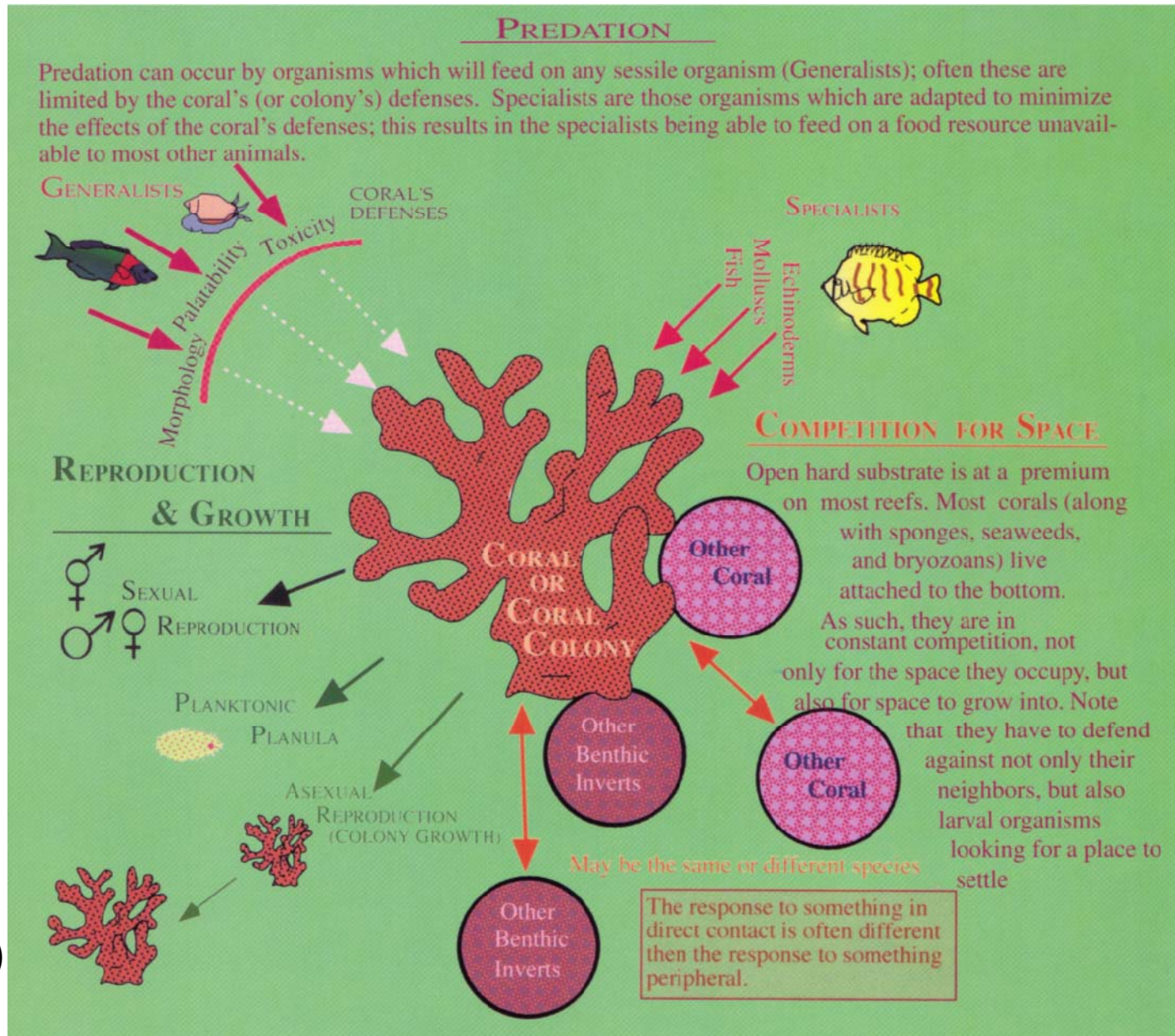


Figure 8.34. Mean percent coral cover at each island in the MHI along a geological (longitudinal) gradient from oldest (west) to youngest (east). Coral cover was calculated from 1,682 transects/sites surveyed between 2001 and 2006. Data sources include CRAMP/DAR (n=692), PIFSC-CRED (n=108), FHUS (n=859) and WHAP (n=23). Mean percent cover  $\pm$  1 SE.

