

# **Animals of the Benthic Environment**

## **Chapter 15**

***Homework: 2, 3, 4, 5, 7, 10, 12, 13, 14, 16***

Approx 98% of the known marine animal species live on or in the ocean floor

Most known benthic species live on the continental shelf and in shallow areas or within or close to the euphotic zone (e.g. coral reefs)

Surface currents, water temperature, and water column productivity greatly affects the distribution of species, species diversity, and biomass of benthic animal communities.

### **WHY?**

- Currents?
- Temperature?
- Productivity?

Type of benthic substrate (Hard vs. Soft) greatly influences the types of benthic animals.

### **Hard Bottoms**

- Animals adapted to live on the top of rocks:

Epifauna

*Epi = On*

*Fauna = Animal*

### **Soft Bottoms**

- Animals adapted to live in the sediment:

Infauna

*In = In*

*Fauna = Animal*

Typically observe a zonation of benthic fauna related to the physical and geological environment:

- Tides
- Wave Energy
- Slope of Shoreline
- Source of Sediments

## **Rocky Benthic Habitat (Rocky Shores)**

Two General Groups of Epifauna

Sessile (Attached)

Mobile (Move Around)

Animals that live on Rocky Shores exhibit many adaptations to withstand the conditions imposed by these environments.

Rocky shorelines are typically much more dynamic than pelagic or deep sea benthic environments

Rocky Shorelines divided into 4 major zones which generally support different types of animals, different diversity, and differences in biomass

### **Intertidal Zone**

**Spray Zone (Supralittoral)** – Above spring high tide line but occasionally wet from wave spray and during storms

**High Tide Zone** – Submerged only during the highest high tides

**Middle Tide Zone** – Alternately submerged by all high tides and exposed during low tides

**Low Tide Zone** – Usually submerged but dry during the lowest low tides.

# **Adverse Conditions of the Rocky Intertidal Zones and Animal Adaptations**

## **Dessication**

- Ability to seek shelter
- Shells that can be closed
- Thick “skin” to prevent drying out

## **Strong Wave Energy**

- Strong holdfasts & or other attachment mechanisms
- Hard structures (e.g. shells)

## **Many Predators**

- Firm attachment to rocky substrate
- Stinging cells
- Camouflage
- Ability to break off (and re-grow) body parts

## **Difficult Reproduction**

- Release of large number of eggs and sperm in synchrony – Reproduction is often tied to spring high tide.

## **Rapid Changes and Large Range of Temp, Salinity, pH, and O<sub>2</sub>**

- Shells such that internal environment can be maintained

# **Sediment Covered Shorelines**

Includes: Beaches, Salt marshes, mudflats, and mangrove forests

Most animals that inhabit these environments live in the sediments “infauna”, but there are often species of “epifauna” present as well.

The higher the energy of the shore line (e.g. beaches are more energetic than mudflats) the  $O_2$  and nutrients are delivered.

Therefore, higher energy shorelines support more large  $O_2$  breathing animals and lower energy environments support smaller animals and anaerobic organisms (e.g. bacteria)

**BACTERIA RULE** Saltmarsh and mud flat environments since these environments are often dominated by anaerobic conditions.

# Intertidal Zonation of Sediment Covered Shorelines

Never as dramatic as seen in Rocky shorelines

Most pronounced on steeper slopes where there is a high tidal range.

Maximum # of species and biomass near the low tide zone (Similar in this respect to Rocky Shorelines)

# Life in the Sediments

## Feeding Styles

### **Suspension Feeding**

Animal buried in sediment but has special structure to filter food (plankton) from the overlying water column  
(e.g. Clam)

### **Deposit Feeding**

Process organic material coating the sediments  
(e.g. worms & Benthic crustaceans)

### **Carnivorous Feeding**

Prey on Infaunal species  
(e.g. Sand Star)

Muddy/Sandy environments typically support smaller organisms (e.g. crabs, worms (polychaetes), bivalves, microalgae.

Rarely support macroalgal species because not enough substrate for these species to attach to and often the water is too turbid and sedimentation rates too high.

A good example is our coastline (no Macroalgal Species Present)

# Shallow Offshore Ocean Floor

Area defined from the Spring Low Tide line to the edge of the continental shelf

Moderate to low species diversity. Diversity is lowest beneath upwelling zones. Benthos in these areas are often anoxic (devoid of O<sub>2</sub>) because of bacterial degradation of dead/dying algae.

Rocky bottoms usually dominated by Macroalgae (e.g. Kelp) which can effectively take advantage of sunlight in these environments.

Support a number of important fishery species including Lobsters, Crabs, Bottom Fishes, etc.

# Coral Reefs

Restricted to warm, clear, tropical, low nutrient waters

Corals are animals related to Jelly Fish

Individual animals called polyps. Coral polyps live symbiotically with algae called zooxanthellae so corals have the benefits of being both an animal and a plant.

Corals are colonies of polyps

## Requirements for Growth

- Temp between 18-30°C (64.4 - 86°F)
- Low Nutrients
- Strong sunlight
- Strong waves/currents
- Clear water
- Salinity
- Hard substrates

Similar to other benthic environments, zonation of species and biomass occurs. Gradients of wave energy and sunlight (related to depth)

Coral reefs are highly adapted to low nutrient conditions

Extremely effective at retaining and recycling nutrients. Unlike most of pelagic environments which are generally N limited, corals are probably P limited

In fact, if higher nutrients are present coral polyps are quickly out competed by other animals and algae

Coral Reefs appear to be in decline. This is a global not a local phenomenon.

Bleaching of corals is a good example. Bleaching results from the expulsion of the zooxanthellae, thought to be associated with warmer than normal temperatures such as occur during El Niño events.

Many other diseases of coral becoming more common and globally distributed

We really don't know why

- Nutrients?
- Pathogens?
- Hole in the ozone and increased UV?
- Global warming?

# The Deep Ocean Floor

## Characteristics of the Physical Environment

- Vast Area
- Stable Environment
- Dark
- Cold
- Homeogenous
- Constant Salinity
- O<sub>2</sub> Content Constant are Relatively High
- High Pressure

Life is largely dependent on material that sinks from the ocean surface. Deep sea benthic fauna are therefore usually food limited.

Relatively little is known about life on the deep ocean floor because it is vast and difficult to explore. Technology is helping here.

But... Evidence that the diversity of very small animals is high (rivaling a rain forest). However, biomass is low.

Dominated by small infauna (Meiofauna)

# **Hydrothermal Vents**

Oases of life based on bacterial chemosynthesis (not photosynthesis)

Chemosynthetic bacteria utilized reduced metals released from mantle material by superheated (volcanic) waters.

Because related to volcanic activity, individual vents have relatively short life spans (years – decades)

Chemosynthetic bacteria living in symbiotic relationships with mollusks (e.g. Riftia) support complex food webs.

## **Hypersaline, Hydrocarbon, and Subduction Zone Seeps**

Support similar oases of life as do hydrothermal vents but supported by different types of chemosynthetic bacteria.