Unit IV. Problems and Solutions

Lesson I: Seagrasses and Mangroves

In today's program we will begin a unit concerned with the problems and solutions that face our wetlands, oceans and fisheries. Our first lesson focuses on examples of diverse ecosystems and communities. Both are excellent examples of diverse ecosystems.

Lesson Objectives

- Students will be able to identify the common species of mangroves and seagrasses and recognize the importance of seagrass and mangrove systems as habitats for a wide diversity of organisms as well as understanding their ecological importance to humans
- Students will gain an understanding of the structure of mangroves and seagrasses and how these plants are adapted to survive.
- Students will be able to construct food webs typical of mangrove and seagrass systems.

Vocabulary Words: embayments, halophytes, rhizome, lenticels and propagules

What are the Seagrasses and Mangroves?

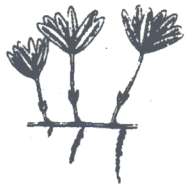
Seagrasses

Two very productive ecosystems are ecologically and economically important parts of subtropical areas: **seagrass meadows** and **mangrove** fringes or forests. These systems are named for the flowering plants that form the bases of the communities (see figure 1 for general diagram on the following page). Five seagrasses occur commonly along Florida's coasts: *Halodule wrightii* (shoal grass), *Ruppia maritima* (widgeon grass), *Syringodium filiforme* (manatee grass), *Halophila engelmannii* (star grass), and *Thalassia testudinum* (turtle grass).

Some of the names indicate the organism that eats the grass (manatee grass) while others indicate where the grasses are found (shoal grass). These seagrasses are

submerged vegetation that exist in the intertidal and subtidal areas of **embayments**. Because the plants need sunlight to photosynthesize, they tend to grow in shallow water and in areas where waters are not turbid. There are several large seagrass meadows remaining in Florida. Florida Bay, a part of the Everglades National Park, has an extensive seagrass area.

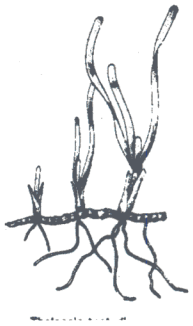
There are many different kinds of seagrasses. Each looks a little different from the other. Diagram 1 shows a few of the different seagrasses worldwide. The following are seagrasses that are found in the intertidal regions along the Florida Coast.



A

B

C



D

E

A. Star Grass (*Halophila*) B. Widgeon Grass (*Ruppia*) . Manatee Grass (*Syringodium*) D. Turtle Grass (*Thalassia*) E. Eelgrass (*Zostera*)

Mangroves

More than seventy species of mangroves exist worldwide, with three species occurring in Florida: *Rhizophora mangle* (the red mangrove), *Avicennia germinans* (the black mangrove), and *Laguncularia racemosa* (the white mangrove). The common names typically refer to the color of the bark or surface just below the bark of the trees. These plants are **halophytes**. That is they thrive in salty environments. However, the presence of salt in the environment is not a requirement for growing mangroves. They tend to grow faster and larger in areas along riverbanks where there is freshwater. In mangrove forest areas, single types of mangroves dominate. Such forests occur in southern Florida. Florida currently has about a half million acres of mangrove remaining.

How do These Plants Survive?

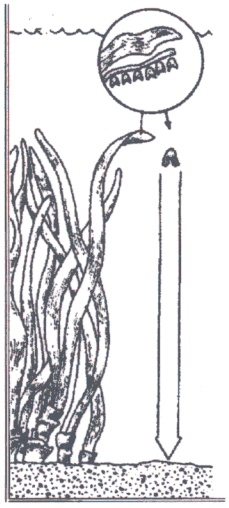
Seagrasses

The environment that seagrasses live in is salty, wet, and turbulent. In order to survive, plants must have special adaptations. Seagrasses have roots, stems, and flowers just like other flowering plants. However, they do not reproduce through pollination alone. They can reproduce through a asexual reproduction. They have a special organ beneath the sediment surface called **rhizomes** that produce shoots. A root anchors each shoot and the shoots grown from a common rhizome are called **clones.** A clone is an exact genetic replicate of the parent plant. In this way, large areas of seagrass meadows may actually be a single individual with several parts that are all connected by the rhizome. The rhizome is also important in gas exchange.