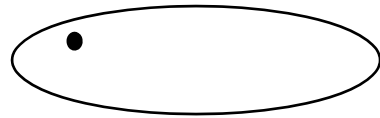
# General Ecological Interactions in Corals



(Gulko 1998)

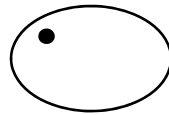


# Reef fish body types



Body type: tapered

Species: snapper



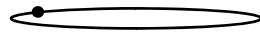
Body type: compressed oval

Species: butterflyfish



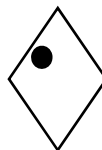
Body type: spherical

Species: puffer



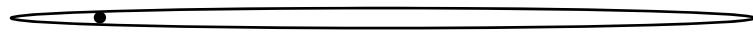
Body type: depressed

Species: rays or flatfish



Body type: angular

Species: triggerfish



Body type: elongated/long

Species: cornetfish

Damselfish  
Family:  
Pomacentridae



Fiercely protective, keystone spp?

Redlip parrotfish, pālupaluka,  
*Scarus rubroviolaceus*



Sexually dimorphic, scrape/bite off substrate/coral, extract plant material, produce sand

# Herbivorous reef fish

Rabbitfish  
Siganidae



Surgeonfish  
Acanthuridae



Achilles tang, pāku'iku'i  
*Acanthurus achilles*



Active,  
aggressive  
seaweed  
grazer

butterflyfish, lauhau  
*Chaetodon quadrimaculatus*



Prefers *P. meandrina*

# Direct coral grazers

Triggerfish  
Balistidae

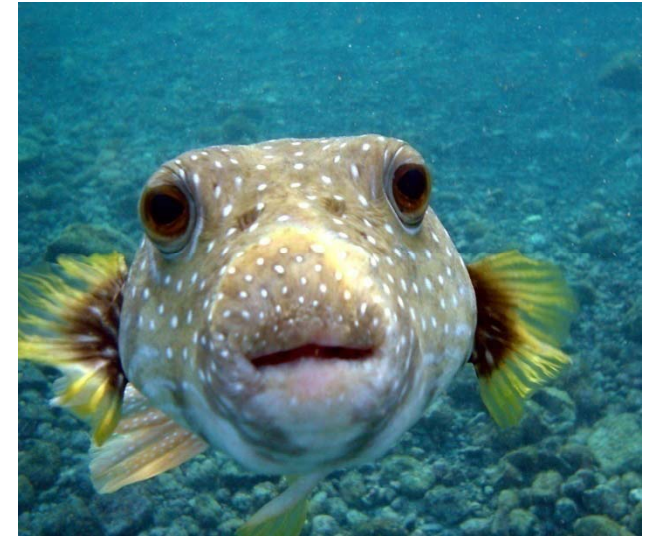


Lagoon triggerfish



Reef triggerfish, humuhumu-nukunuku-  
ā-puaʻā, *Rhinecanthus rectangulus*

Spotted puffer, 'o'opu hue  
*Arothron meleagris*



Bite off chunks of substrate, produces deadly toxin

Spectacled Parrotfish  
*Chlorurus perspicillatus*



Titan (Thailand)



Hawaiian cleaner wrasse,  
*Labroides phthirophagus*



<12 cm, sets up cleaning stations, pick off parasites, dead tissue from larger fish

## Other Hawaiian reef fish

Old woman wrasse, hīnālea  
luahine,  
*Thalassoma ballieui*



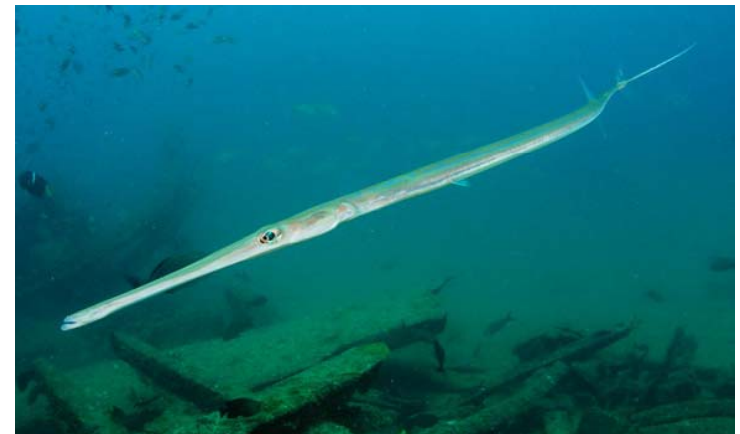
Endemic, fearless, aggressive feeder

Moorish idol, kihikihi, *Zanclus cornutus*



Only spp. in family Zanclidae, sports long graceful filament extending from its back, & pointed snout used for finding food in crevices

