Wetlands Ecology

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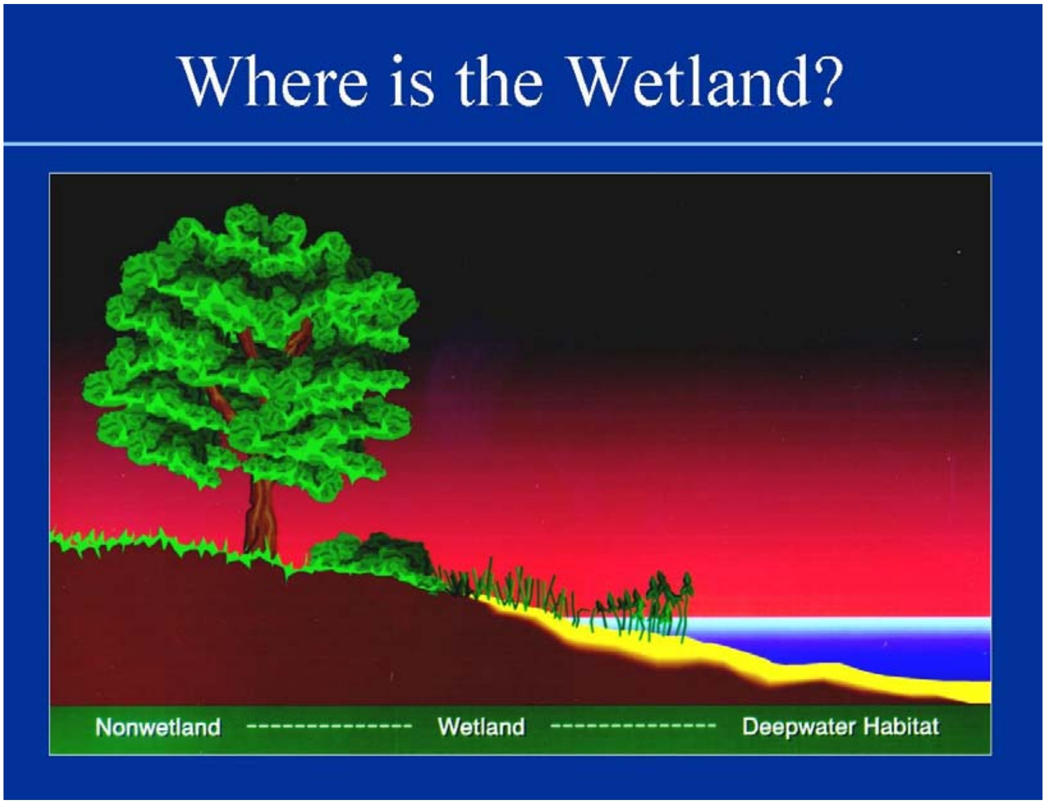


OBJECTIVES

The purpose of this unit is to familiarize yourself with the fundamental aspects of wetlands ecology. General information is valid for most wetlands, while specifics are provided on wetlands in Virginia. This review will touch on the role of wetlands in the ecosystem, what makes a wetland, different wetland types and the plants and animals of the wetland. Following completion of the module, you will: 1) have a basic understanding of the role of wetlands in the ecosystem, 2) be able to recognize wetlands, and 3) define/describe hydrophyte, primary production, detritus, secondary production, food web, zonation.

LECTURE NOTES

Introduction

What is a wetland? (Figure 1) A wetland is composed of three fundamental components; water, plants and soil. (Figure 2)

