Intertidal Zonation

Intertidal organisms seek a suitable habitat such as a sandy beach, muddy beach, rocky beach, or human-built structures such as jetties, breakwaters, or pilings. Superimposed on this habitat selection is a zonation which corresponds to the tide levels. Certain organisms prefer the Splash Zone, High Tide Zone, Mid Tide Zone, or Low Tide Zone. A brief description of these zones follows:

**Splash Zone** (above the 10 foot mark at Seattle): The region that is only occasionally wetted by spray from waves when the tide is high. The sparse population of organisms in this zone must be able to endure long periods of exposure to air (80% or more of the time), and must face large temperature fluctuations and solar radiation.

**High Tide Zone** (5 to 10 foot tide level at Seattle): The upper tide pool region. Organisms here must be adapted to frequent, prolonged exposure to air (35-80% of the time).

**Mid Tide Zone** (0 to 5 foot mark at Seattle): Contains organisms that must be adapted to daily exposure to air (10-35% of the time) alternating with submersion in sea water.

**Low Tide Zone** (below the 0 tide mark): Exposed to air only a few hours per month (not at all during some months). These organisms are exposed to air only 10% or less of the time. A large variety of organisms lives here.

Although it may seem at first that zonation is caused strictly by the tides, it is actually more complex than that. Animals and plants are responding to changes that result from periodic covering and uncovering by seawater. The upper limits of zonation are set by *physical factors* such as drying, large temperature changes, solar radiation, wave action, and changes in salt content due to rain. The lower limits of zonation are more often set by *biological factors*, such as competition for space and predation. Conditions for survival must not only be right for an adult specimen of a particular species, but also for its larvae, which are often more fragile.

**Structural and Behavioral Adaptations**

Intertidal zone organisms are particularly well suited to the study of structural and behavioral adaptations, since their environment changes drastically during...
the course of a day. With the change of tides there are enormous changes in temperature, salinity, food availability, and oxygen availability.

Structural adaptations include specialized body parts (tube feet, pincers, tentacles, siphons, and hard shells to name a few) that enable intertidal organisms to dig into and out of mud or sand quickly, shield themselves to avoid predators and conserve water during exposure to air, anchor themselves to solid objects such as rocks or pilings, and reach out and trap food in moving water. Some animals in the intertidal zone are able to use cryptic coloration (camouflage) to avoid predators, and others are able to regenerate lost body parts sacrificed during escape from a predator.

It sometimes appears that organisms move randomly about the beach or rocky intertidal zone. In actuality, most organisms are responding to some stimulus in their environment. Examples of environmental stimuli include immersion and drying due to tidal action, light and temperature variations, water movement due to waves and currents, and movement of sediment. Behavioral adaptations such as migration, burrowing, hiding, hunting for prey, and avoiding predators are all keyed to changing environmental stimuli during the daily tidal cycles.

In this lab, you will be asked to analyze and speculate about certain structural and behavioral adaptations exhibited by some common intertidal organisms.
Online Oceanography 101
Laboratory Exercise #10
Intertidal Marine Life

Questions to Answer

Use your textbook, and other references as necessary. Find reputable books and/or web pages to supplement the information in the textbook. Remember to cite your outside sources!

1. Different types of marine animals live in the intertidal zones of the three main kinds of littoral habitat -- rocky shores, sandy beaches, and mud flats. Answer the following questions regarding the differences in these animals.

   a) Waves and currents move sand and mud from place to place. Sand and mud can be piled up or washed away. What special problems might an animal face if it lives under sand or mud? How might it solve the problem?

   b) What special problems might an animal face if it lives on exposed rocks where powerful waves crash over it? What are some ways it might solve the problem?

   c) Most intertidal animals get oxygen directly from sea water. Why might this be difficult in a mud flat? How can an animal solve the problem? [Hint: Think about what clams do.]
2. Answer the following questions regarding specific intertidal zone species.

a) Sea stars move very slowly. How do they avoid being covered by sand or algae?

b) Compare and contrast the ways barnacles and sea anemones capture their food.

c) Compare and contrast the reaction of octopuses, limpets, and sea cucumbers to a perceived danger.

3. A beach profile is shown below. Place the letter of each species below in the zone (or zones) where it is most likely to be found. (Consult your textbook and other sources.)

A few websites that may be useful starting points:

http://www.mbayaq.org/efc/living_species/default.asp?hab=4
http://www.enchantedlearning.com/biomes/intertidal/intertidal.shtml
http://www.beachwatchers.wsu.edu/ezidweb/animals/index.htm
A. Rock Prickleback  I. Shield Limpet
B. Tidepool Sculpin  J. Rough Chiton
C. Purple Shore Crab  K. Rock Louse
D. Acorn Barnacle  L. Broken Back Shrimp
E. Purple Sea Urchin  M. Sea Lettuce
F. Sun Star  N. Surf Grass
G. Ochre Star  O. Rock Weed
H. Checkered Periwinkle  P. Elegant (Aggregated) Anemone

Representative beach profile, for use in Question #3.