Cornetfish, nūnū peke  
*Fistularia commersonii*



Feeds by sucking in small fish like vacuum

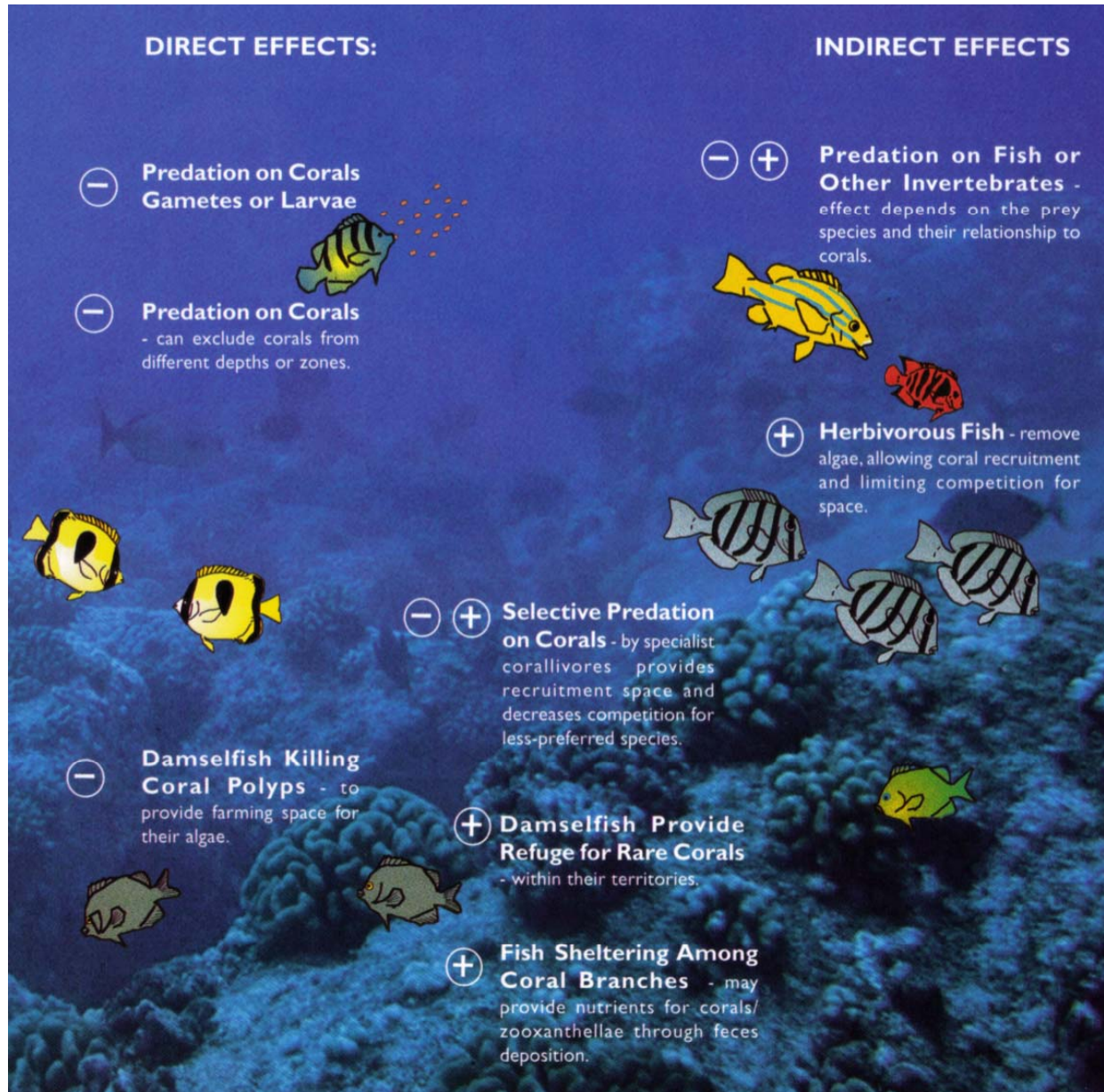
# Territoriality in Reef Fishes

TYPE OF RESOURCE	EXAMPLE
<b>FOOD</b>	
Corallivores	Assorted Butterflyfish Blue-eyed Damsel Short-bodied Blenny
Deposit Feeders	Certain Angelfish Blennies
Herbivores	Angelfish Blennies Damsel Certain Surgeonfish
Benthic Animal Feeders	Angelfish Butterflyfish
<b>SHELTER</b>	Damsel Blennies Gobies
<b>NESTS</b>	Damsel Gobies Blennies Longnose Hawkfish
<b>MATES</b>	Damsel Wrasses Parrotfish Groupers & Basslets Hawkfish Gobies

