Paul R. Pinet

SIXTH EDITION

Invitation to

Oceanography

Chapter 9

Marine Ecology

Ocean Habitats

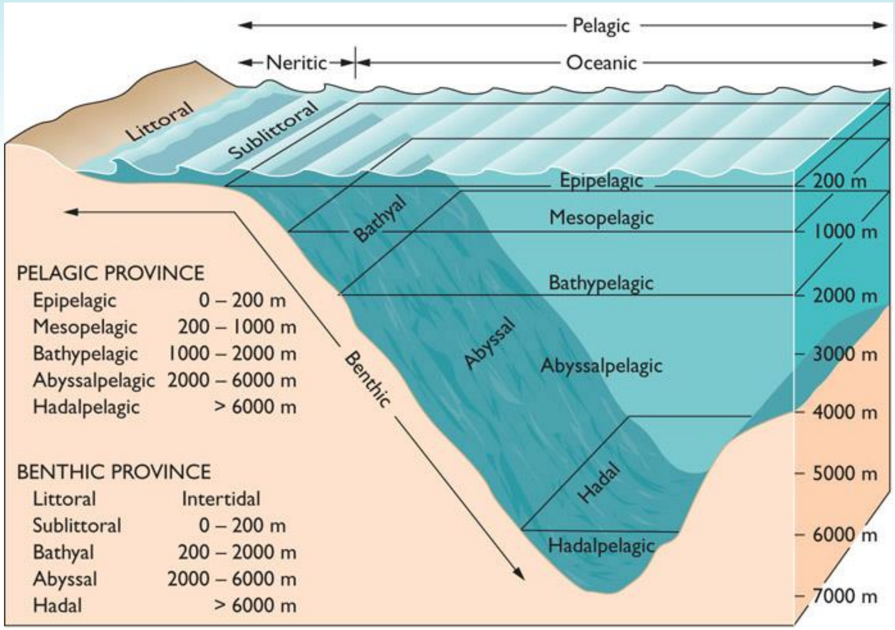


Figure 09.01a: Both the water column (the pelagic province) and the sea bottom (the benthic province) are divided into discrete zones.

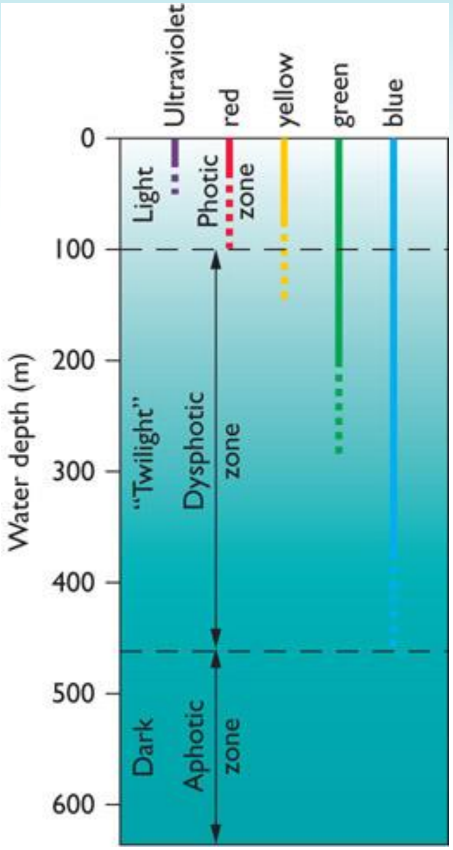


Figure 09.01b: On the basis of light, the water column is separated into a three-part division.

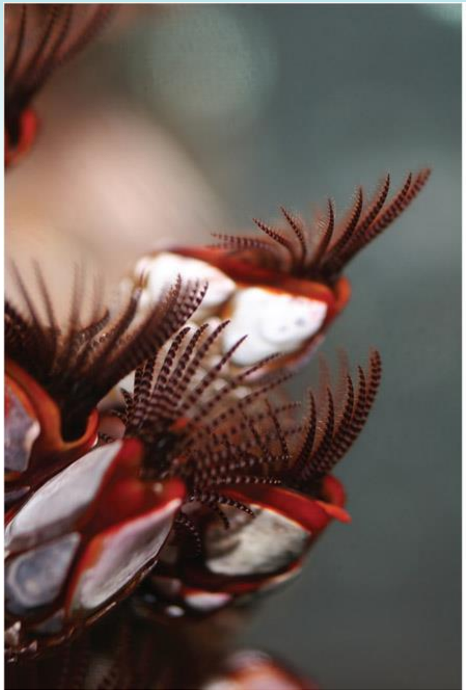
Environmental Factors

in the marine environment, these include:

- Temperature
- Salinity
- Pressure
- Nutrients
- dissolved gases
- Currents
- Light
- suspended sediments (water clarity and food source)
- substrate (bottom material)
- river inflow
- tides
- waves

- **Ecosystem** is the <u>total environment</u> including:
  - **biota** (all living organisms)
  - non-living physical and chemical aspects

- **Temperature** can control aspects of an organism's life:
  - Distribution
  - Degree of activity
  - Reproduction



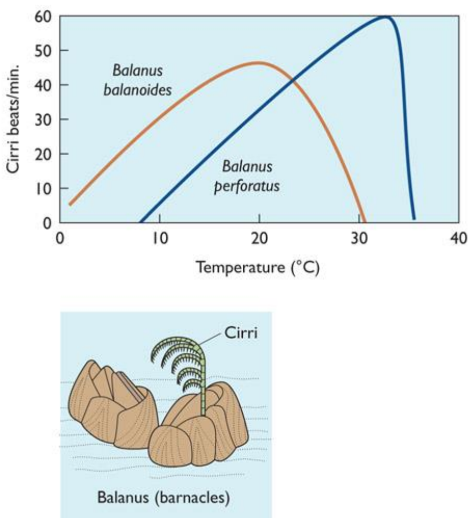


Figure 09.11: Many organisms are not able to regulate their body temperatures, which therefore vary with the temperature of the surrounding water.

Phytoplankton and Water Temperature

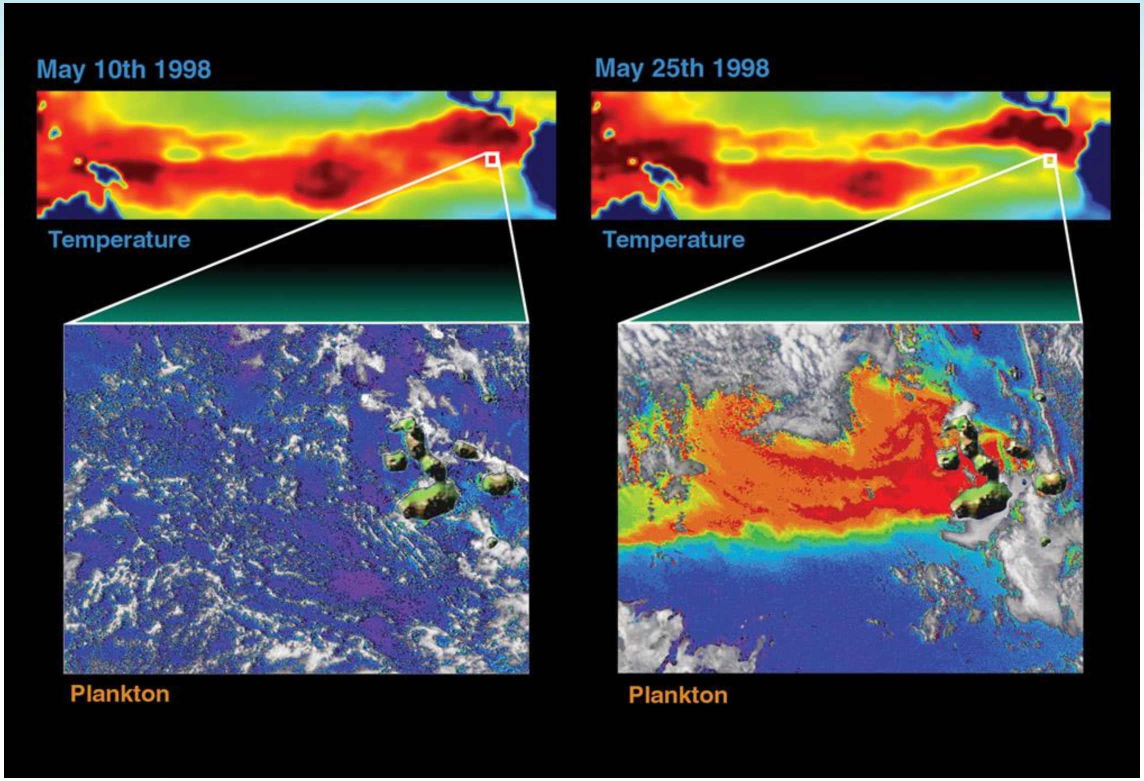


Figure 09.12: Phytoplankton and water temperature. A comparison of SeaWifs images and NCEP sea-surface temperatures of ocean water near the Galapagos Islands taken on May 10, 1998, and May 25, 1998, shows a clear correlation of plankton abundances and cool water temperatures. Sea-surface temperatures range from warm (red) to cold (blue), plankton abundances from low (blue) to high (red).

