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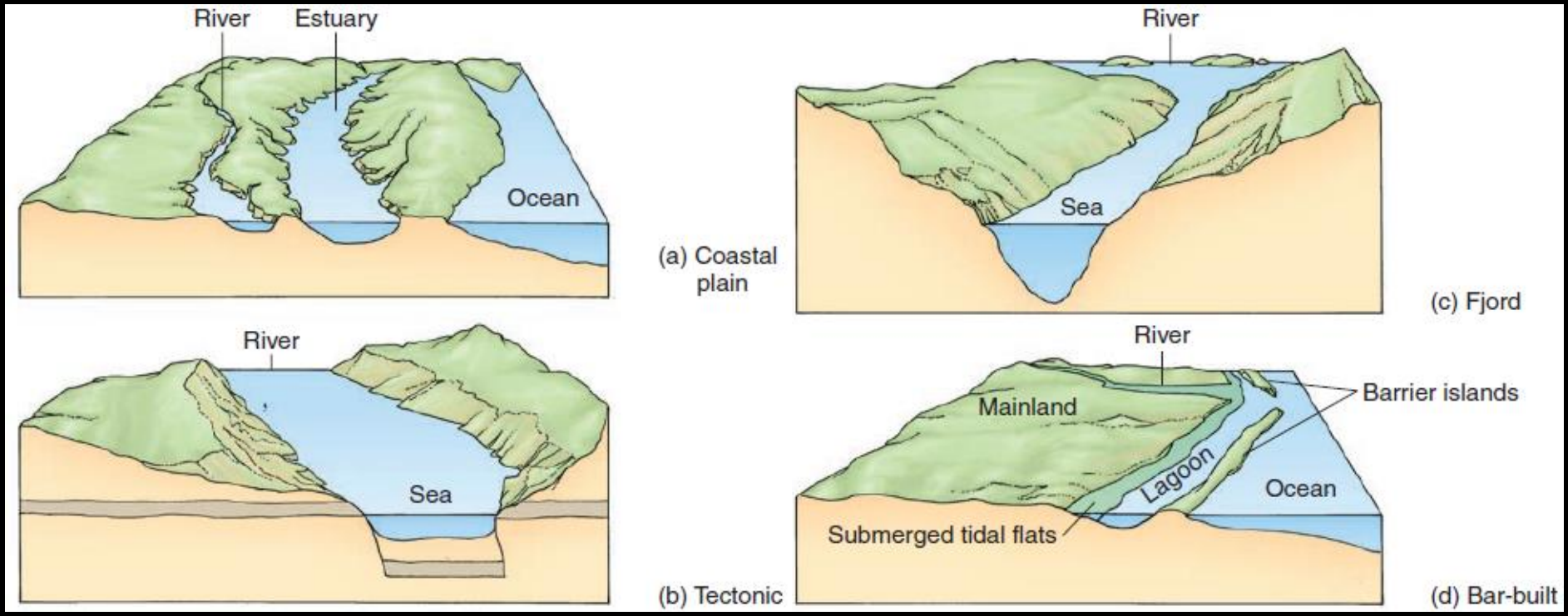
Estuaries

Estuaries

- Estuaries form where rivers meet the sea.
- High productivity, grow rapidly, and produce large populations.
- Estuaries are important to marine ecosystems.
- Estuaries support many commercially important animals.
- Estuaries are also fragile habitats.

Estuaries

- An *estuary* is an inlet of the ocean that extends into a river valley as far as the upper limit of the tide.

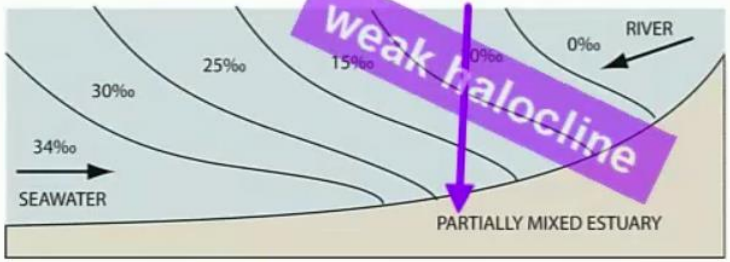


Salinity and Mixing Patterns

River: strong, high volume
Halocline: strong

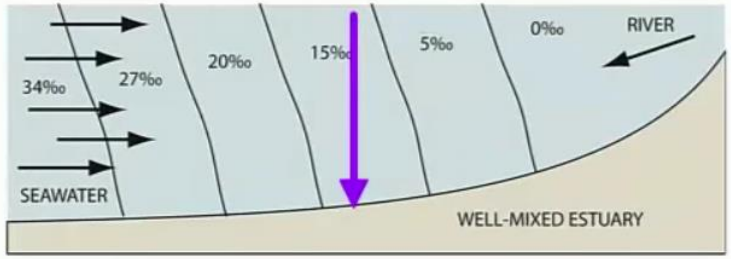
salt-wedge estuary

River: medium volume
Halocline: weak



partially-mixed estuary

River: weak, low volume
Halocline: none



well-mixed estuary

River: evaporates in summer
Halocline: weak and reversed

reverse estuary

Temperature

- Because estuaries are relatively shallow, the water temperature changes rapidly with changes in air temperature.
- Temperatures in estuaries can fluctuate dramatically seasonally and even daily. For instance, in northern temperate regions, water temperature may range from almost 22° C to 30° C, and portions of estuaries may freeze during the winter.