(Gulko 1998)



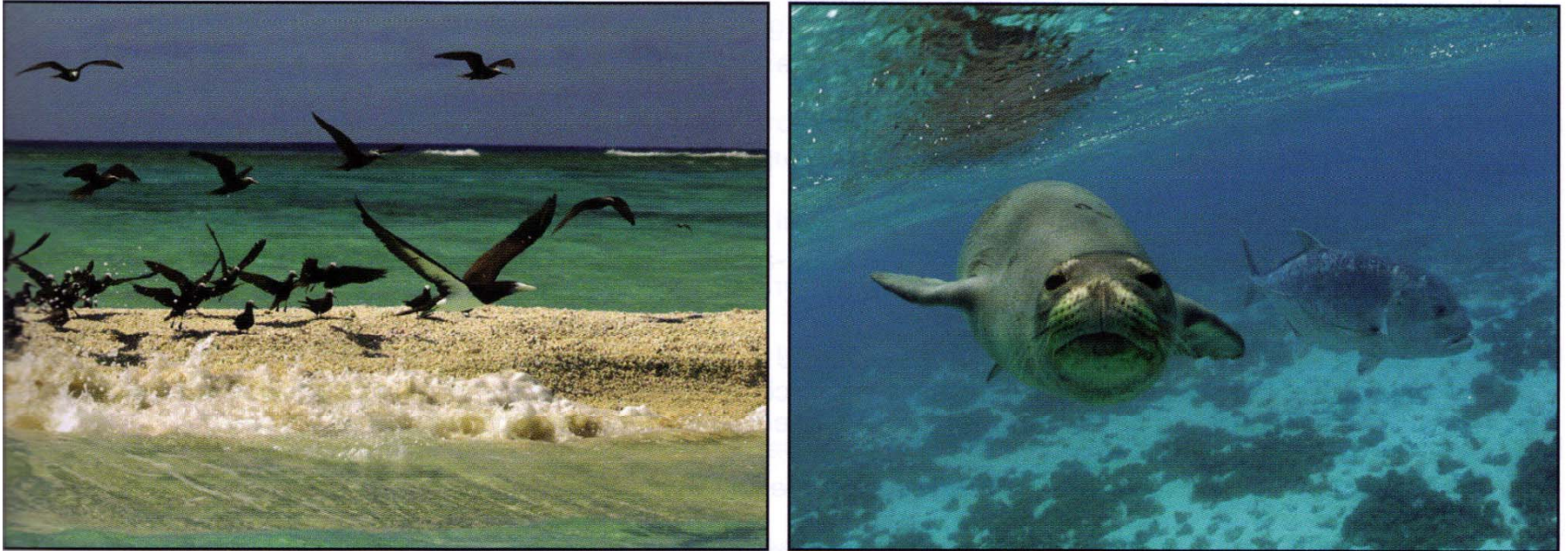
# Effects of Fish on Corals



(Gulko 1998)



# Seabirds and Seals



**Figure 10.39.** Seabirds, such as these Brown noddy terns and Brown booby at P&H (left photo), rely on the NWHI for nesting, feeding and breeding. The critically endangered Hawaiian monk seal (right photo) is an intergral component of the NWHI ecosystem. Photos: J. Watt.

(Waddell 2005)



# Apex Predators NWHI



**Figure 10.27.** Large apex predators, such as sharks (left panel) and jacks (right panel), are abundant in the NWHI and dominate the ecosystem in terms of biomass. Large predators are conspicuously absent from most of the other jurisdictions in this report. Photos: J. Watt.

(Waddell 2005)



# Feeding Guilds on a Coral Reef

## **Carnivores**

### **Benthic Animal Feeders**

*Ambushers* (hawkfish), *Foragers* (eels, goatfish, wrasses), *Grazers* (butterflyfish)

**Corallivores** (butterflyfish, damselfish, crown-of-thorns)

**Molluscivores** (octopus, rays, puffer, wrasse)

### **Piscivores**

*Ambushers* (scorpionfish), *Stalkers* (barracuda, cornetfish), *Chasers* (jacks, sharks)

**Deposit Feeders** (sea cucumbers, surgeonfish)

## **Herbivores**

*Browsers* (angelfish), *Croppers* (surgeonfish), *Grazers* (sea urchins),  
*Grovelers* (mullet),  
*Scrapers* (sea turtles, parrotfish)