Phytoplankton and Water Temperature

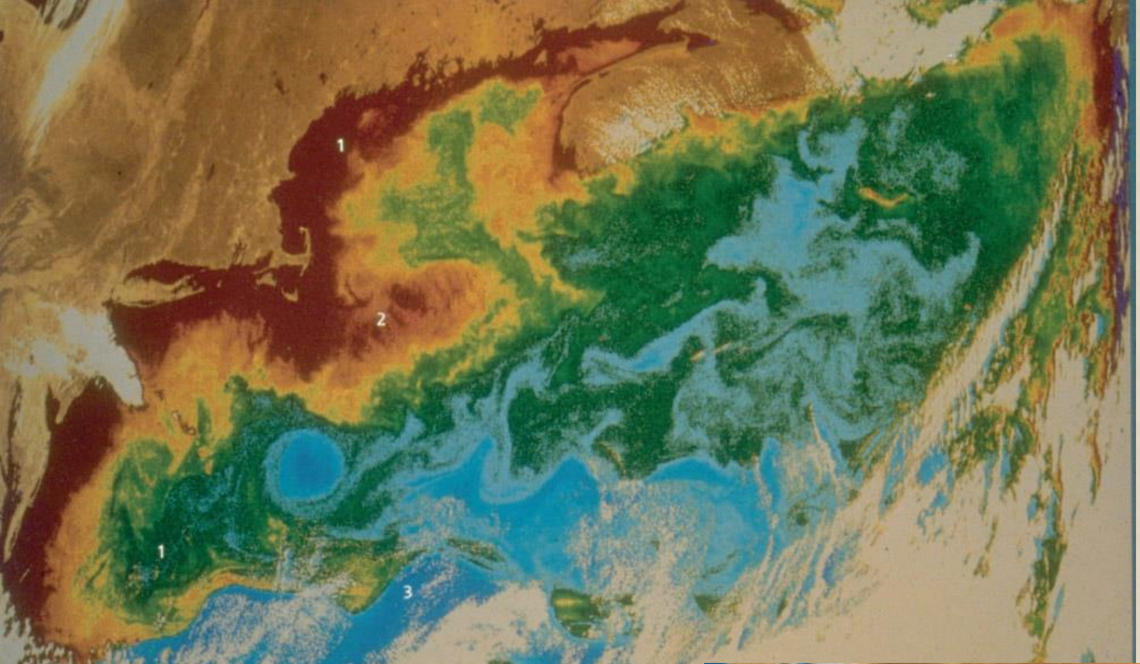


Figure 9-12a Phytoplankton

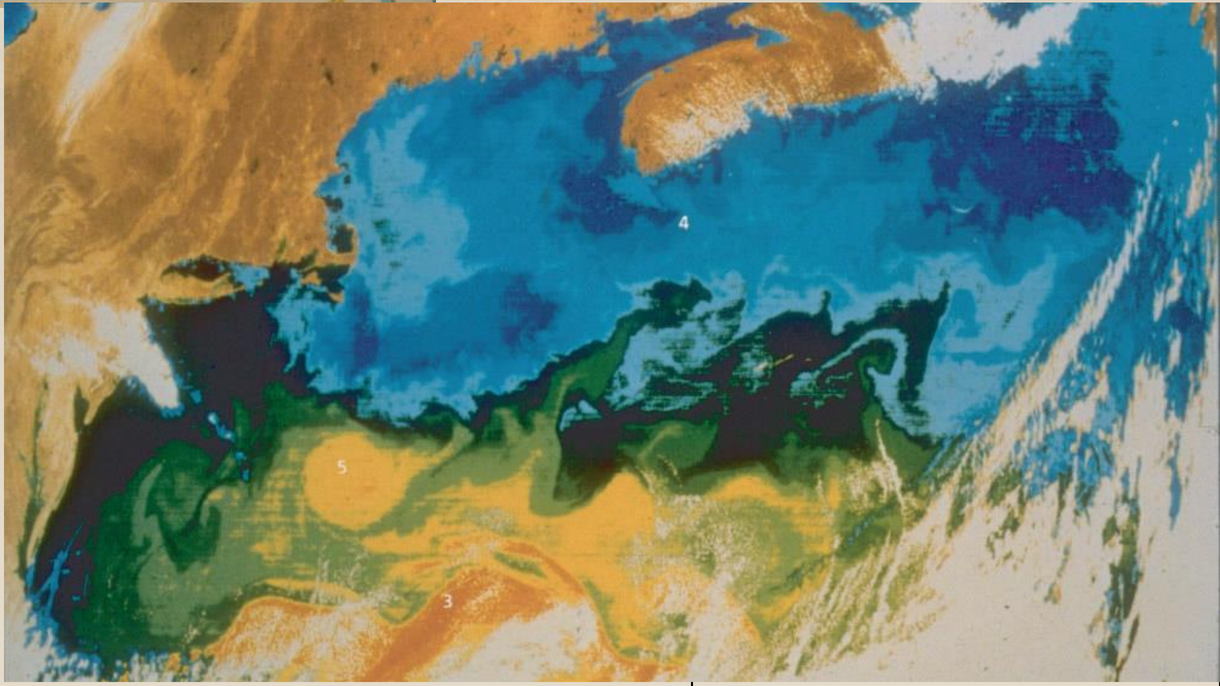


Figure 9-12b Sea Surface Temperature