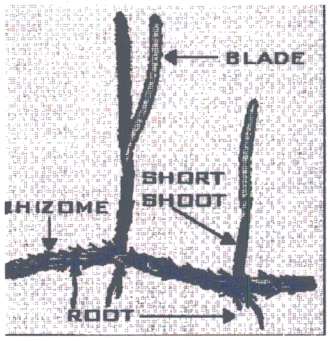
Seagrasses are **angiosperms.** That is, they produce both asexually and sexually. Seagrasses also reproduce via seeds. Female plants retain seeds in special blades that are fertilized by free-floating sperm released by male plants. The seeds are released and distributed by the currents and fall to the bottom of the root.

The root structure of the seagrasses is very important for supporting the plant, and the holding the soil in the tidal areas so that it is not removed with erosion. For one genus, *Thalassia*, the roots are very long – up to 5 feet. The long roots help to hold the plants in place. Other seagrass groups generally have short, thin roots that function more in nutrient uptake and gas exchange than in anchoring the plants.

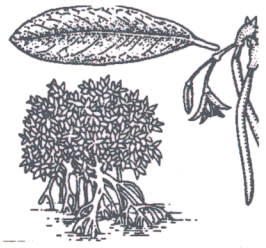
Syringodium has a round blade, which makes it unique among the seagrasses. The blade's shape and size is important for all seagrasses. This is the part of the plant that extends above the surface. The blade slows down the flow of water across its surface, resulting in sediment and other particles dropping among the stems. In this way, the seagrasses trap sediment and can stabilize movement of sediment. Trapped sediments can also provide additional nutrients for continued growth of the seagrasses.



Reproduction. Left: Female plants retain seeds in special blades that are fertilized by free-floating sperm released by male plants. The seeds are released and distributed by the currents, falling to the bottom of the root. Right: Asexual reproduction through growth of a rhizome which produces shoots that are clones of the original plant.



Mangroves



Like seagrasses, mangroves have a number of specializations that allow them to survive in a salty, wet environment. The most distinctive of the mangroves in Florida is the red mangrove. It is typically the most seaward of the mangroves where forest zonation occurs. The tangle of prop roots that extend from the tree allow it to anchor and to take up nutrients over a large area.

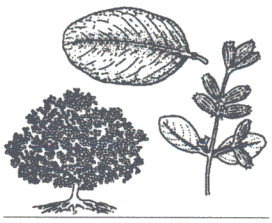
The prop roots are also the main breathing organs for the plants, especially when the tide is high. The roots have special pores called **lenticels** that are open at low tide to allow air to diffuse into the plant and down to the submerged roots. At high tide, these lenticels are closed, preventing the roots from becoming too wet inside. The submerged root of the mangrove excludes much of the salt from water that enters the plant by **ultrafiltration**. The red mangrove is very efficient at this. Thus, the water that is inside of the plant is relatively fresh. The red mangrove leaves are dark green and

relatively "tough". They have a thick, waxy cuticle on the upper surface. The leaves also manufacture chemicals that deter insects and other animals from eating the leaves (typically little insect damage can be seen on red mangrove leaves in the field).

The black mangrove also has unique specializations. The roots of this tree are also aerial, extending out of the ground as **pneumatophores** (for gas exchange).

The size and number of the pneumatophores can vary greatly among trees of similar sizes and in similar habitats. Some pneumatophores can be as long as 30 cm. Unlike the red mangrove, the roots of the black mangroves contain chlorophyll and can photosynthesize, increasing the ability of the plant to absorb solar energy. Black mangroves also have lenticels, but these are usually found on the lower trunks of the plants rather than on the roots. The black mangrove excretes salt from special structures on the upper surfaces of the leaves referred to as "salt glands". This helps to decrease the salt content of the water inside of the trees. Black mangrove leaves are also dark and waxy. The black mangrove is the most tolerant of colder temperatures, thus it tends to occur further north along the coasts of Florida than the other two dominant species.

The white mangrove does not have aerial roots. It is typically the most landward of the mangroves, sometimes seen as part of home landscapes in upland areas. Like the black mangrove, the white mangrove has small "salt glands" on the surface of leaves. The leaves of this mangrove are light green. It does not have the chemical defenses against insects and other animals found in the black and red mangroves. Therefore, its leaves can be severely damaged by these animals.



