Fun Facts about Sponges!

- Sponges produce a vast array of chemical toxins and thus have few predators. Some of their predators include specific:
  - sea stars (echinoderms)
  - sea slugs (mollusks)
- Sponge cells that are disaggregated at the cellular level can re-combine to form a viable sponge!

http://main.uab.edu/antarctica/Templates/Article.aspx?pid=394

Coastal Marine Communities

Substrates (Hard Surfaces) and Adaptations: Rocky Intertidal Zones and Beaches

Kelp Forests

Graphic: Kelp forest, S. Fisher courtesy of National Marine Sanctuaries and NOAA.

Ecology - Organisms and Their Environment

Ecology:
How organisms interact with each other and with their environment

Habitat:
Place where an organism lives

Niche:
An organism's role in its habitat

Community:
The populations of all species that occupy a particular habitat

Graphic: Fish in a coral reef environment (NOAA)

Success in Marine Communities

Physical, biological and chemical factors determine the composition of marine communities

The success of an organism within a community depends on
- its tolerance for the conditions of its environment
- the range of variability of physical, chemical and biological factors in its habitat

Population - Growth and Controls

J Shaped - Population growth without control
S Shaped - Population growth with control
Many different processes affect the size of the population that can be sustained in an environment (the "carrying capacity")

Graphic: Garrison, Fig. 16.4.

Biological Factors

Biological factors arise due to interactions among organisms

Interactions can be among:
- members of the same species
- members of different species

Examples:
- crowding
- predation
- availability of food

- availability of a mate

Graphic: Coral community, NOAA

Where is Each Type of Marine Community Found?

Photosynthetic
- Coastal or estuary
- Open ocean (shallow)
- Coral reef

Detrital
- Open ocean (deeper)
- Deep sea floor

Chemosynthetic
- Hydrothermal vent
- Cold seep
- **Brine pool**

Graphic: Garrison, Fig. 13.21.

Predator-Prey Interaction

A species' distribution may be controlled by predation

Predation strategies:
- foraging
- ambushing ("sit and wait")
- scavenging
- filter feeding
- deposit feeding

Graphic: (top) polychaete worm, Cordell Bank National Marine Sanctuary, (center) nurse shark, (bottom) moray eel, courtesy of NOAA Photo Library.

Competition

Competition occurs when organisms require a resource that is in limited supply

Competition can occur among members of the same species or between members of different species

Competition can restrict the range of a population

Graphic: See Garrison, Fig. 16.3.

Seaweeds - Large Marine Plants

- Multicellular
- Lack vascular systems
- Most attach to a substrate
- Account for 2-5% of marine primary productivity
- **Economically important**

Graphic: Kelp forest, Channel Islands National Marine Sanctuary Collection. Courtesy of NOAA.

Algae and Color

Marine plants have many pigments to take advantage of the penetration of different colors of light in the ocean

- primary = chlorophyll (green)
- accessory = brown, red, tan etc

Green algae (chlorophytes) 0-10 m
Brown algae (phaeophytes) 0-35 m
Red algae (rhodophytes) to 250 m

Graphic: (top) Garrison, Fig. 13.14b, (center) Brown algae, A.Shepard (OAR/NURP), (bottom), Red algae, National Estuarine Research Reserve Collection.

Intermediate Disturbance Hypothesis

Maximum species diversity often occurs at intermediate levels of disturbance

High disturbance
- very unstable communities
- disturbance-tolerant species dominate

Low disturbance
- exclusion of less competitive species
- dominance by a single or a few species

Intermediate disturbance
- moderate disturbance stress and competition

Graphic: (top) Rocky intertidal zone, courtesy of NOAA, S. Stancyk, photographer. Courtesy of NOAA NURP and Univ. of S.Carolina.

Rocky Intertidal Communities

Intertidal = band below high and low tides

- high energy environment
- rapid changes in temperature, moisture, salinity
- many different habitats
- abundant food

Graphic: (Top) Rocky intertidal zone. Olympic National Marine Sanctuary Collection. (Bottom) Painted Urticina anemone. Both Courtesy of NOAA.