Estuarine Productivity

- Primary production in estuaries is generally low compared with coastal seas, and the basis of most estuarine food chains is detritus. The large amounts of detritus along with the primary production that does occur makes these areas some of the most productive in the marine environment. Nutrients and organic matter are trapped in estuaries by silt and clay that is brought in by rivers and streams and by the action of some organisms, for instance, the formation of pseudofeces by bivalves.

Life in Estuaries

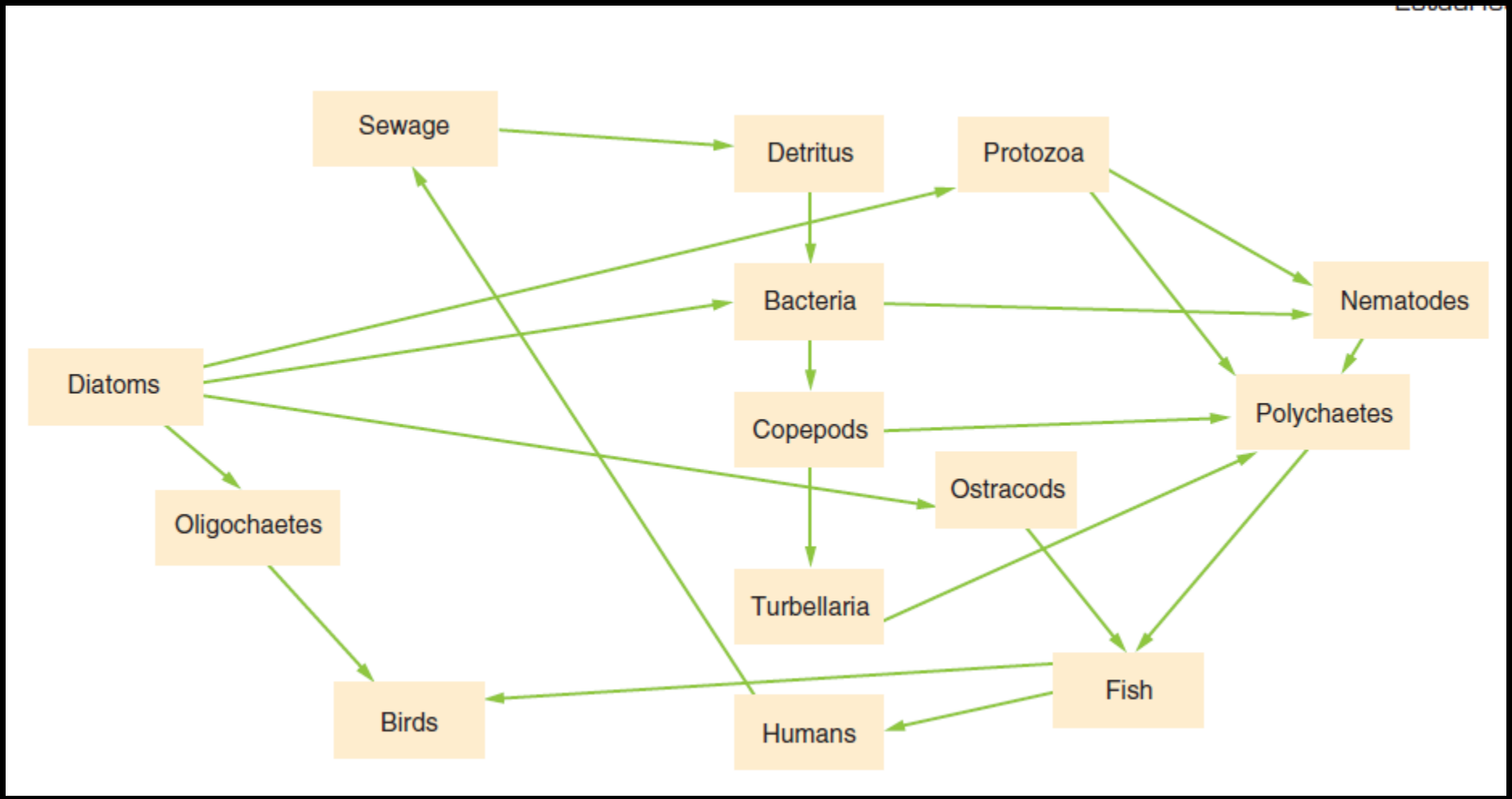
- Organisms that live in estuaries must be able to adapt to changing salinity. Osmoconformers have tissues and cells that can tolerate changes in salinity. Remaining stationary is another challenge for organisms in an estuary. The characteristics of estuaries tend to favor benthic organisms. Motile organisms must actively work to maintain position or move in and out with the tides. Because estuaries are highly productive and relatively protected from wave action, they make good nurseries for the juveniles and young of many species. Many important commercial fish and shellfish spend at least a portion of their life cycle in the protected waters of an estuary.