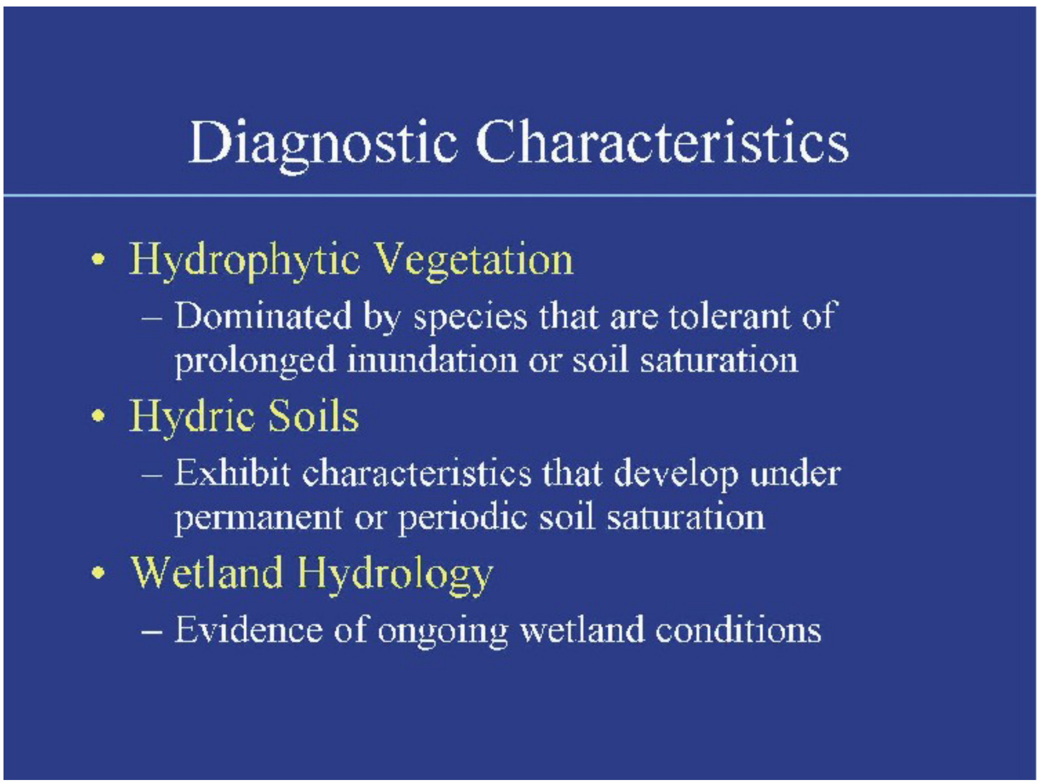


Figure 2.

Wetland Hydrology

Wetlands gain and lose water constantly through a variety of pathways

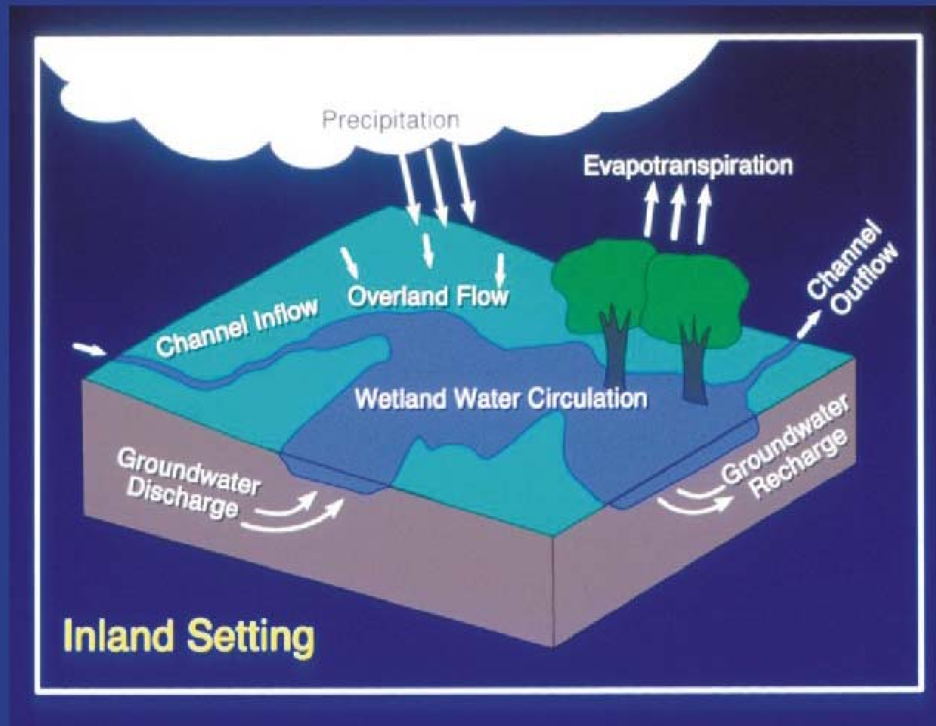


Figure 3.