All three genera of mangroves in the Florida area have interesting methods of reproduction. Their flowers are pollinated in part by bees and by crabs. Some beekeepers in Florida place hives near mangrove fringes in the spring to add a distinctive flavor to the bee honey. The mangrove tree crab (*Aratus pisonii*) has been observed with pollen grains attached to hairs on the legs, moving between flowers to eat portions of the blooms. It is likely that some pollination occurs from this activity.

Each tree produces seeds that sprout while still on the tree, forming **propagules**. These propagules mature and then drop to the ground or water surrounding the mangrove trees. They may sprout near the parents or they may be carried away on currents and be deposited elsewhere. The red mangrove propagule is particularly well developed for water transport. It has a tough outer covering and a

cylindrical shape. The fruits can float for several months and still produce a tree when in the proper environment. The end of the fruit that will grow roots is heavier than the end that will produce leaves. Therefore, when the fruit floats into shallow water, there is a tendency for the heavy end to become stuck in the sediment. This allows the correct growth orientation for the plants.

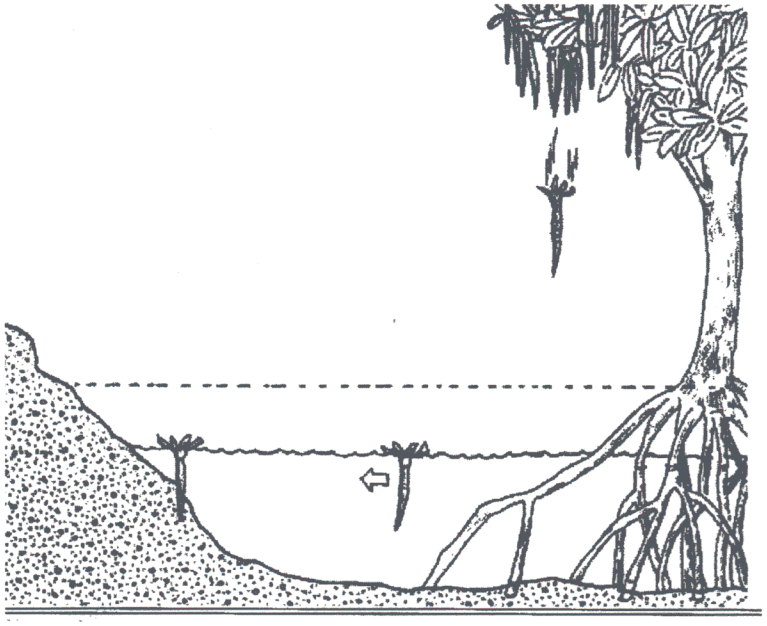


Figure 2. Mangrove Seed Distribution. Fertilized seeds drop from mature plants into the water or mud. Either they will stick into the mud and take root, or float with the tide and currents until they land on shore.

What Kinds of Organisms are Found in Seagrass and Mangrove Systems?

Seagrasses and mangroves are thriving but delicate habitats, and many animals depend on the **estuary** for life. Some of the "trademark" Florida animals such as pelicans and manatees are associated with seagrasses and mangroves. Other kinds of organisms such as marine bacteria form important parts of the mangrove and seagrass systems. The contributions of these tiny organisms have not been well studied, so we will not detail them here.

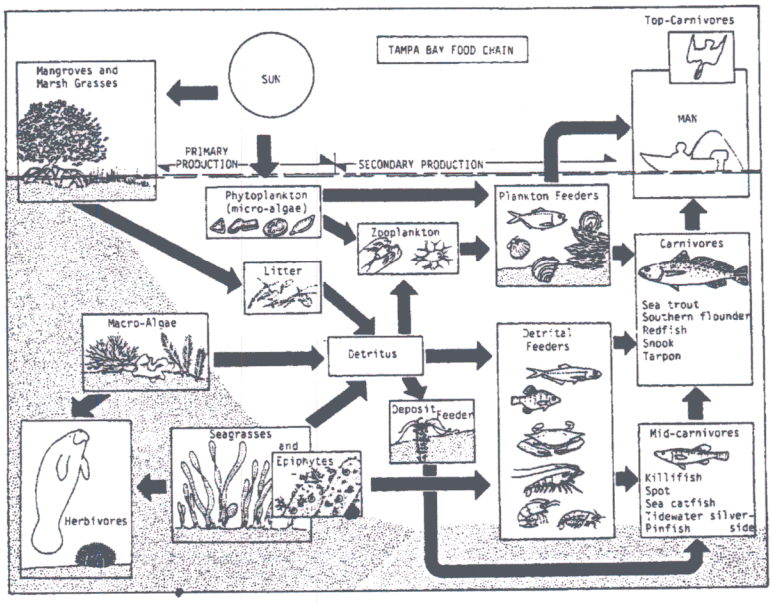
Seagrass meadows harbor a variety of plants and animals. Plants that grow upon the blades of the seagrasses are called **epiphytes**. Most of these epiphytes are small (microepiphytic) and large (macroepiphytic) algae. Epiphytes can cover the blades of the seagrasses and compete with the host plant for light and nutrients. In some more tropical areas, **coralline** algae associated with seagrasses likely contribute significantly to sand formation in shallow coastal waters. Seagrasses also supply food for grazers that move over their blades.