**Omnivores** (moorish idols, triggerfish)

## **Planktivores**

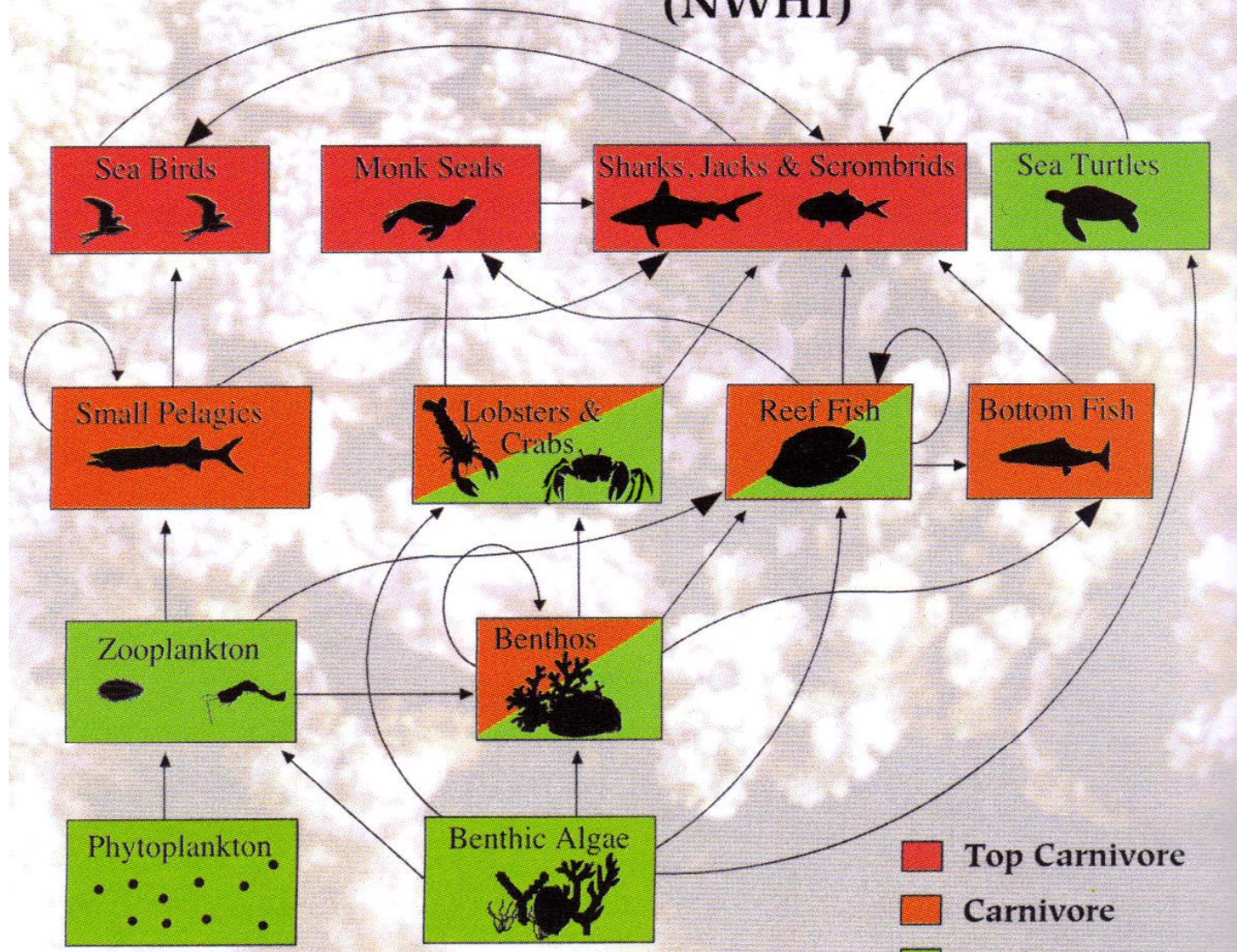
*Strainers* (manta rays, whale sharks), *Pickers* (butterflyfish, squirrelfish)

**Scavengers** (crabs, lobsters, wrasses, sharks)

**Suspension/Filter Feeders** (barnacles, featherduster worms, sponges)

(Gulko 1998)