Oyster reefs

- Oyster reefs provide habitat for a variety of other organisms, including algae, sponges, hydrozoans, bryozoans, polychaetes, molluscs, echinoderms, and barnacles.
- Many of these organisms depend on the oysters not only for protection and a surface for attachment but also for food.

Mud Flats

Mud Flat Food Webs



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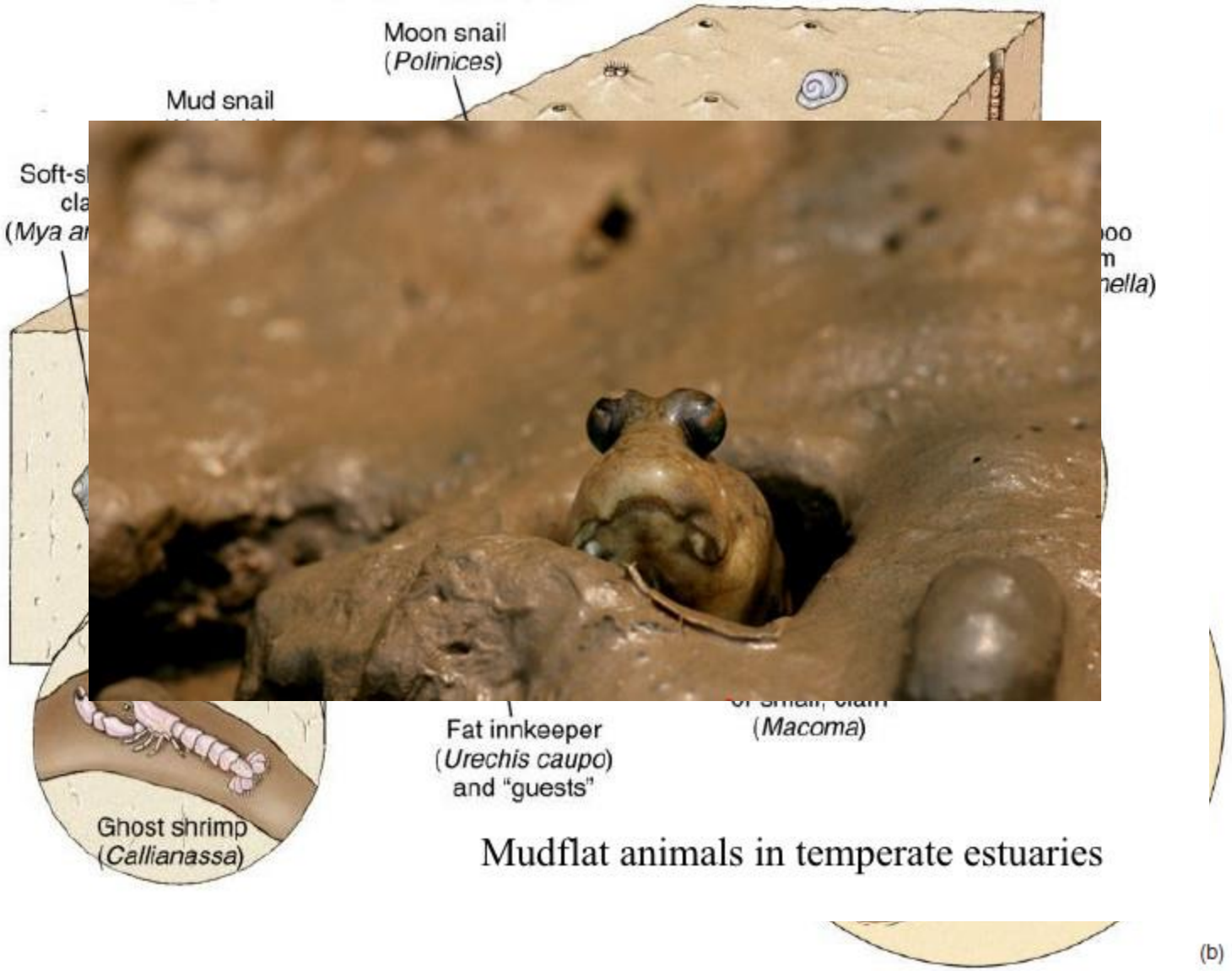
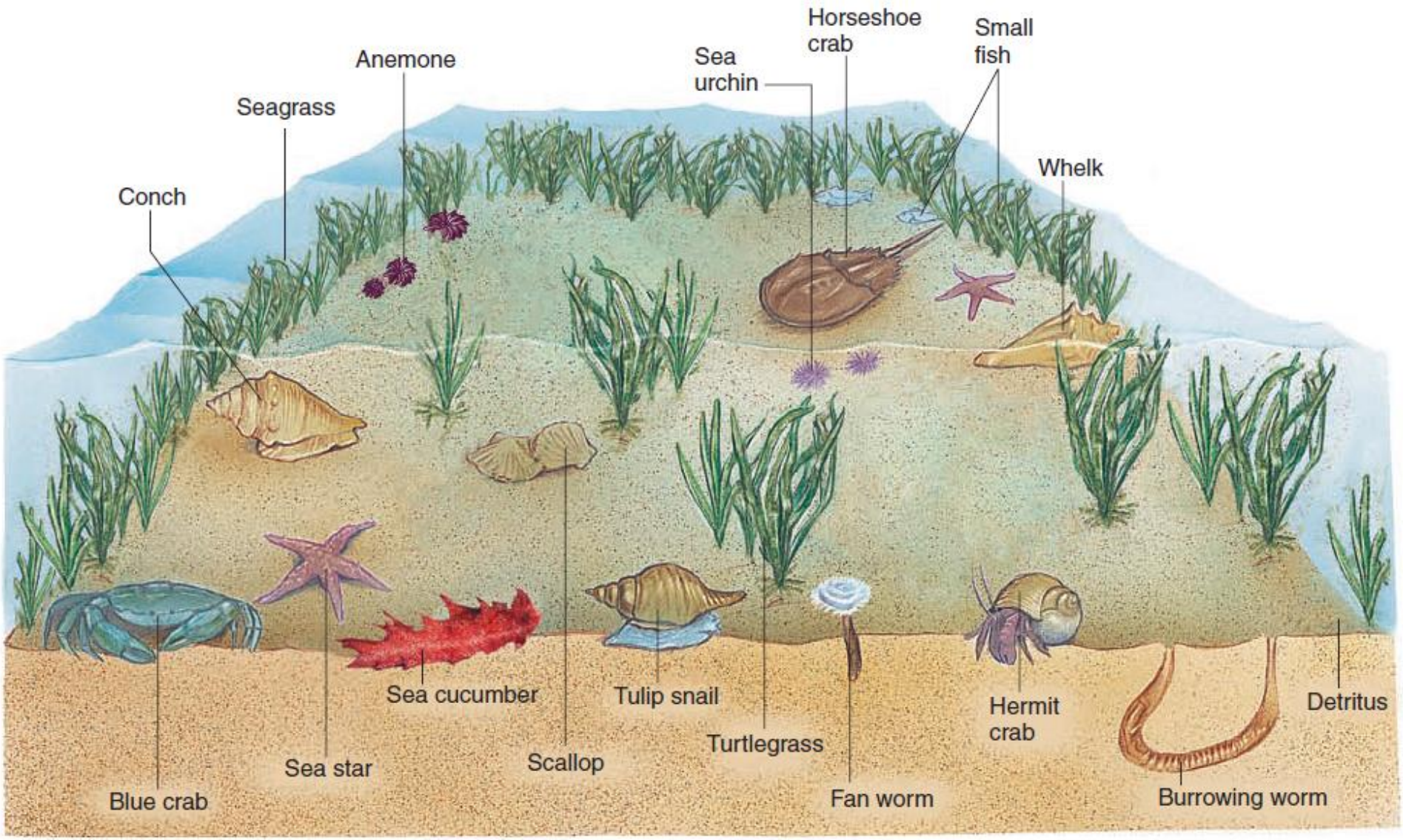
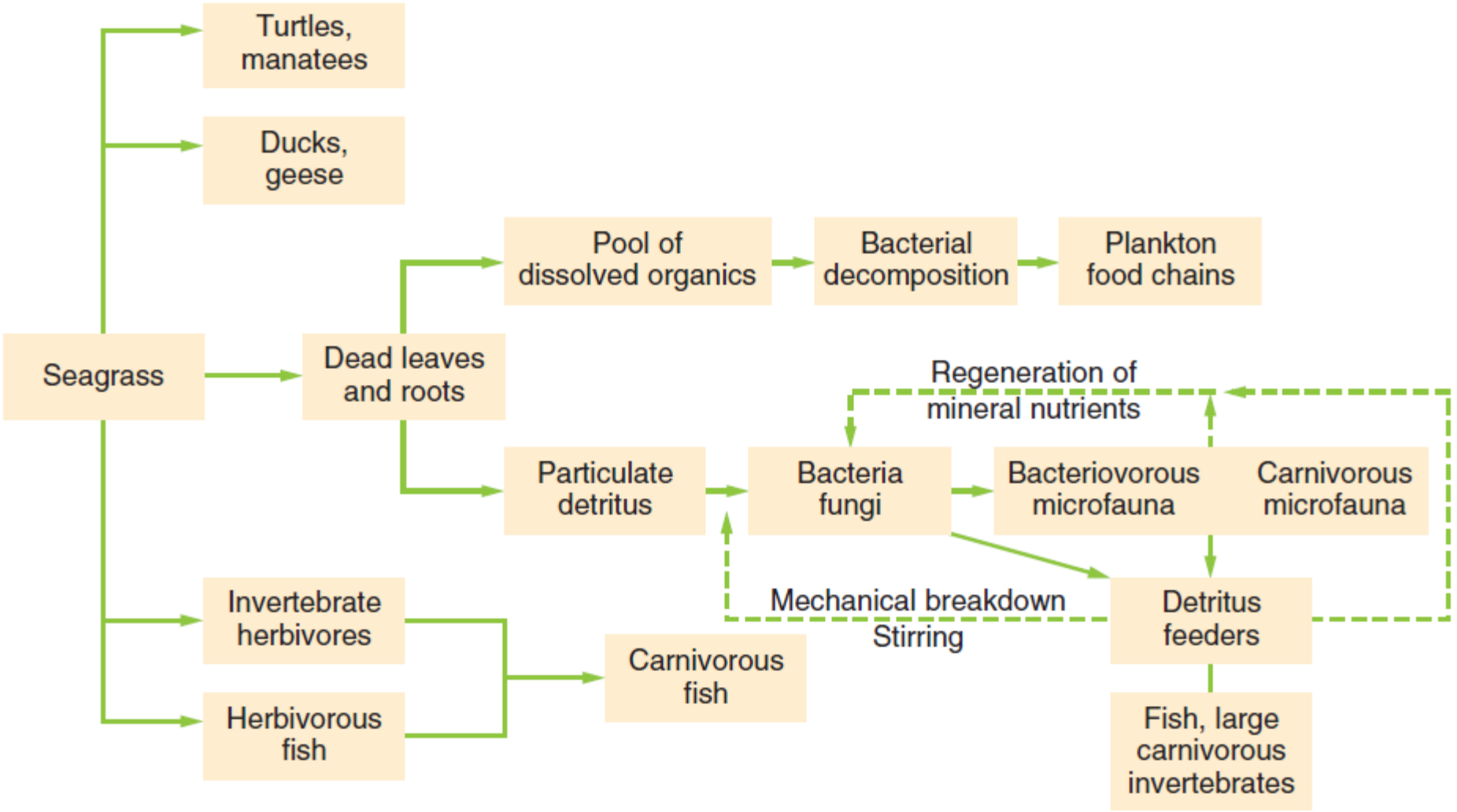