Grazers range in size from those that harvest epiphytes to those that

consume patches of seagrass. One of the largest grazers is the manatee (*Sirenia*). These animals can consume 10 to 15% of their body weight a day. For a 1000 pound animal that is not travelling, about 100 to 150 pounds of vegetation are consumed per day. When traveling or pregnant, the consumption may be higher! Sea turtles will also include seagrasses as a part of their diets. Other grazers like sea urchins (Echinodermata) can feed as individuals or in large groups. Herds of sea urchins can eat wide paths through seagrass beds.

Crustaceans are common to the seagrasses and mangroves. Several types of hermit crabs live in and around seagrasses. These crabs must find an empty gastropod shell to cover their soft abdomens. Some hermit crabs patrol the edges of seagrass beds collecting shells that are trapped by the grasses. Most also eat epiphytes from grass blades or consume detritus. One species from Florida, *Pagurus maclaughlinae*, scrapes epiphytes from the blades and uses the rhizomes as an underground "subway" for movement around the seagrass bed. Smaller grazers include crustaceans like copepods (3-10 millimeters long). These crustaceans live among the blades and harvest epiphytes. The arrow shrimp (*Tozeuma carolinense*) has a transparent body and feeds on epiphytes. The green and brown colors of the epiphytes can be seen in the guts of the shrimps, giving the animals a form of camouflage! The shrimp lie along the length of the seagrass blades and become almost invisible against the grass background.

Seagrasses also produce a large amount of detritus (blades that are dead or dying), creating material for use by organisms in both marine and terrestrial systems. **Detritivores** (organisms that feed on detritus) and marine bacteria help to break down



the grass blades and to recycle. Birds such as the reddish egret (*Egretta rufescens*), the great blue heron (*Ardea herodias*), brown pelican (*Pelicanus occidentalis*), and the anhinga (*Anhinga anhinga*) are found frequently foraging in and around the seagrass meadows. At low tide, a variety of gulls and other wading birds pick through exposed seagrass for crustaceans and fish.

Other animals with commercial value are associated with seagrass meadows. A variety of crustaceans, including juvenile blue crabs (*Callinectes sapidus*) and shrimps (*Penaeus* species), live in and around the grassbeds.

Mangrove fringes and forests are extremely important habitats for a variety of plants and animals. In Florida, over 220 species of fish, 24 species of reptiles and amphibians including turtles, snakes and frogs, 18 species of mammals, and 181 species of birds depend on mangroves for nesting, for food, and for refuge as adults and/or juveniles. Many algal species as well as vines and coastal plants are common occupants of the mangrove habitat.

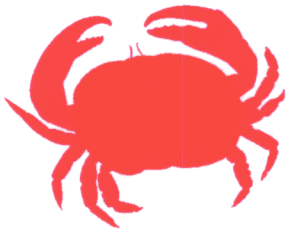
Some of the larger users of mangrove areas are the Florida panthers (*Felis concolor*). Panthers use mangrove areas as part of their hunting range, finding prey such as raccoons (*Procyon lotor*), mink (*Mustela vison*), deer and rabbits. In the Everglades, crocodiles are found in mangrove areas (*Crocodylus acutus*). Foxes and raccoons are common inhabitants of fringe mangroves. Fish including snook

nutrients in the system.