# The Coral Reef Food Web at French Frigate Shoals (NWHI)

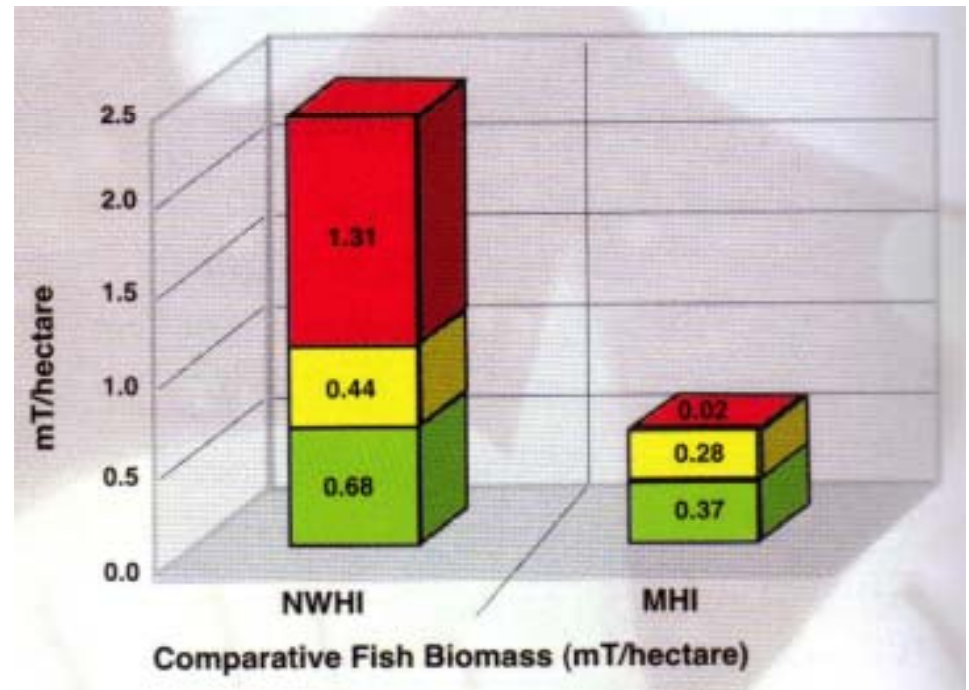
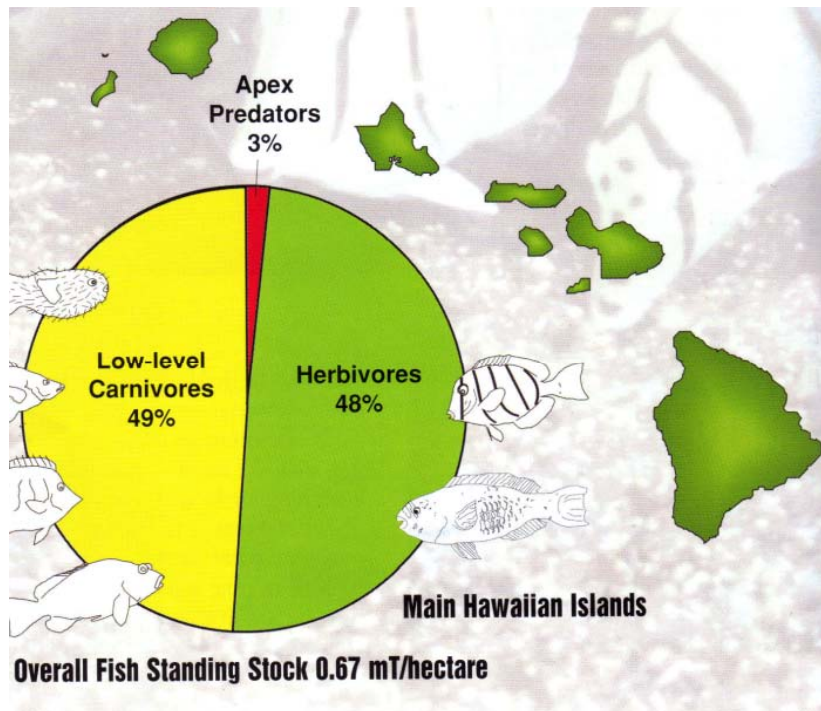
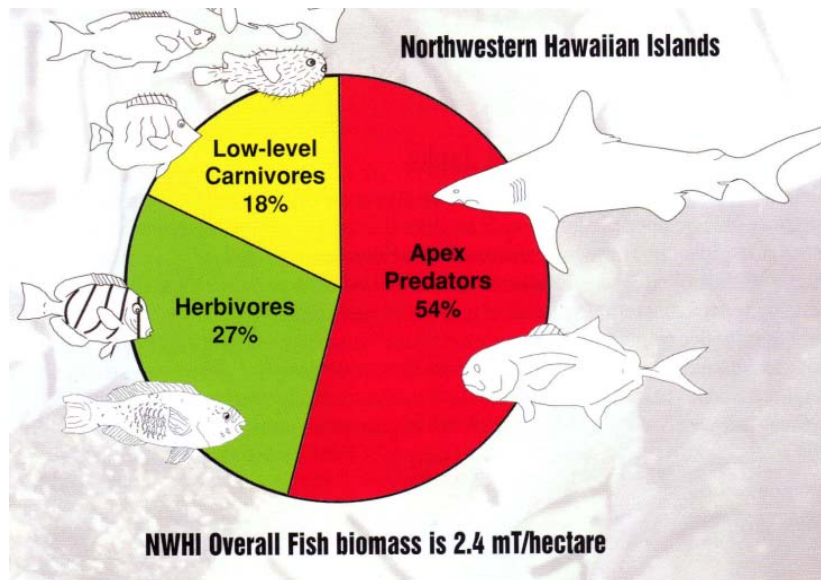


