Ch. 9 Tropical & Subtropical Shallow Seas

Mangroves, Seagrasses, Coral Reefs
Biologic Communities

• Substrate is a limiting factor in tropical seas

• Mangroves, seagrasses, coral reefs create physical structure

  – Home to diverse assemblage of species
Coral Reefs

• Created by colonial Cnidarians

• Stony corals (order *Scleractinia*) build reefs

• Polyps produce CaCO$_3$ exoskeleton
  – Can grow upward or asexually reproduce to grow outward

• When polyps die, new coral built on skeletal remains
Coral Reefs

• Coral polyps are connected via Cenosarc

• Thin sheet of soft tissue over reef surface
  – Easily crushed or damaged

• Only found in clear, shallow, warm seas

• Limited by light availability, (depth, turbidity), water temp, food, predation.....
Coral Reef Growth Forms

- Skeleton eroded by Grazers & scrapers (fish & inverts), boring infauna (sponges, worms), etching algae, bacteria

Parrotfish (picker)

Polychaete Worm
**Coral Reef Zones**

**Reef Crest:** Where wave breaks
- 0-6 ft. deep
- Coral must be robust (branching, encrusting forms)

**Lagoon:** Small patches of coral

**Back Reef:** 1-100 ft. Deep
Greatest biodiversity, lush coral
Coral Reef Distribution

• Tropical & Subtropical Latitudes (0-30° N&S)
• Sea surface temp. >20 (68 °F), optimum = 23-29°C (73-84°F)
• Sea salinity ~35 ppt (not found near freshwater runoff)
• In upper 50m (164 ft.) of photic zone

• Zooxanthellae require sunlight for photosynthesis

[Map showing coral reef distribution with markers for 700 species, 145 species, and Amazon river]
Hermatypic Coral

- Reef-building corals with **symbiotic** zooxanthellae (unicellular protist) in tissues

- Dinophytes w/out flagella & cell walls
  - Largely responsible for color of coral

<table>
<thead>
<tr>
<th>Coral provides</th>
<th>Zooxanthellae provide</th>
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<tbody>
<tr>
<td>Protection</td>
<td>Oxygen</td>
</tr>
<tr>
<td>Living space</td>
<td>Food (glucose, amino acids) - up to 90%</td>
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<tr>
<td>Nutrients ($CO_2$, $NO_3^-$, $NH_4^+$)</td>
<td>Excess Carbon for $CaCO_3$</td>
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Reefs & Coloration

• Many anemones & corals have bright pastel pigments fluoresce orange, red, or green
  – May serve as sunscreens, or light absorbers to boost growth

• Coral parasites also use color:
  – Fluorescent splotches develop where coral is infested, which attract fish
  – Fish nibble spots, take up parasite, & becoming its host
Coral Reef Formation

- **2 Types**

  - **Shelf reefs**: fringing reef on continental margins
  
  - **Oceanic reefs**: surround islands

  1. **Fringing Reef**: on submerged edge of islands or continents where larval coral settle out & develop

  **Ex**: Caribbean
**Oceanic Reef Subtypes**

2. **Barrier Reef:** land mass subsides, coral growth produces a barrier reef separated from land by a lagoon

**Ex: Great Barrier Reef**
Oceanic Reef Subtypes

3. Atolls: volcanic island subsides below sea level as it cools (more dense)

Coral reef left as a ring around a central lagoon

EX: seamounts in S. Pacific
Charles Darwin & Reef Formation

- On HMS Beagle (1831-1836): identified 3 types of reefs & proposed mechanism for their formation. Theory substantiated in late 1900’s.
Coral Reproduction

• **Asexual:**
  - Budding (polyps split & coral grows in diameter)
  - Fragmentation (broken pieces form new colony)

• **Sexual:** Most are hermaphroditic broadcast spawners
  - Mass spawning is common (all spawn 1 day/yr.)
  - Planktonic larvae (planulae) settle & form new colonies
Coral Reef Fishes

• Reef: shelter, protection, food for herbivores & carnivores

• Sharks: Benthic (nurse, bamboo, wobbegong) & pelagic (tiger, blacktip, whitetip, & reef)

• Most rest on seafloor

• Many not apex predators (eat inverts)
Coral-Reef Teleosts

- Great diversity & evolved many *symbiotic* relationships: cleaning, inquilinism (remora – gets a ride & food scraps)

Clownfish protected by anemone, Attract food for their host

Wrasse, cleans external parasites from lionfish
Fish Coloration

• **Bright colors & patterns:** advertise (cleaners, mating), disguise, & conceal roles in a colorful environment

• **Spots & stripes blur together,** allowing fish to merge into reef background

• **Mimics** (blennies mimic cleaning wrasses)

Disruptive coloration
Ultraviolet Light (UV) in Sea

• Now know that UV penetrates beyond 300 feet deep

• Some fish have UV reflectors on bodies to communicate with their kin (predators can’t see it)

• Many plankton-eating fish see UV → plankton appear black & more visible

• Mantis shrimp: ~16 kinds of light-sensing retinal cells (4 for UV)
  – Humans have 4 retinal cell types & can’t see UV
Tropical Marine Tetrapods

Marine Crocodile

Marine Iguana

Sea Turtle

Manatee
Importance of Coral Reefs

• Most biologically diverse ecosystems on Earth

• Protect coasts from storms, hurricanes, tsunami

• Act as shock absorbers, dissipating energy before reaching shore

• 250,000 died in 2004 Sumatran Tsunami

• Villages spared were protected by coral reefs & mangrove woodlands
Gleebruk Village, Indonesia

Before

After
Threats to Coral Reefs

- Support 25% of known marine species
- 27% of reefs dead, 14% more in 10 yrs.

- **Coral Bleaching**: ↑ sea surface temps. (El Nino, Global Warming)
  - ↑ of 2°F for few weeks causes bleaching
  - Stressed coral expel zooxanthellae
  - Soon die w/out symbiont
Threats to Coral Reefs

- **Land development, farming, & pollution:** sediments & freshwater runoff kills coral
  - Nutrients (fertilizer & sewage)
  - Sewage introduces bacteria that cause coral diseases
  - Algae & shades out coral
  - Algae & plankton feed crown of thorns seastar larvae (adults eat coral)
Threats to Coral Reefs

- **Overfishing:**
  1. Remove herbivore fish = ↑ algae growth, smothers coral,
  2. Predators removed = prey species ↑ (Crown of Thorns eats coral)

- Use cyanide & dynamite, walk on reef
  - Food, aquarium trade, trad. medicine

Crown of Thorns seastar (eats Coral)

Dynamite fishing
Animal Coloration & Communication

• Most marine species use non-visual (smell, sound, taste, touch)

• Vision predominates in clear, sunlit reefs

• Use color to entice mates, threaten foes, advertise services, evade predators, catch prey, camouflage

• Red not visible (long wavelengths absorbed by water molecules & debris)

• Red may function as gray/black at depth (purpose of red pigment unknown)

• In natural light, pale green, yellow, violet, & blue blend with reef → camouflage
Chromatophores & Coloration

• Some change colors with chromatophores (skin pigment cells)
  – Controlled by neurons & hormones

• Colorblind octopus shifts patterns of dark & light on skin to match reef texture & color

• Many reef fish blink colors on & off:
  – Males shoot neon stripes across bodies to attract females who release eggs to mix with sperm

  • Job done, the male instantly goes drab

• Ability to turn off color to avoid predators is just as important as turning it on