(*Centropomus undecimalis*), snapper (*Lutjanus griseus*), jack (*Caranx hippos*), red drum (*Sciaenops ocellatus*), and sheepsheads (*Archosargus probatocephalus*) are dependent on mangrove areas for food along parts of the Florida coast.

Birds such as the brown pelican (*Pelicanus occidentalis*) nest in the mangroves on islands and in mangrove fringe. On islands, the nestlings are safer from climbing predators such as raccoons. The peregrine falcon (*Falco perigrinus*) and the bald eagle (*Haliaeetus leucocephalus*) and other birds of prey may use mangroves for temporary roosts and as hunting grounds in Florida. Mangroves also serve as nesting or roosting areas for wood storks (*Mycteria americana*), white ibis (*Endocimus albus*), roseate spoonbills (*Ajaia ajaja*) and diving birds such as cormorants (*Phalacrocorax spp).*

Among the interesting crustaceans that are part of the mangrove system, is the mangrove tree crab (*Aratus pisonii*). This animal is most unusual. Considering its size and the fact that it has a heavy outer



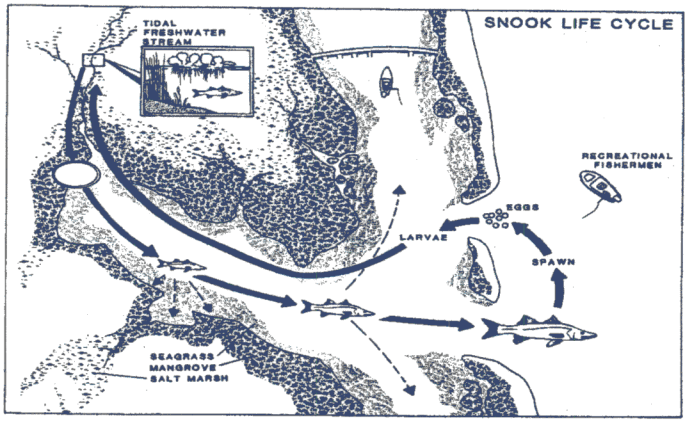
covering called an **exoskeleton**, it has a vertical ability that rivals the best human athlete. It can vertically jump a half of a meter! It is an **arboreal** crab, living in the tree canopy for much of its life. Another arboreal crab found in the mangroves of Florida is the land hermit crab (*Coenobita clypeatus*).

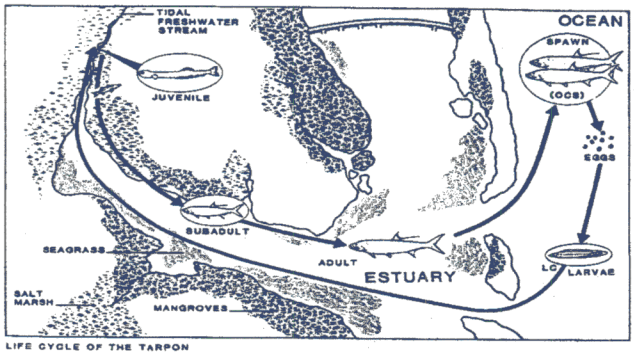
The land hermit crab is collected and sold in the pet market. There is also one type of land shrimp associated with mangroves. It comes out of the water and feeds on the prop roots. However, this shrimp (*Merguia rhizophorae*) is found only in tropical mangrove forests.

A wide variety of mollusks (gastropods-snails and bivalves-oysters, clams and mussels) are found in mangrove areas. The bivalves form an important part of the root community, providing food and shelter for other organisms.

Why are Seagrasses and Mangroves Important to Humans?

Seagrass meadows are generally important feeding grounds and refuges for commercially important benthic invertebrates and some species of fishes. In addition to being a feeding ground for juvenile fish, many fish use the area as a nursery to lay eggs, or for the young to mature into adults. In the seagrasses and mangrove roots, juvenile fish can not be easily seen. In the figure above, the life cycle of the tarpon can be followed. The snook follow a very similar pattern. Both fish spend part of their time in the ocean and in the brackish waters of the wetlands. Without the wetlands serving as a nursery, there would be no more snook, or tarpon, as part of their lives must be spent in the lower salinity waters in the mangrove forests and seagrass meadows.





LIFE CYCLE OF THE TARPON

The florida lobster (*Panularis argus*) also spends a part of its juvenile existence in seagrasses and in mangrove areas. The pink shrimp (*Penaeus duorarum*) can also be found in seagrass meadows.