- Top Carnivore
- Carnivore
- Herbivore
- Primary Producer

(Maragos & Gulko 2002)

(after Polovina, 1984)





(Maragos & Gulko 2002)





## Land-based threats to coral reefs



Plume of fine silts & clays discharging into the sea in Indonesia.

([http://www.dfid-kar-water.net/w5outputs/soil\\_erosion\\_slides.htm](http://www.dfid-kar-water.net/w5outputs/soil_erosion_slides.htm))

# Other threats



(<http://courses.washington.edu/larescue/projects/devin/index3.htm>)



(Photo: Reefbase/T. Heeger)





**Figure 3.13.** A closeup of a crown-of-thorns starfish, *Acanthaster planci*, on a reef in the PRIAs. Photo: J. Maragos.

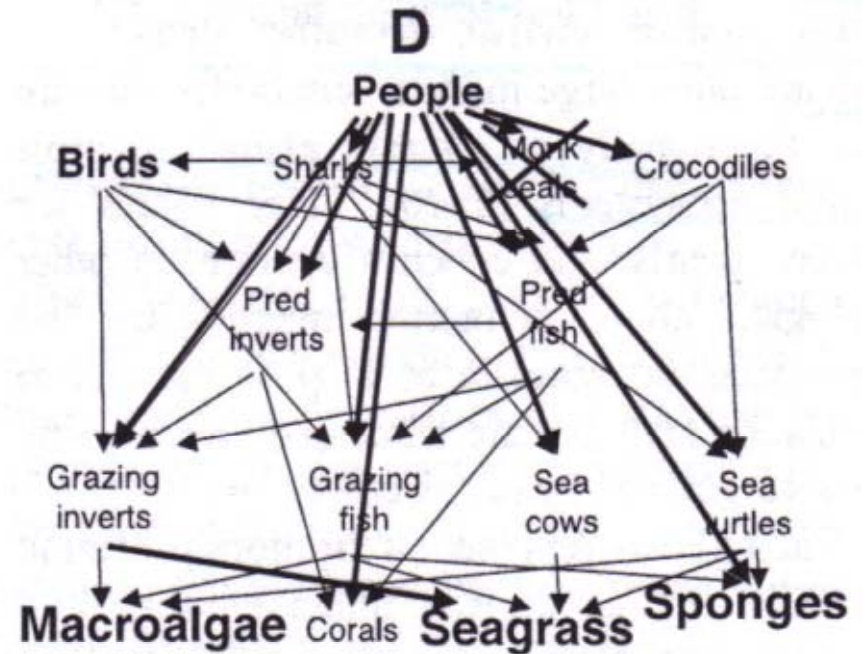
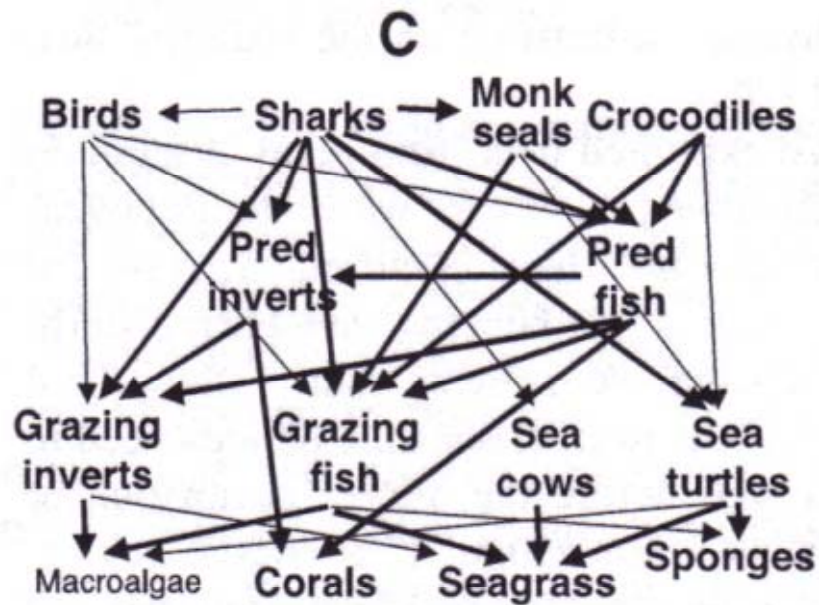
(Waddell 2005)