Mudflat animals in temperate estuaries


Horseshoe crab
Small fish
Anemone
Sea urchin
Seagrass
Whelk
Conch
Sea cucumber
Tulip snail
Hermit crab
Detritus
Turtlegrass
Sea star
Scallop
Blue crab
Fan worm
Burrowing worm

Seagrass Food Webs



Seagrass Meadows as Habitat

- The surfaces of seagrasses provide a place of attachment for many tiny organisms (epiphytes and epifauna).

Seagrass Research

- Shark-Turtle-dolphin

Wetlands

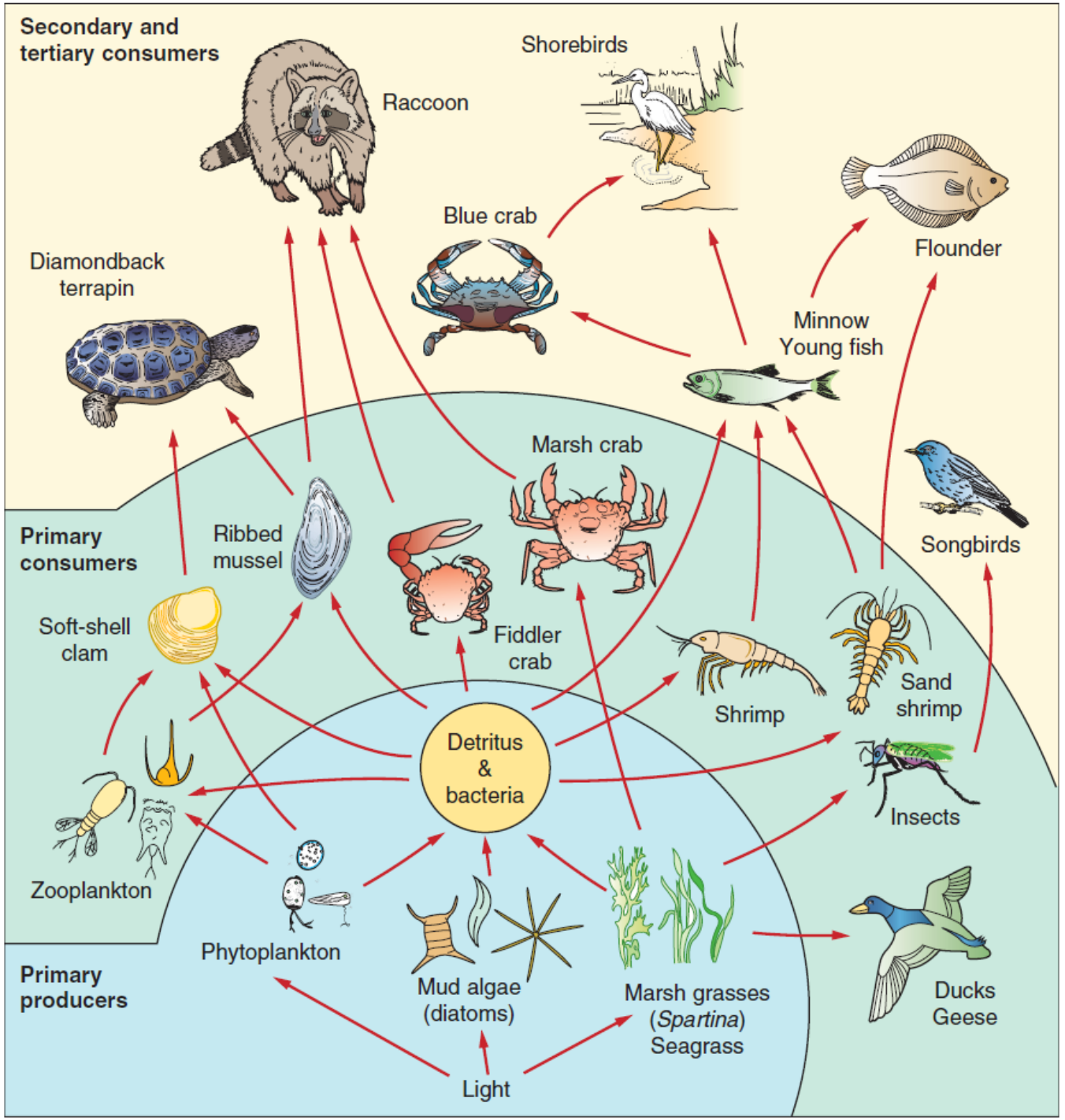
- Salt marshes and mangrove swamps are examples of wetlands.
- Coastal wetlands are very productive ecosystems and supply large amounts of food in the form of detritus to both estuaries and offshore communities.
- They act as nurseries for many important commercial fish and shellfish.
- There is also strong evidence that suggests coastal wetlands act like buffers in floods and they can suppress the impact of tsunamis and hurricanes by absorbing wave energy and storing excess storm water.