Juvenile seatrout, spot, striped mullet and silver perch are found commonly in seagrass meadows of Florida. Snook use the meadows for feeding and refuge during their life cycle.

Mangrove areas are important for several species of commercially important fishes. The mangrove root community contains fish such as the sheepshead minnow, the sailfin molly, the pinfish and the long nose killifish. While these are not commercially important, they do form a vital component of the food used by juvenile snook, seatrout and tarpon.

Mangroves and seagrasses serve as filters for excess nutrients in runoff water from over-fertilized lawns and farms. The nutrients captured by the plants are phosphorus and nitrogen, which the seagrasses and mangroves need for healthy growth. By removing these materials from the water and turning them into plant material, mangroves and seagrasses help to maintain important nutrient balances in their habitats.

Fringing mangroves are buffers for storms and waves that enter estuaries. The mangrove roots help to dissipate the energy from waves, lessening the amount of shore erosion. Areas cleared of protective mangroves suffer erosion, usually requiring artificial stabilization from seawalls or similar structures. From the landward vantage, the mangroves act as a sediment trap for materials that originate on land. By trapping this sediment, mangroves help to keep the water of surrounding areas from being turbid. High turbidity can affect how well submerged plants, such as seagrasses, **photosynthesize**.

DID YOU KNOW?

- Fish and other animals depend on seagrasses for oxygen and food.
- Seagrasses play many important roles in the environment. Seagrasses provide food, oxygen, a refuge, a nursery ground for juvenile fish and sediment stabilization
- Mangroves are trees that live at or near the water's edge in protected marine habitats. This means that you are likely to find mangroves along calm banks, but you won't find them on wave-beaten ocean shores.
- Mangrove Trees are unique in that they:
  - Are tolerant of high soil salinity.
  - Are tolerant to submergence in water or waterlogged soil, and to low oxygen conditions.
  - Reproduce by means of specialized seeds called "**propagules**."
  - Use water to disperse young plants.

If you find any interesting facts, or have any questions that you would like to share with the staff at Project Oceanography, please feel free to call us live during the show at 1-888-51-OCEAN. Or, e-mail us anytime at pjocean@marine.usf.edu Your questions will be answered via e-mail, or on the air during a broadcast. Visit our website at http://www.marine.usf.edu/pjocean