Shellfish Harvest in Maine

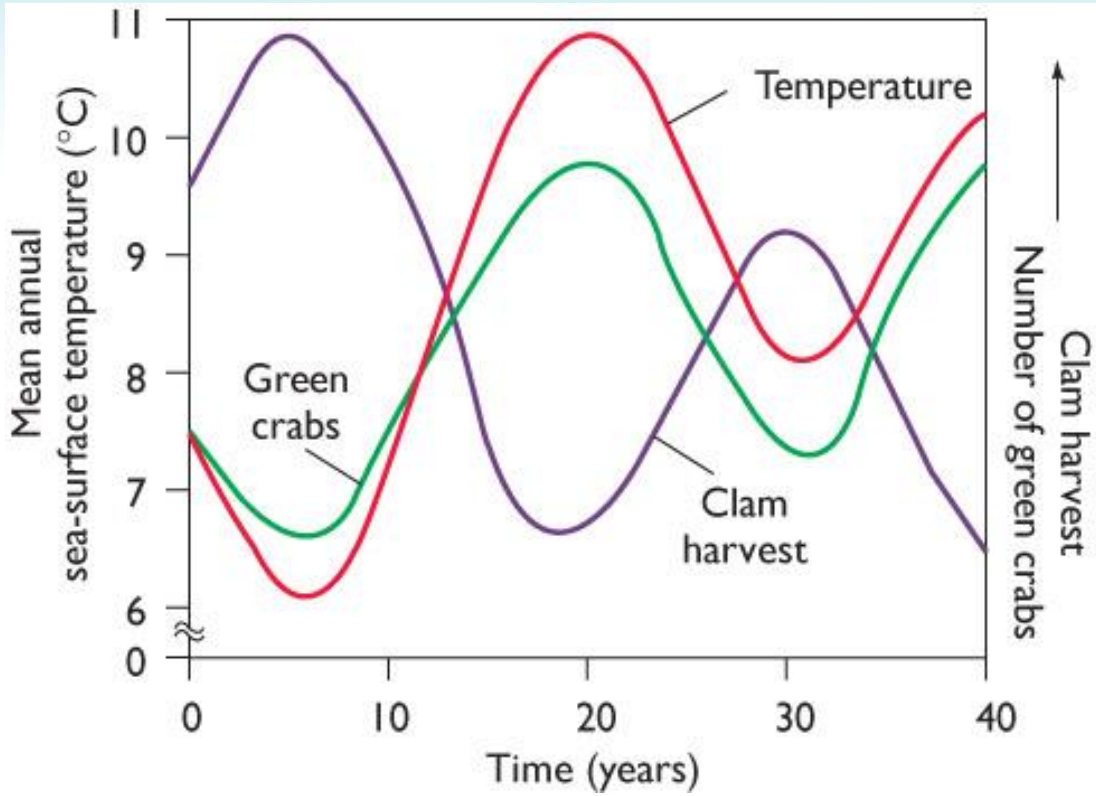


Figure 09.13: The clam yield in Casco Bay, Maine, is inversely related to the mean annual sea-surface temperature (SST).