Tide Pools

Tide pools provide refuge from dessication, but experience rapid changes of temperature, salinity and oxygen

Organisms must tolerate rapid changes in their physical environment

Graphic: Tide pools on the Olympic Coast of Washington State, photo by N.Sefton, courtesy of National Marine Sanctuaries, NOAA.

Kelp Forests – Biologically Rich Coastal Communities

- Cold water
- High productivity
- Shallow (2-30 m depth)

Kelp provides shelter and food and supports diverse communities

Graphics: Garrison, Figs 14.19, 14.18a.

Seaweed Communities

Herbivores

- feed directly on seaweed (snails, limpets, small fish)

Carnivores
- feed on animals that in habit the kelp forest

Detritivores
- feed on dead matter that has sunk to the bottom

Graphic: (top) Fishing in a southern California kelp forest, B.Chrisney, photographer, courtesy of NOAA. (bottom) Giant kelp, an important fish habitat can grow up to 2 feet per day. Courtesy of NOAA Restoration Center.

The Kelp Canopy

Giant kelp prefer calm waters

Bull kelp dominates in higher energy environments

Where the two ranges overlap, Giant Kelp out competes Bull kelp for light

Graphics: Top Giant Kelp. Bottom, Bull (Whip) Kelp. Courtesy of NOAA.

Canopy Assemblage

Canopy dwellers live on the seaweed

Members of this community
- small crustaceans
- worms

Opportunities and challenges
- plenty of food
- plenty of predators

Graphic: (top) Kelp community, courtesy of National Undersea Research Program, (bottom) Close up of giant kelp, S.Anderson, photographer, courtesy of National Marine Sanctuaries, NOAA.

Bottom dwellers

Members of this community
- crustaceans
- echinoderms
- sponges
- anemones

Seasonal disturbances present opportunities and challenges

Graphic: (top) Benthic invertebrate community, (bottom) urchins and sea stars. Both: N.Sefton, photographer, courtesy of National Marine Sanctuaries, NOAA.

The Marine Mammals

Kelp forests are home to sea otters and feeding grounds for sea lions, seals and whales

Otters are keystone predators - they feed so extensively on crabs, urchins, clams that they control the abundance of these organisms

Graphic: (top) Alaskan fur seal, (bottom) sea otter, J.Bortniak, photographer top photo, both photos courtesy of NOAA.

Kelp, Urchins, Otters

Urchins feed voraciously on kelp

- Can deforest an area within weeks if their numbers are not controlled

- Otters control urchins by predation

- Otters were hunted for their pelts along the west coast; kelp forests (and some fisheries) declined

- Otters are now protected and kelp forests are recovering

Graphics: (top) Otter, K.Evans, photographer, (bottom) purple urchin, L.Francis, photographer, both courtesy of NOAA National Marine Sanctuaries.

Making a Living in the Open Ocean

<u>Food is limited</u> in most areas of the open ocean

Below the sunlit zone, most open ocean consumers depend on the productivity of organisms in the water column above

Graphic: Image provided by the SeaWiFS project, NASA/Goddard Space Flight Center and Orbimage, see Garrison Fig. 13.6.

Types of Communities

Photosynthetic – sustained by production of new plant material within the community

Detrital – sustained by export of organic matter from the euphotic zone

Chemosynthetic – sustained by production of organic matter via non-photosynthetic chemical reactions (chemosynthesis)

Graphics:(top) Kelp community, M.Golden, photographer, courtesy of NOAA Restoration Center. (bottom) Octopus on the muddy sea bottom. Courtesy of OAR/NURP and North Carolina State University.