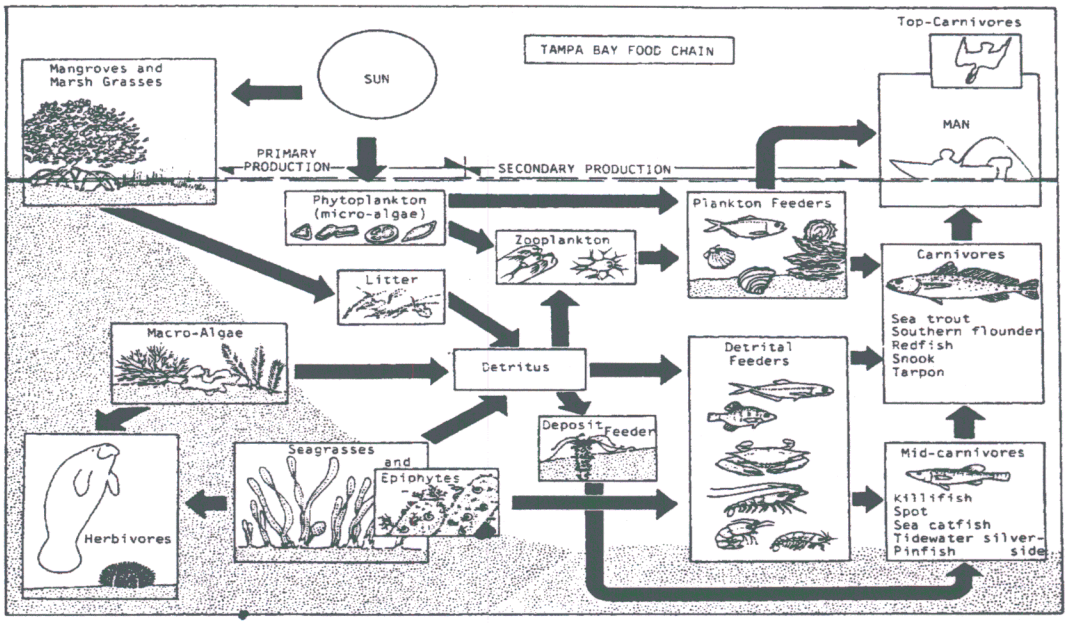
Student Information Sheet I

Seagrass meadows and **mangrove** fringes or forests are very important in subtropical regions in the world. These systems are named for the flowering plants that form the base of the communities. Seagrasses are submerged vegetation that exists in the intertidal and subtidal areas of **embayments.** There are more than seventy species of seagrasses that exist worldwide! Seagrasses have roots, stems, and flowers just like other flowering plants.

There are only four species of mangrove trees: the buttonwood, the white mangrove, the black mangrove, and the red mangrove. Mangrove trees have **pneumatophores**, or prop roots that help them to absorb nutrients, and breathe in the wet environment. The **lenticels** (air holes) close during high tide, so that the tree does not drown. The lenticel is important to the mangrove tree because is takes in the necessary carbon dioxide the plant needs to photosynthesize. Remember from other units, photosynthesis is the process by which plants use carbon dioxide to produce oxygen and energy.

Seagrasses can reproduce through seeds, called **propagules.** A propagule is a seedpod that protects the seed before it sprouts. These drop from the blades and are dispersed by the currents in the water. Seagrasses also produce **clones**. This is when a shoot grows from a subsurface root and is genetically identical to the original plant.

The seagrasses and mangrove trees are **halophytes**. That means they thrive in salty environments. However, they tend to grow faster and larger in areas along riverbanks where there is freshwater.



Animals such as pelicans, crabs, snook, manatees and other fish are associated with seagrasses and mangroves. Other kinds of organisms such as marine bacteria, and algae form important parts of the mangrove and seagrass systems.

Animals use mangroves and seagrass meadows for many reasons. One of the primary reasons is for a nursery. Larval and juvenile fish can mature in the brackish waters before entering the open ocean as adults. This pattern works well for the fish because they use the seagrass and mangrove roots as protection.

Mangroves and seagrasses serve as filters for excess nutrients in runoff water from over-fertilized lawns and farms. Often, the nutrients captured by the plants are phosphorus and nitrogen. Seagrasses and mangroves for healthy growth need these.

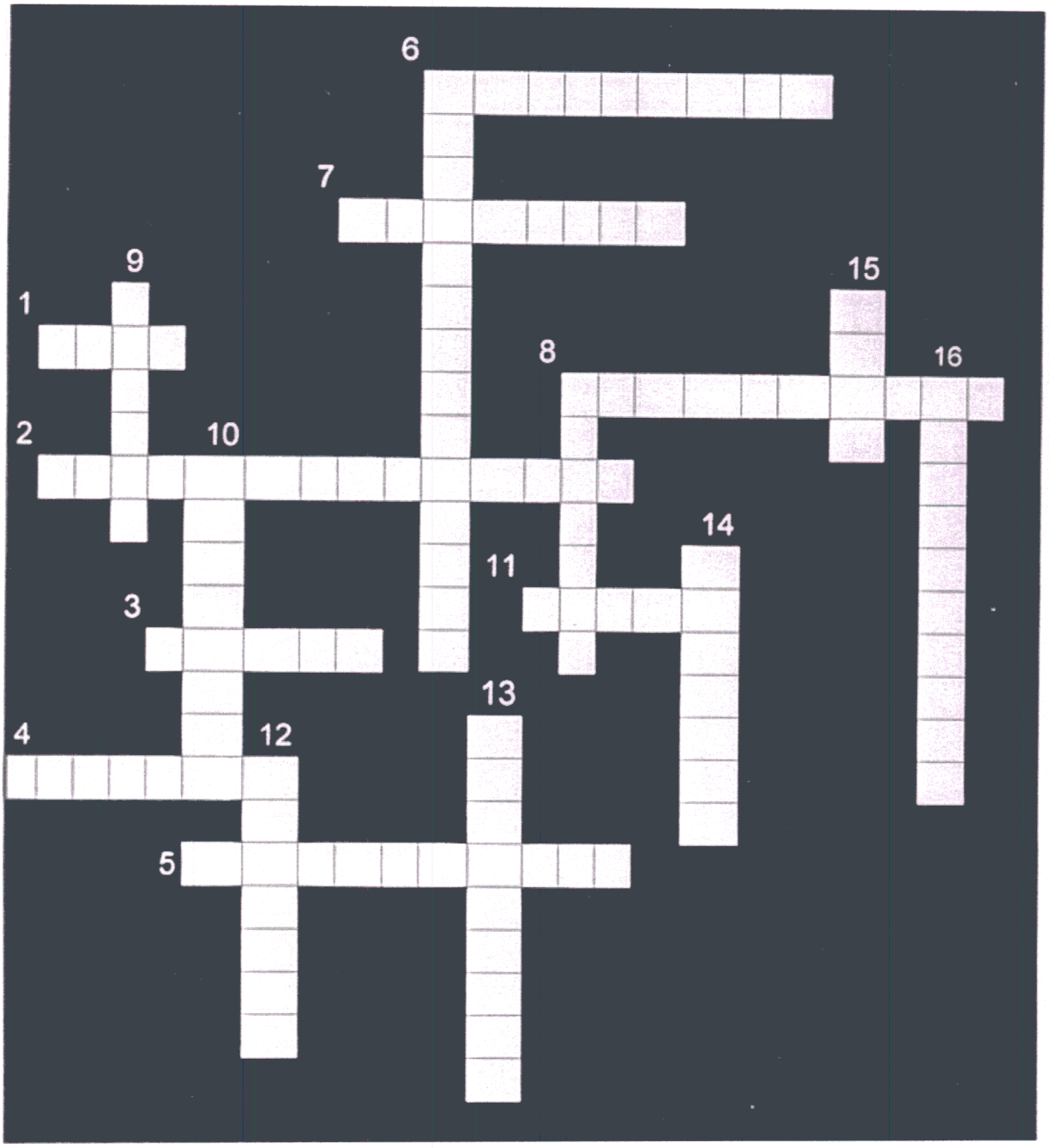
DID YOU KNOW?