Salinity can control the distribution of organisms and force them to migrate in response to changes.

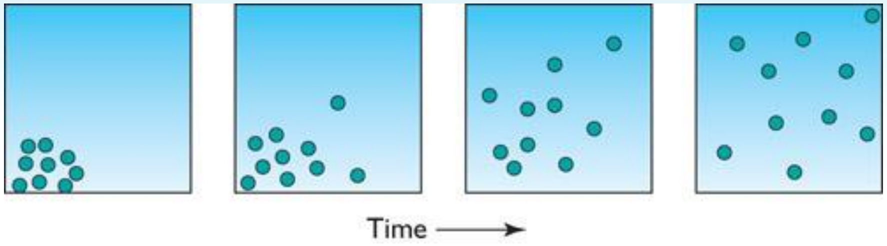


Figure 09.14a: Random molecular motion results in the movement of substances from points of high concentration to points of low concentration.

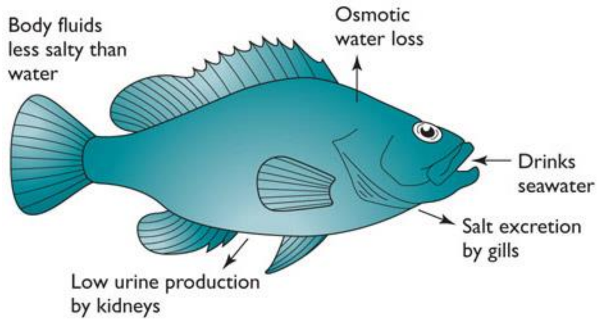


Figure 09.14b: Marine fish counteract the osmotic diffusion of water out of their cells in various ways.

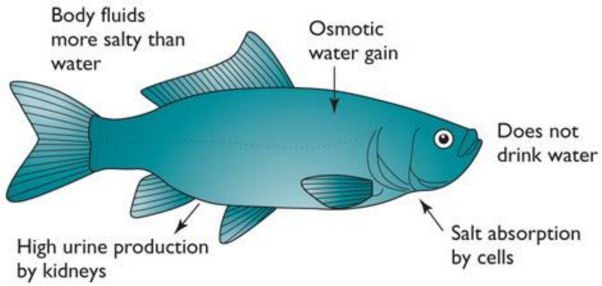


Figure 09.14c: Freshwater fishes osmoregulate by not drinking water, urinating frequently, and absorbing salt ions through chloride cells in the gills.

Hydrostatic pressure is exerted by a column of water above an organism.

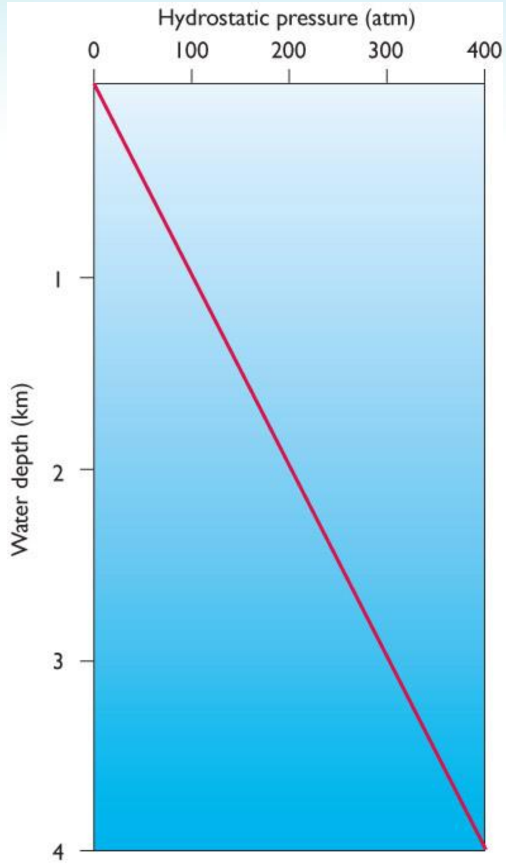


Figure 09.15a: On the average, hydrostatic pressure increases with water depth at a rate of about 1 atm per 10 meters of the water column.

Marine and Terrestrial Plants

- Plants on land are relatively large, multicellular, and rooted.
- They transfer nutrients and water to their leaves through a **vascular system**, generally from roots in the ground upward to the leaves.