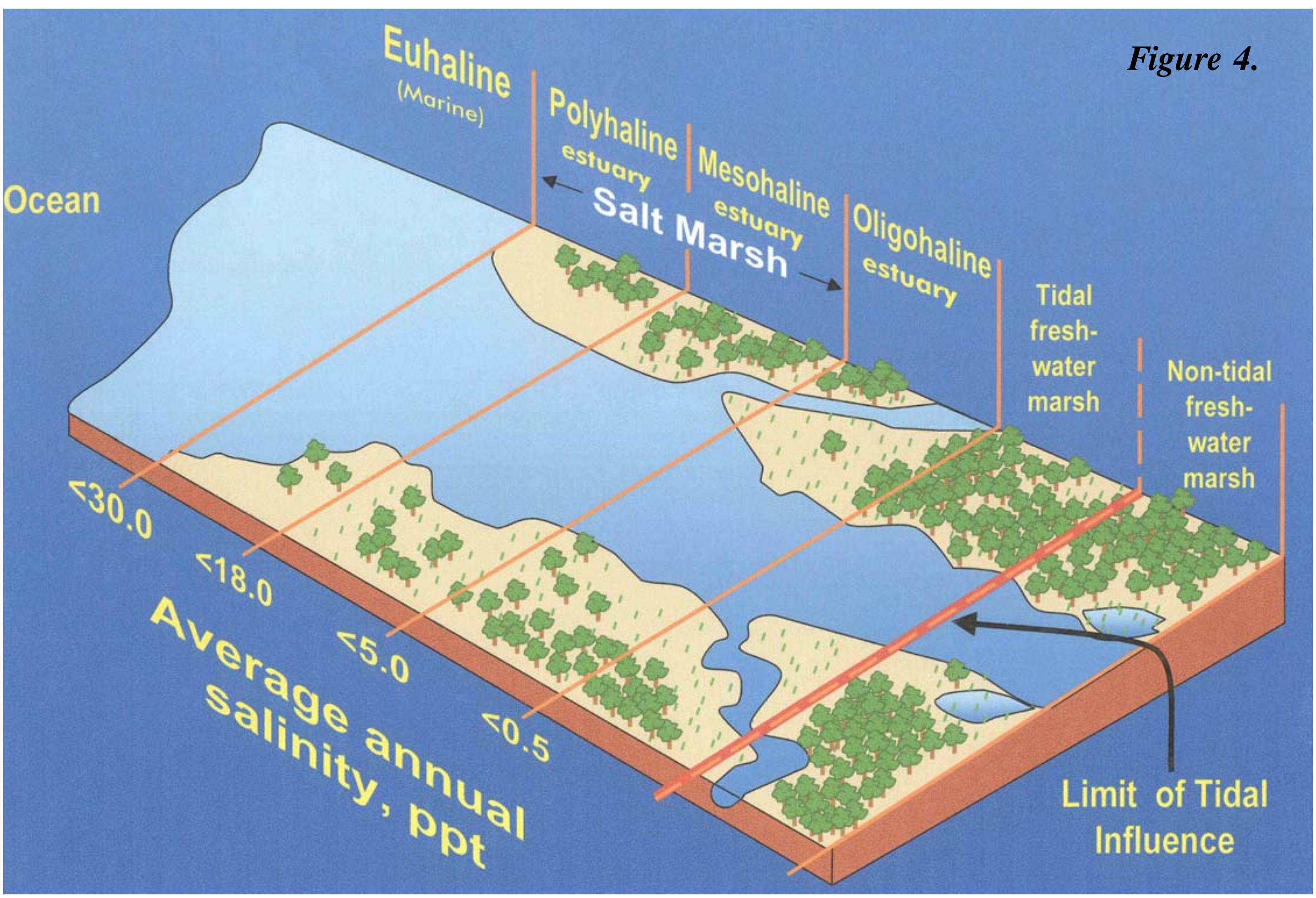


Figure 4.