# Natural vs human-modified coral reef food web

## Before Fishing

## After Fishing

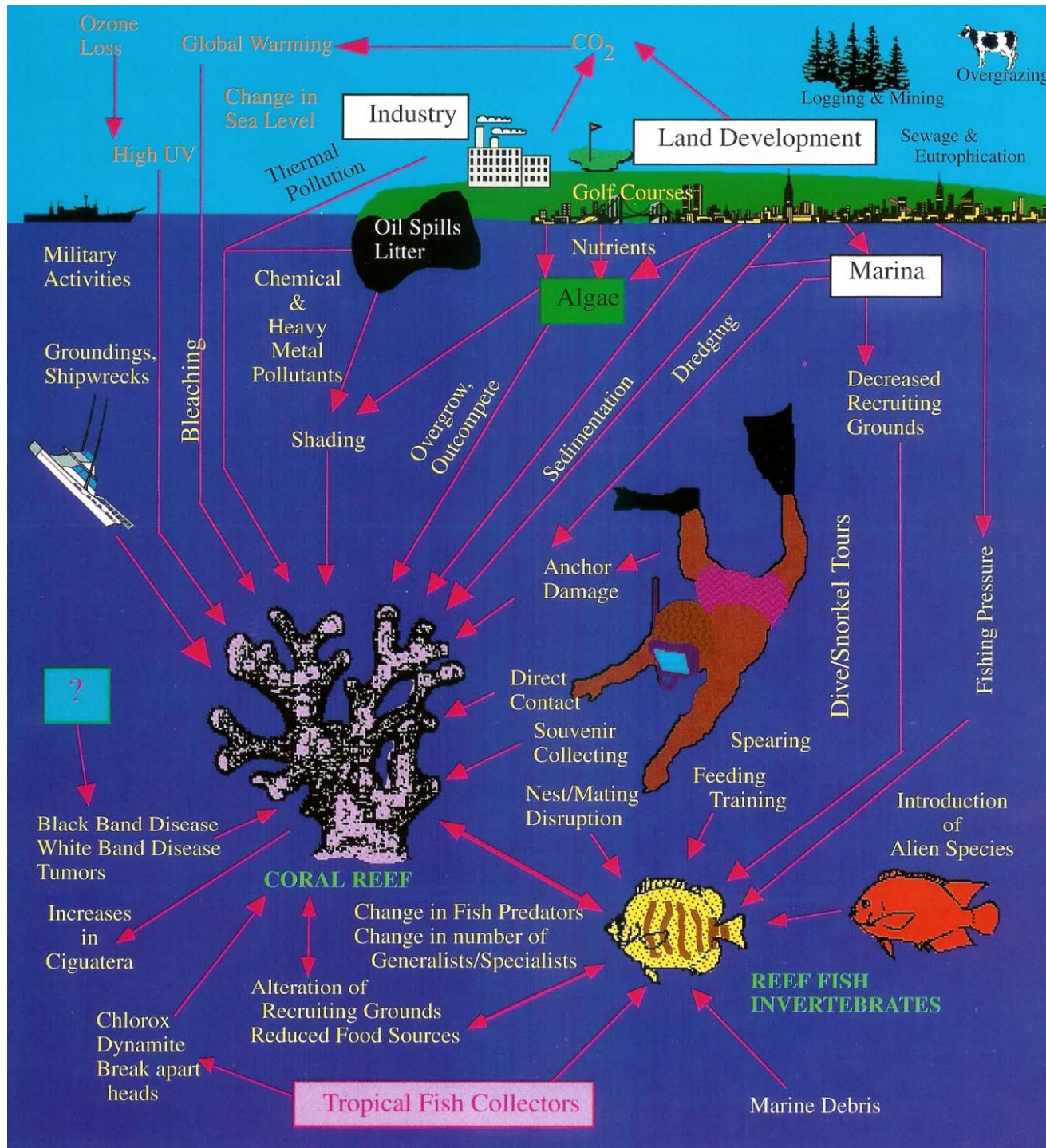


**Bold font = abundant**

Normal font = rare

(Jackson et al. 2001)





# Human Impacts on Coral Reefs

(Gulko 1998)