Coastal Ecosystems

- Salt marshes
- Rocky Intertidal
- Sandy Shore
- Kelp Forests
- Oceanic

Salt Marshes

- Beds of intertidal rooted vegetation which are alternately inundated & drained by tides
- Characterized by strong gradients in physical factors:
  - Salinity
  - Oxygen levels
  - Temperature
  - Disturbance
  - Nitrogen availability

Strategies of Salt Regulation

- Minimize water loss (CAM, C4, leaf area)
- Succulence
- Elimination
- Secretion
- Produce organic osmolyticas

Adaptation--other

- Anoxia:
  - Aerenchyma
  - Rhizosphere oxygenation (*Spartina*)
- Nutrient absorption (nitrogen & sulfur)
  - Oxidize rhizosphere
  - Maintain metabolic activity
  - Direct absorption

Plants

- Typically low diversity but high productivity
- Many are "halophytes," most perennials

Common Plants

- Low marsh: cordgrass
- Midmarsh: Pickleweed, salt grass, *Jaumea*
- Highmarsh: bird's beak, gum plant

Animals

- Important habitat for food & shelter
- High diversity of animals
  - Microbial
  - Invertebrates (including spiders)
  - Fish (150 spp.)
  - Birds/mammals (300 spp.)
- As marshes disappear, several species threatened (clapper rail, salt marsh harvest mouse)

Value of Tidal Marshes

- Water quality (" kidneys")
  - Filter non-point pollution
  - Purify water
  - Trap sediment
- Carbon sink
- Flood control
- Reduce erosion

Rocky Intertidal

- Rocky outcrops along the coast that regularly covered & uncovered by tides
- Display distinct zones resulting from tolerances of & interactions of biotic & abiotic factors to
  - Dessication
  - Salinity
  - Temperature
  - Wave action
  - Competition
  - Predation

Strategies for coping with water loss & changes in temperature & salinity

- Mobile—hide under algae, in crevices & tidepools
- Nonmobile—close up tight
- Mucus (crabs, algae)
- Thick body, reflective color
- Loose water & recover (90% water loss in *Ulva*)

Avoidance

- Hide in cracks, crevices,
- Build close to surface

Competition

- limited resources
- Competition highest where physical stress is least
- Space—major limiting resource in rocky intertidal
- Strategies
  - dispersal
  - growing on top of others
  - bulldozing neighbors
  - Resistance (wave action, predation)

Predator (keystone)

Zonation

- Reflect interaction between physical and biological factors
- Upper zone organisms tolerate:
  - Dessication
  - Temperature & salinity extremes
- Lower zone organisms better at:
  - Competing for space
  - Avoiding predation

Splash Zone

- wetted by surf spray during high tide
- Stresses:
  - Dessication
  - High salinity
  - Lack of food
- Few organisms: bluegreen algae, lichens, rock louse

Upper Intertidal

- covered at most high tides, exposed by most low tides
- Stresses:
  - Salinity/Temperature
  - Dessication
  - Competition for space
  - Predation by birds
- More diverse than splash
  - animals
    - grazers (limpets, snails)
    - filter feeders (barnacles)

- green algae (sea lettuce *Ulva*)

Middle Intertidal

- uncovered by many low tides (not all), covered by all high tides
- Stresses:
  - wave action
  - competition
  - exposure
- Animals
  - Many herbivores (gastropods)
  - filter feeders (mussels)
  - Carnivores (anemones)
- Lots of resilient, attached algae

Lower Intertidal

- exposed during lowest low tides
- Stresses
  - Competition
  - Resources (space)
- Filter feeders less common, herbivores dominant (urchins, polychaetes, kelpfish) & predators (sea stars, anemones, crabs)
- Diverse algae (kelps, surf grass, red algae)

Sandy Shore

- Interspersed between rocky headlands
- Lots of small invertebrates (infauna)
- 2 sources of productivity:
  - microscopic phytoplankton
  - drift seaweeds

Seasonal Changes

- Shifting sediments:
  - Finer sediments in less energetic systems
  - Coarser sediments in more energetic systems
- Sediment texture affects filtration
- Winter: beach erosion
- Summer: beach building

Kelp Forests

- Distribution:
  - Temperate regions with cold water <20° C & lots of nutrients (upwelling zones)
  - require rocky bottom for anchor to with their holdfasts
  - Need enough light so usually in water above 60 ft.
  - Wave action needed so nutrients can wash over kelp
- Complex habitat
  - High productivity
  - Resource partitioning
  - High biodiversity

Kelp of the Kelp Forest

- *Macrocystis:* Southern to north, Outcompetes bull kelp for light,<tolerant of heavy wave action, Perennial,Picture on p. 48 in Atlas
- *Nereocystis:* Northern, Tolerant of heavy wave action,annual

Sea Otters—keystone predator

Oceanic Zone

- Benthic – bottom
- Pelagic – open ocean off of the bottom
  - As depth increases, temperature decreases & pressure increases
  - Zones: Photic zone: (0-200m deep) "light zone", Mesopelagic zone (200-1,000m) "low light", Bathypelagic zone (1000-4000m) "no light"

Phytopankton

- Primary Producers of open water
- Distribution & Productivity influenced by:
  - Light: Seasonal, By depth, attenuates with depth
  - Temperature: Cold water contains more nutrients
  - Upwelling: Area of cold water with increased nutrients
- Cycle with herbivores (zooplankton)

Marine Mammals

- **Whales—"Cetaceans"**
  - **Baleen whales** (Gray, Blue,Fin,Sei,Minke, Humpback)
  - **Toothed whales** (Sperm, Orca, Pilot, Harbor porpoise, Pacific white-sided dolphin, Dall's porpoise, Risso's dolphin, Common dolphin)

- **Pinnipeds**
  - Harbor Seals
  - Sea lions
  - Fur seals
  - Northern Elephant seals

California Gray Whales

- Breathe air, Warm blooded, Nurse young
- Migrate:
  - In October, as Arctic ice forms, head south to Baja to calve
  - After calving, head north for feeding
- By 1946, hunted to only a few 1000
- Today, population now recovered (~16,000) thanks to the Marine Mammal Protection Act

Transient Orcas

- Far ranging
- prey only on marine mammals
- live in smaller, cooperative groups

Common Pinnipeds: Harbor Seals,Sea lions

Northern Elephant Seal

- Largest seal in Northern Hemisphere
  - Historically extended from Baja California to Pt. Reyes
  - male can be 16ft. & weigh 5000lbs.
  - Foot long snout of males used as a resonating chamber
  - Blubber helps insulate against cold water temperature
- Nearly hunted to extinction
- By 1892, their population <100 individuals
- Today: population recovering (~90,000 individuals)
  - Returned to Pt. Reyes Headlands in 1970s (after being absent for 150 years)
  - In 1981, 1st breeding pair discovered (now 1,500-2,000 individuals)

Brown Pelican

- listed as an endangered in 1970 (<500 nests)
  - DDT, which caused egg shell thinning of 35% in some populations
  - ~20 time lag before started affecting birds
- Now ~6,000 nests