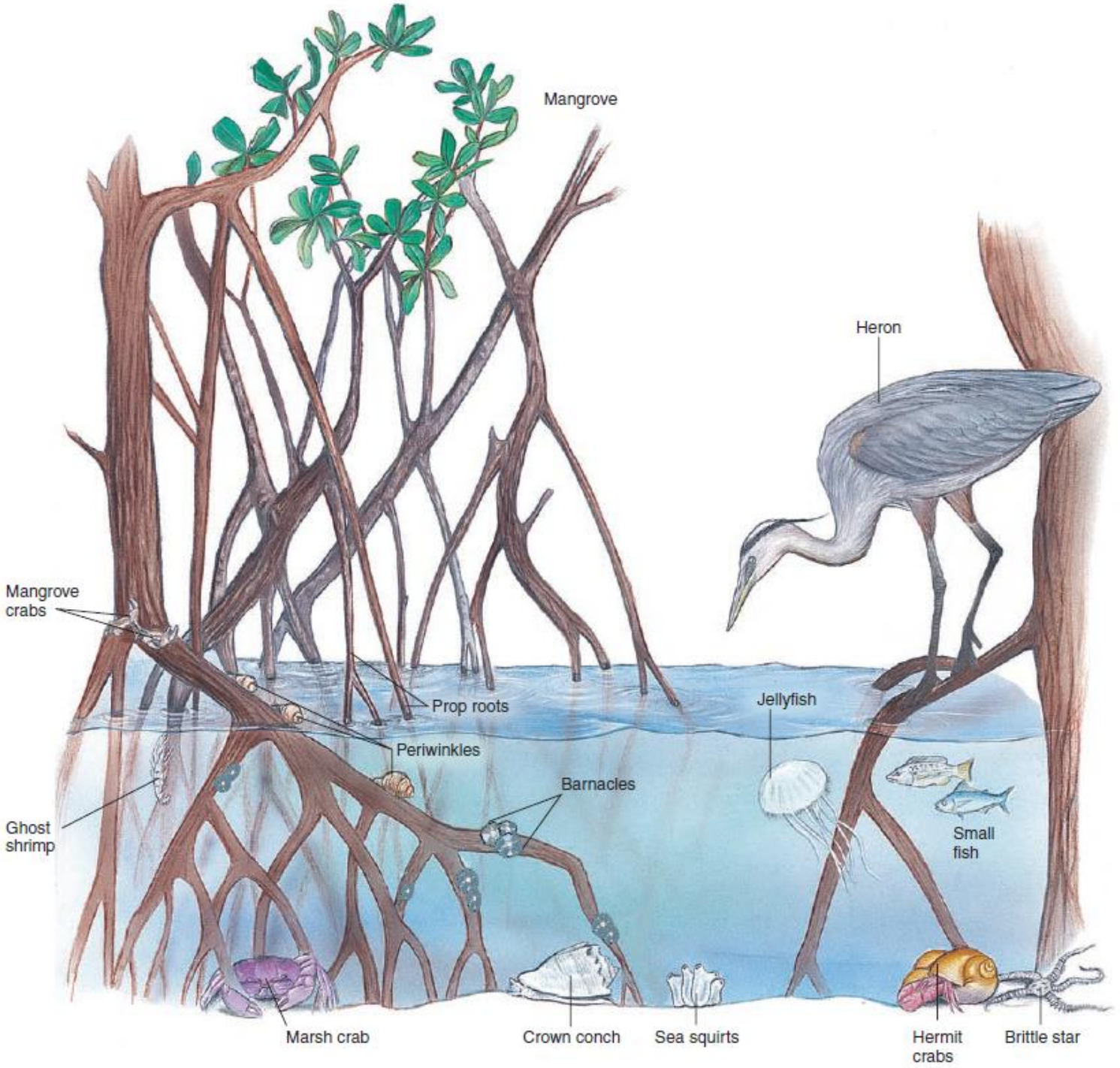
Salt Marsh

- Salt marsh communities are found on the shoreward side of mud flats in temperate and subarctic regions of the world.
- Most of the primary production of salt marshes, however, supports detrital food chains.