The water that makes wetlands wet is referred to as wetland hydrology. Wetland hydrology can come from many sources.

The water may come from tides or nontidal sources such as rain, streams or groundwater. (Figure 3) Tidal waters can be salt or fresh. In most tidal systems there is a gradient from saltwater to freshwater progressing up-stream. (Figure 4)

In general nontidal wetlands are freshwater, although some are saltwater. This can occur where there is a high amount of dissolved minerals in the water and high evaporation rates increase the concentrations (Chapman, 1960).

Wetland soils are hydric soils. When soils are inundated with water, anaerobic (without air) conditions usually result.

Anaerobic conditions lead to chemical changes in the soils. (Figure 5) Hydric soils are, generally dark in color. (Figure 6)

Wetlands can be vegetated or nonvegetated. The plants that vegetate wetlands are called hydrophytes meaning water loving. Hydrophytes are adapted to life in the water. (Figure 7)

Adaptations can be morphological, reproductive or physiological. Plants that have adapted to grow in saline waters are called halophytes meaning salt loving.

Some common terms can be used to describe tidal wetlands by their relative position in the landscape. (Figure 8)

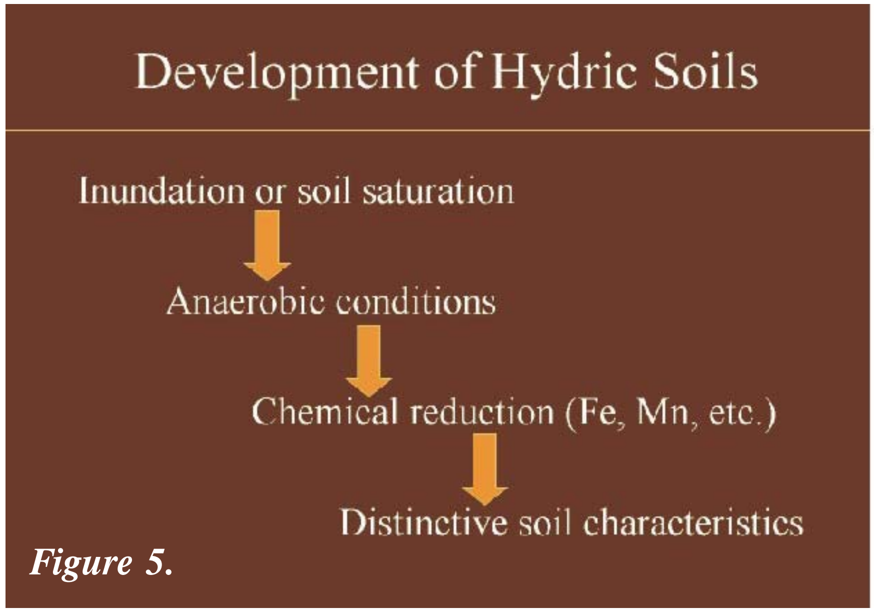


Figure 5.