- Fish and other animals depend on seagrasses for oxygen and food.
- Seagrasses play many important roles in the environment. They are food, provide oxygen, a refuge, a nursery ground for juvenile fish and sediment stabilization
- There are more than seventy species of seagrasses worldwide!
- Mangroves are trees that live at or near the water's edge in protected marine habitats. This means that, you are likely to find mangroves along calm banks, but you won't find them on wave-beaten ocean shores.
- Mangrove Trees are unique in that they:
  - Are tolerant of high salinity.
  - Are tolerant to submergence in water or waterlogged soil, and to low oxygen conditions.
  - Use water to disperse young plants.

If you find any interesting facts, or have any questions that you would like to share with the staff at Project Oceanography, please feel free to call us live during the show at 1-888-51-OCEAN. Or, e-mail us at pjocean@marine.usf.edu Your questions will be answered either via e-mail, or on the air during a broadcast. Visit our website at http://www.marine.usf.edu/pjocean

Activity I: Seagrass and Mangrove Crossword Puzzle

Objective: The students will fill in the vocabulary words that match the definitions below. As they complete the definitions, have the students place the correct vocabulary word into the crossword puzzle.



Across

1. A Mangrove _____ grows in a wetland.
2. _____ are specialized structures from the roots used in respiration.
3. _____ live on the mangrove trees, and help pollinate the trees.
4. _____ is produced by plants from carbon dioxide.
5. Mangroves provide _____ for juvenile fish
6. _____mature and then drop to the ground or water surrounding the mangrove trees. They may sprout a new tree.
7. _____ is an area where water saturates the soil for several months of the year, usually during the growing season.
8. _____are submerged vegetation that exist in the intertidal and subtidal areas.
11. Prop _____ make a mangrove tree look as if it were walking.

Down

6. A chemical process by which plants make energy.
8. _____ are heavier on one end than the other, and float in the water until they settle in the mud and sprout a new seedling.
9. Mangrove tree _____ secrete salt
10. _____ are the species of which are mostly low trees growing in marshes or tidal shores.
12. Mangrove trees provide a _____ ground for juvenile fish.
13. A corky slash or spot appearing on plant bark, that allows for the exchange of gases between the atmosphere and inner tissue.
14. A semi-enclosed body of water surrounded by land, with an opening to the sea.
15. Snook and trout are these.
16. A bay, or baylike formation.

Teacher Answer Key