- Marine plants are typically microscopic, unicellular, and free-floating.
- They absorb nutrients from seawater through their cell walls.

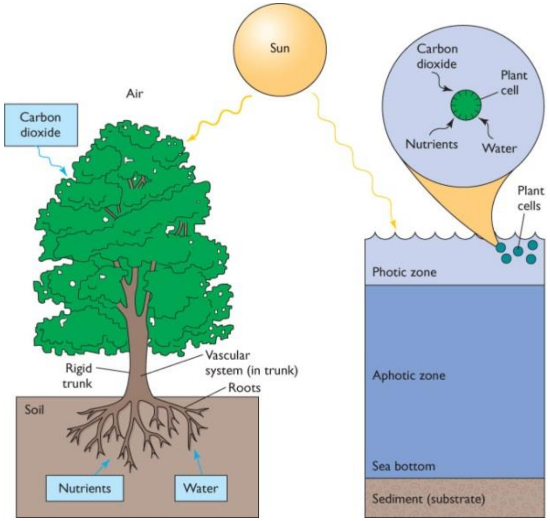


Figure 09.16: Plants on land are relatively large in size and transfer nutrients and water from the soil to their photosynthesizing leaves via an efficient vascular system.

Marine Plants

- Plankton include plants (phytoplankton) and animals (zooplankton).

- More than 90% of marine plants are **algae**.

- To photosynthesize (produce organic material from inorganic matter and sunlight) plants <u>must</u> remain within the **photic** zone.
  - **Settling rates** depend on the plant's size and frictional drag.

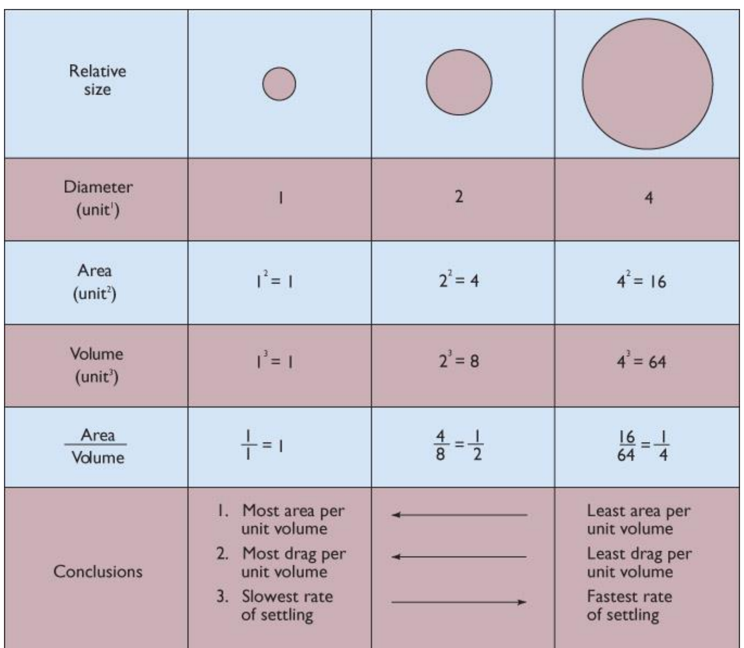


Figure 09.17: Marine plants must remain suspended in the photic zone in order to photosynthesize.

The morphology of fish has evolved to allow them to move through the water easily

- The fish's body must overcome three types of drag (resistance):
  - surface drag
  - form drag
  - turbulent drag

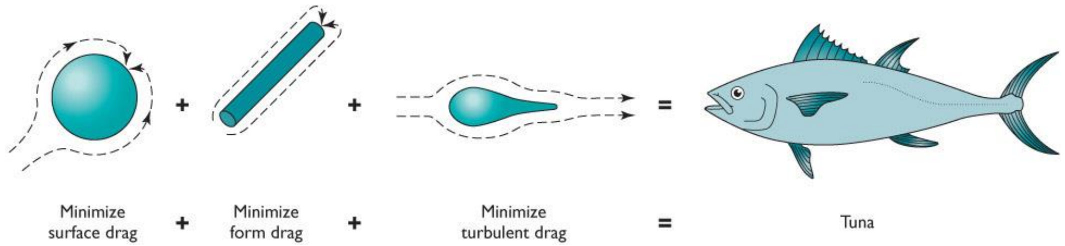


Figure 09.23a: Swimming efficiency in fishes is achieved by minimizing the drag created by friction, turbulence, and body form.