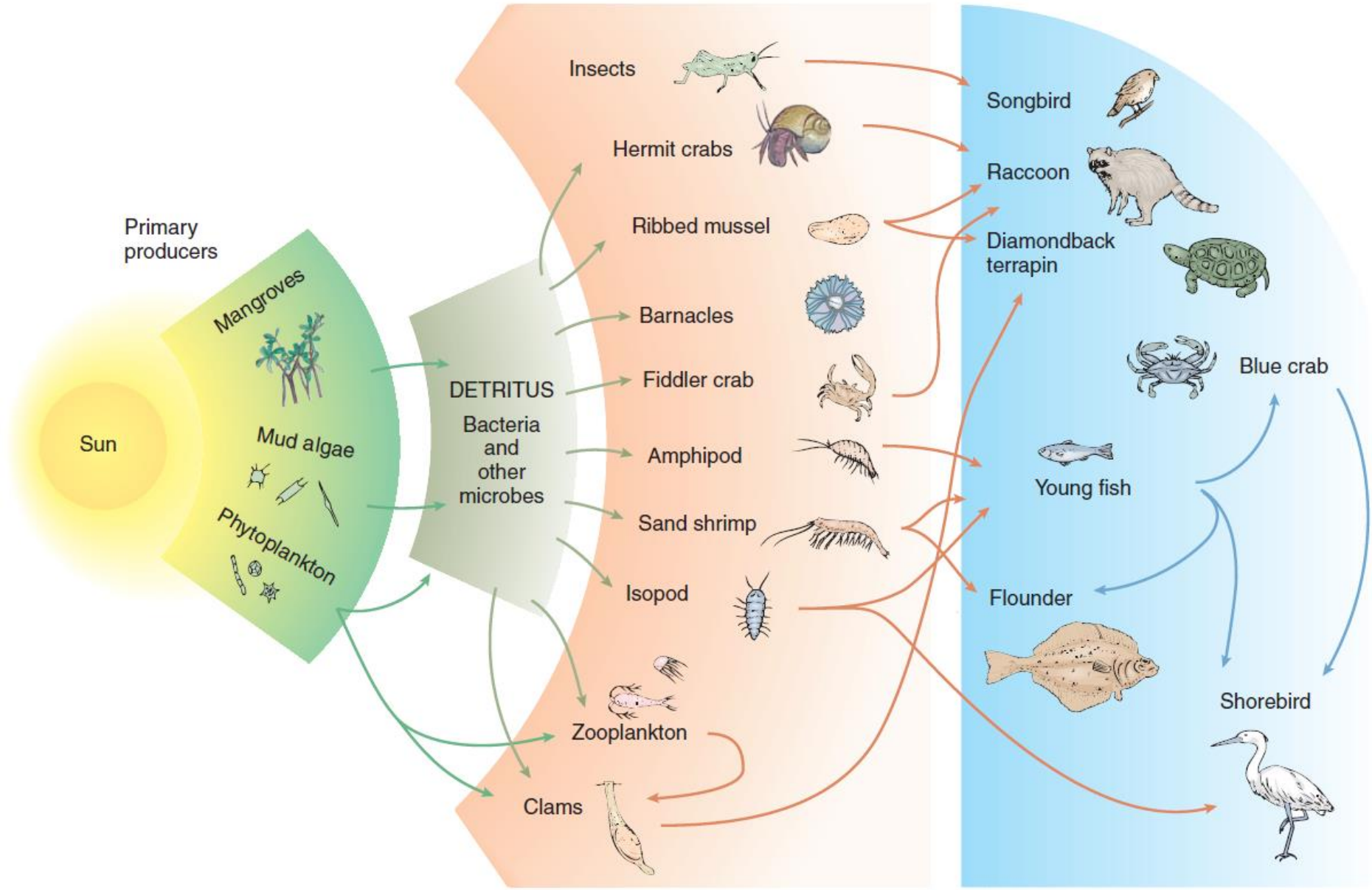
Marsh Grasses and Oyster Reefs

- Food Webs


Secondary and tertiary consumers
Raccoon
Shorebirds
Blue crab
Flounder
Diamondback terrapin
Minnow
Young fish
Marsh crab
Songbirds
Primary consumers
Ribbed mussel
Soft-shell clam
Fiddler crab
Shrimp
Sand shrimp
Detritus & bacteria
Insects
Zooplankton
Phytoplankton
Mud algae (diatoms)
Marsh grasses (Spartina) Seagrass
Ducks Geese
Primary producers
Light


Mangrove
Heron
Mangrove crabs
Prop roots
Periwinkles
Barnacles
Ghost shrimp
Jellyfish
Small fish
Marsh crab
Crown conch
Sea squirts
Hermit crabs
Brittle star

Mangrove Forests


Primary producers
Mangroves
Mud algae
Phytoplankton
Sun
DETRITUS
Bacteria and other microbes
Insects
Hermit crabs
Ribbed mussel
Barnacles
Fiddler crab
Amphipod
Sand shrimp
Isopod
Zooplankton
Clams
Songbird
Raccoon
Diamondback terrapin
Blue crab
Young fish
Flounder
Shorebird

Mangrove as Habitat

In Summary

- Salt marshes and mangrove swamps are examples of wetlands. Wetlands play important roles in producing food, providing habitat, and acting as nurseries for many species. Wetlands may also help protect terrestrial habitats from tsunami and hurricane damage.

Lagoons

- A lagoon is a shallow body of water separated from a larger body of water by barrier islands or reefs.

Key Concepts

- Estuaries form where freshwater from rivers and streams mixes with seawater.
- Estuarine communities include oyster reefs, mud flats, and seagrass meadows.
- Wetlands such as salt marshes and mangrove forests (mangals) are frequently found bordering estuaries.
- The salinity of water in estuaries varies both vertically and horizontally.
- Mixing of nutrients from saltwater and freshwater, combined with plentiful sunlight and relatively shallow water, makes estuaries very productive ecosystems.

Key Concepts

- The basis of many estuarine food chains is detritus.
- Animals and plants that live in estuaries must be able to adapt to changing salinity.
- The physical characteristics of estuaries tend to favor benthic organisms.
- Many commercially valuable fish and shellfish spend a portion of their life cycle in estuaries and wetlands.
- Lagoons are brackish water habitats that are similar to estuaries.

Further Reading

- Hughes, J. E., L. A. Deegan, B. J. Peterson, R. M. Holmes, and B. Fry. 2000. Nitrogen Flow through the Food Web in the Oligohaline Zone of a New England Estuary, *Ecology 8(2).*

- Valiela, I., and J. Teal. 1979. The Nitrogen Budget of a Salt Marsh Ecosystem, *Nature 280:652–656.*
- www.estuaries.org An overview of estuaries and restoration projects.