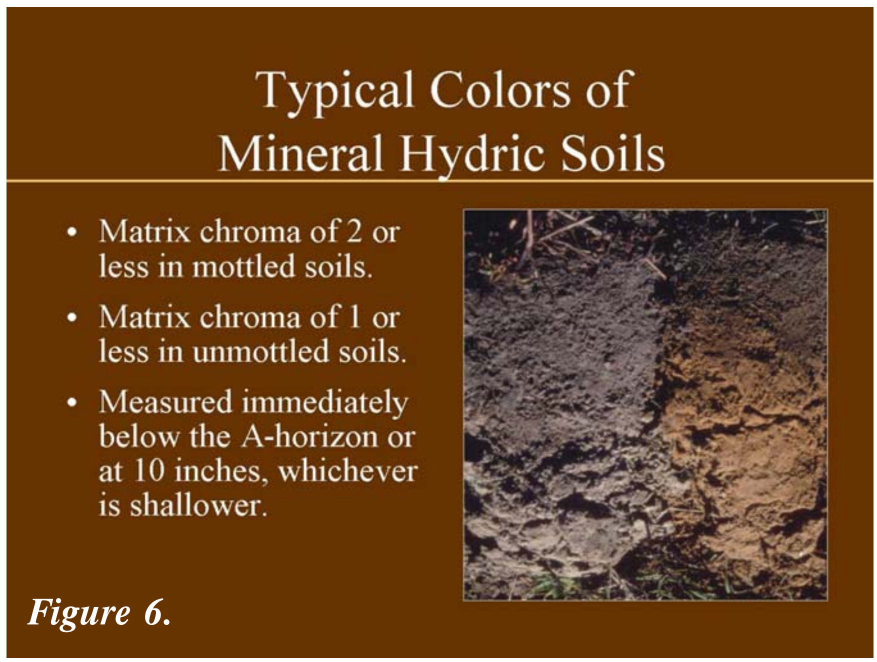


Figure 6.

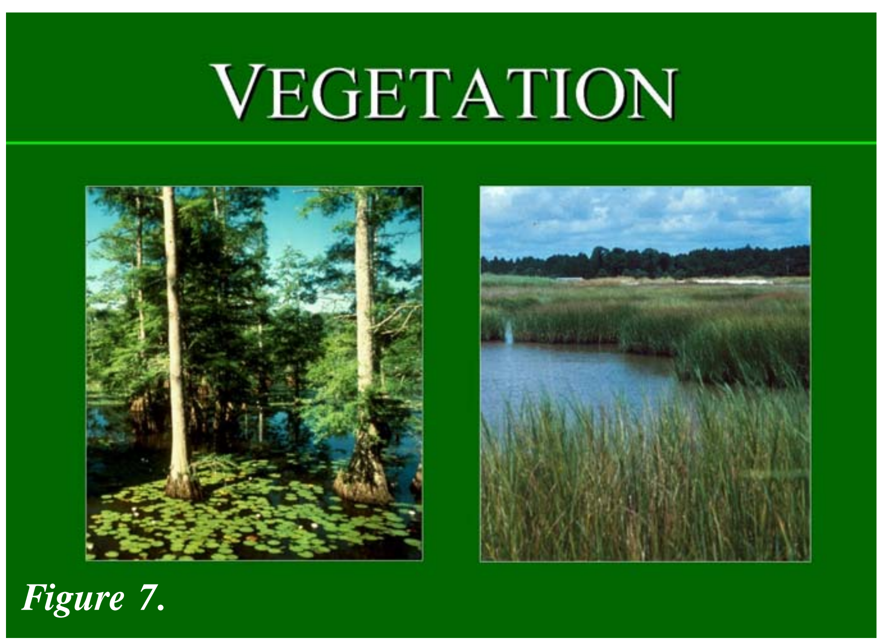


Figure 7.