Aspect Ratio

- the ratio of the square of the caudal fin height to caudal fin area:

$AR = (\text{Caudal Fin Height})^2/\text{Caudal Fin Area}$

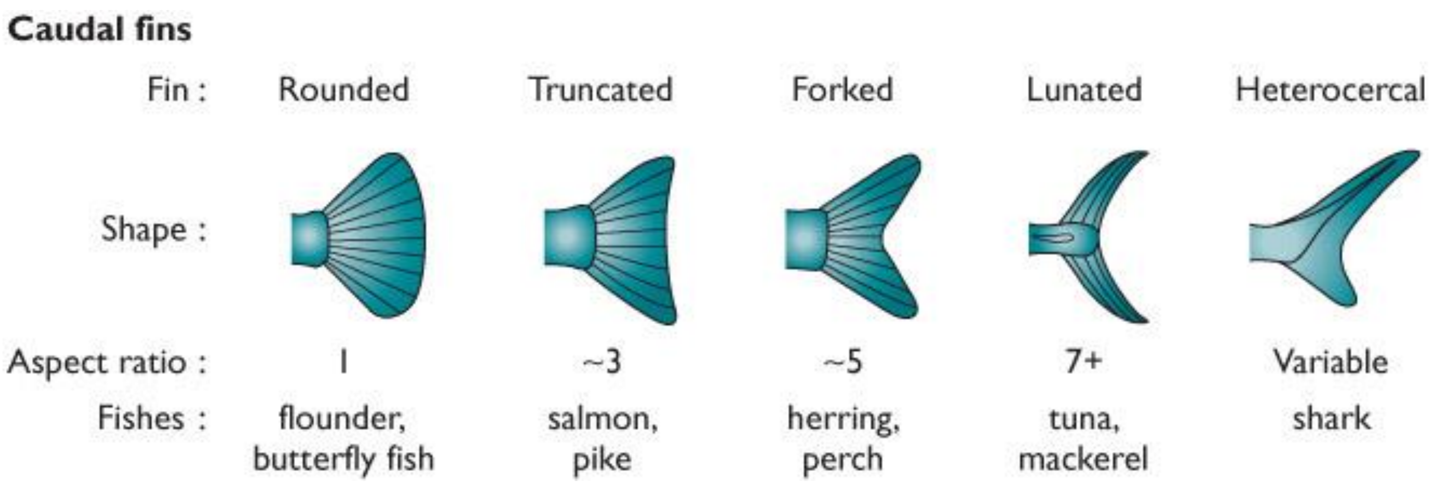


Figure 09.24: Fast-swimming fish possess caudal fins with high aspect ratios.

Classifying fish based on locomotion: Fin and body shape determine predation style