Open Ocean Habitats

<u>Blue Water:</u>
- sunlit zone in non-coastal regions
- limited availability of plant material

<u>Midwater:</u>
- no photosynthesis
- vision is used for hunting in the upper part of this zone

<u>Seafloor:</u>
- most consumers depend on the export of food from higher in the water column

Graphic:(top) Humpback whale and calf, D.Glickman, courtesy of NOAA, (middle) Cyanea jellyfish, P.Auster, NOAA/OAR/NURP and Univ. of Ct., (bottom) wolf eel, V.O'Connell, NOAA/OAR/NURP and Alaska Dept. of Fish and Game.

Blue Water Communities

Even in the sunlit zone, food is limited in most parts of the open ocean

Predation and competition provide important evolutionary pressure

Graphics: A school of jacks in the open ocean. Photo by Dr. J.P.McVey, courtesy of NOAA.

Schooling

School - massed group of similar individuals, closely packed and moving as a unit

- Deter predators

- Reduce chance interactions between predator and prey

- Enhanced mating opportunities

About 25% of fish species school

Graphic: Northern anchovy school, OAR/NURP, Courtesy of NOAA.

More Predator Avoidance Strategies

Sunlit zone:
- **countershading**
- **"fly" out of the water on large fins** **Flying Fish!**
- **large size**

Midwater:
- **silver or black (fish)**
- **red or purple (invertebrates)**
- **transparency**
- **bioluminescence can camouflage**

Deep dwellers:
- **colorless (no pigment) or black fish**

Graphics: (top) Flying fish, S.Rankin, NMFS, SWFSC, (bottom) Jellyfish, M.Youngbluth, OAR/NURP, both courtesy of NOAA.

Between Sunlight and Darkness - The Deep Scattering Layer of the Disphotic Zone

The DSL is composed of millions of organisms.

Many:

- migrate toward the surface at night to feed

- descend deeper during the day for protection from predators

Members of this community include shrimp, squid, and many species of small fish

Graphic: (top) Siphonophore, OAR/NURP Collection, courtesy of NOAA.

Below the DSL, Life in Darkness

Making the most of scarce food…

Deep-sea fish require specific adaptations to survive in areas where the food supply is poor, and the availability of food is unpredictable

Making the most of infrequent mating opportunities…

- **"parasitic" males**
- **hermaphroditism**
  - **some are simultaneously male and female**
  - **some change gender depending on community composition**

Graphics: (left) Hagfish, courtesy of NOAA, (right) Brittle stars in the deep sea off Cape Hatteras. S. Stancyk, photographer. Courtesy of NOAA NURP and Univ. of S.Carolina.

So What Does a Deep Sea Fish Look Like?

Graphic: (left) Fangtooth, courtesy of NORFANZ, copyright by the Commonwealth of Australia, 2001, (top right) Anglerfish, (bottom right) Black dragonfish (female) Bauer, 1906.

Other Strange Inhabitants of the Deep

Graphics: (top left) Humpback anglerfish, (top right) Giant sea spider, (bottom left) Umbrella-mouthed gulper eel, (bottom right) coffinfish. All photos obtained during the NORFANZ expedition, copyright by the Commonwealth of Australia, 2001.

Deep Sea Floor Communities

- Slow metabolic rates reduce the need for food

- Appendages or fins can lift bodies above the ooze

- Other animals burrow

- Mobile species quickly colonize any potential food source

Community members:

- crustaceans

- worms
- sea cucumbers
- sea stars
- fish

Graphic: (top) Deep sea crab and anemone, R.Cooper, OAR/NURP and Univ. of Ct. courtesy of NOAA, (bottom) mobile community members, OAR/NURP and Univ. of Hawaii at Manoa.

Vacuum Cleaners of the Deep

Up to 80% of animals on the deep sea floor are <u>deposit feeders</u>

- feed on organic matter this is mixed within the sediment

A very effective strategy...
- there is little plant material for herbivores
- few live animals for carnivores
- slow currents carry little food to suspension feeders

Graphic: Sea cucumbers!, courtesy NOAA.

Preview of Next Lecture

Nature's Gardens – Coral Reefs

Reading: 12.20-12.22, 15.5, 16.15, 16.21, 17.26

Graphic: Coral reef, courtesy of NOAA.