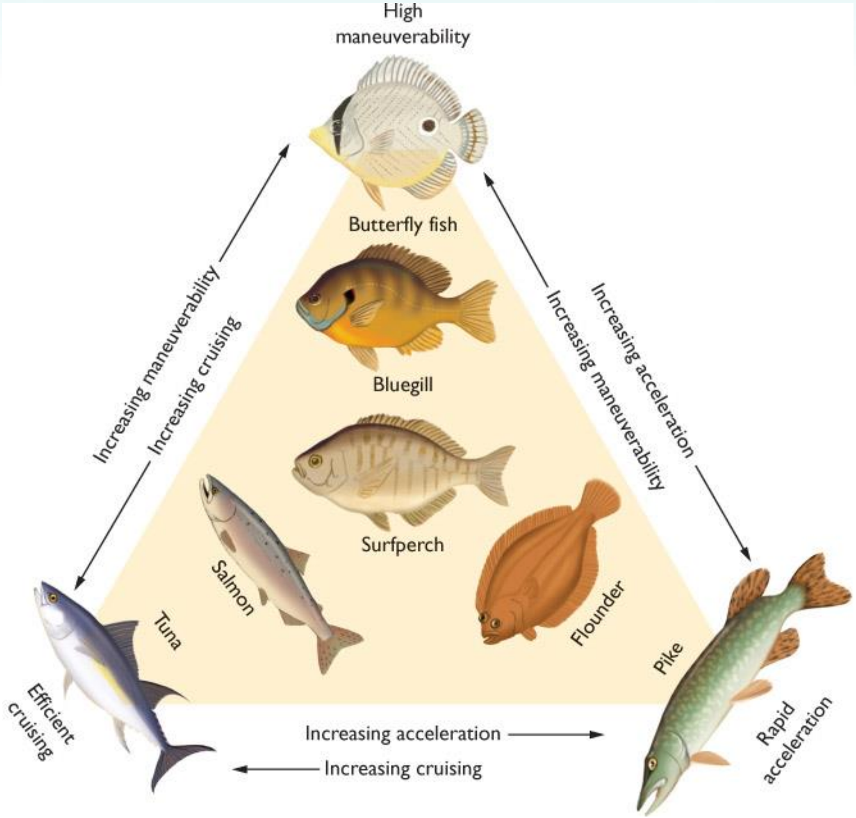


Figure 09.25: Fishes' mode of locomotion: each corner represents a distinct specialty (cruising, acceleration, maneuvering).

Vertical Zonation

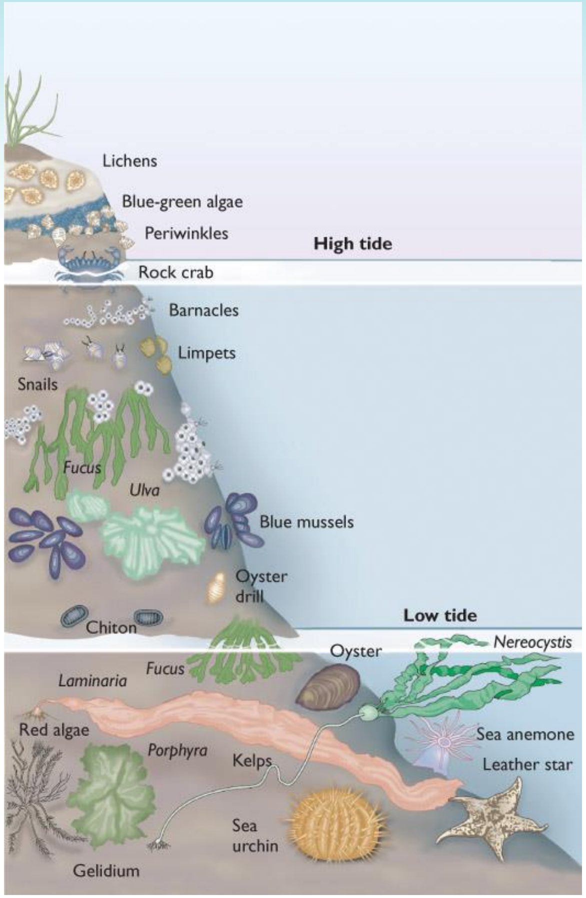


Figure 09.27a: Along the rocky shorelines of the midlatitudes, the benthic biota may display a banded distribution termed vertical zonation.

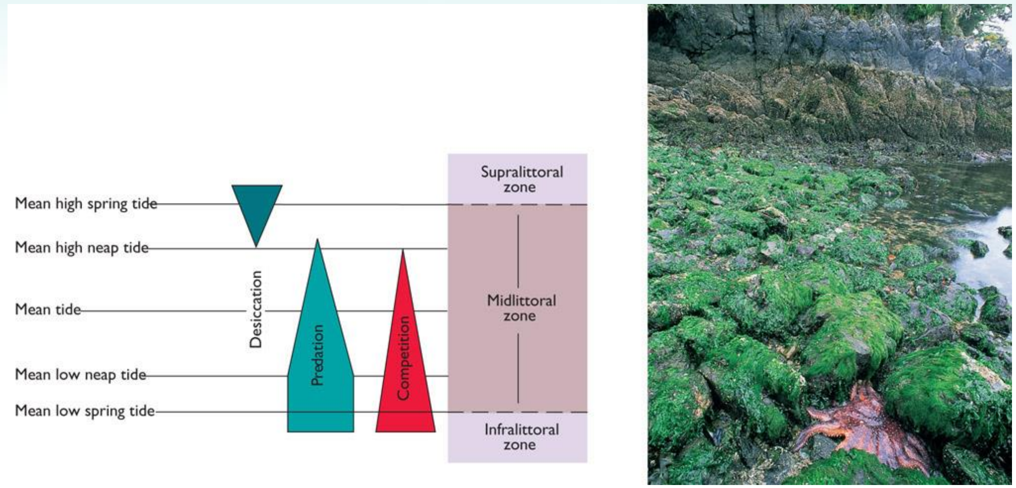


Figure 09.27b: The upper boundary of each zone is related to the degree of tolerance to exposure to air.