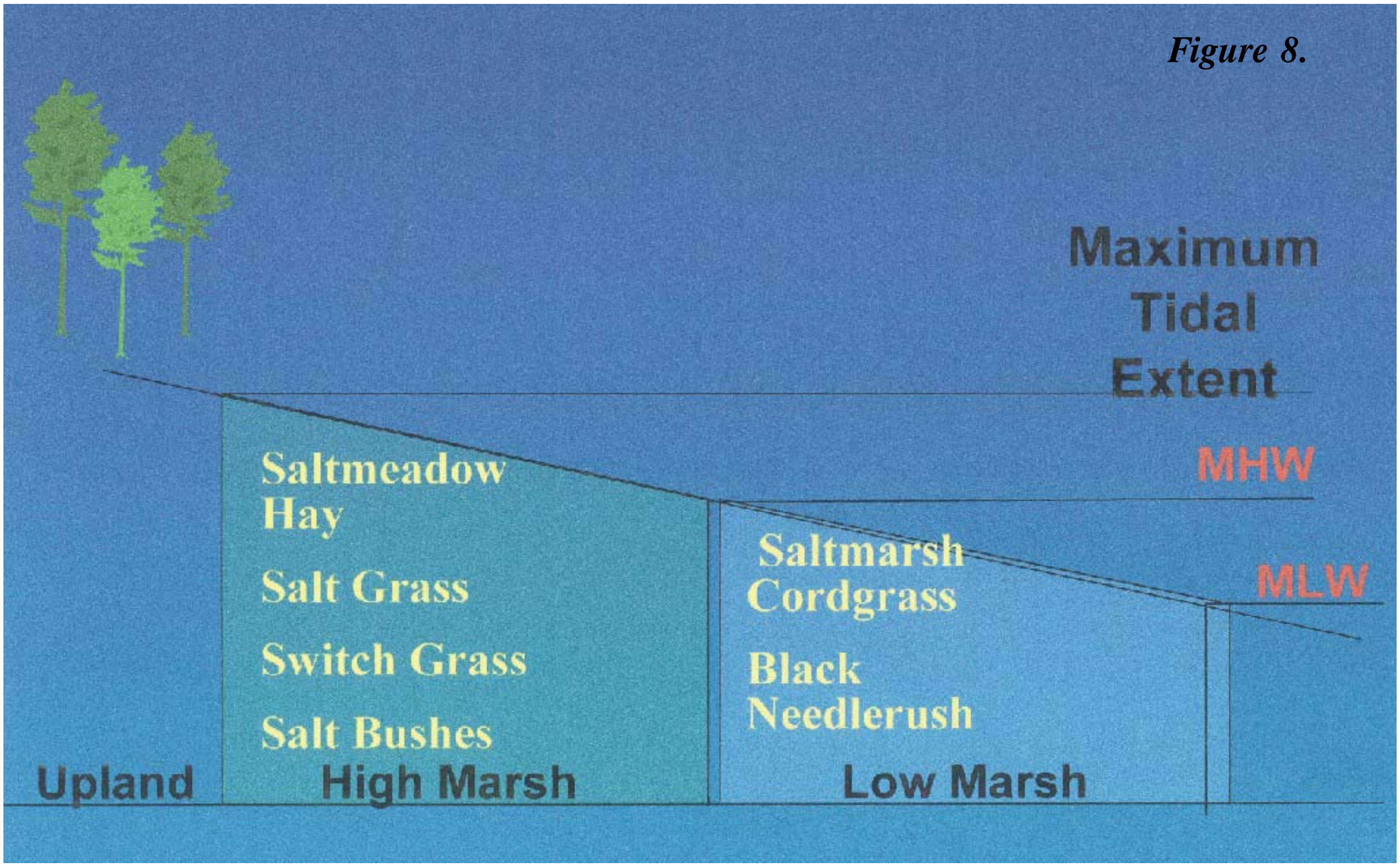


Figure 8.
Maximum
Tidal
Extent
MHW
MLW
Saltmeadow
Hay
Salt Grass
Switch Grass
Salt Bushes
Saltmarsh
Cordgrass
Black
Needlerush
Upland
High Marsh
Low Marsh


Figure 9.

The low marsh is the area of the lowest elevation, often vegetated by saltmarsh cordgrass or pickerelweed. (Figure 9) The high marsh is generally above mean high water and is vegetated with saltmeadow hay, saltgrass, big cordgrass. The marsh-upland ecotone, where the wetlands grade into the uplands, is often indicated by the growth of shrubs like the marsh elder, highwater bush and wax myrtle.

Ecosystem Functions

Primary production and the food web

Green plants use the sun's energy to convert inorganic (non-living) minerals to organic (living) plant tissue. This process is known as photosynthesis. (Figure 10)

At the first level of production of organic material the process is called primary production and is accomplished only by those microorganisms that contain chlorophyll. (Figure 11)

Plant species common to wetlands have high levels of primary production. Estimates of the primary production of tidal wetlands are as high as 4-6 tons per acre per year. Wetlands productivity rivals or surpasses the most productive farmlands (Tiner, 1984). (Figure 12)

Animals that feed directly on plant material are called primary consumers. However, few animals eat wetland vegetation and most of the plant material becomes detritus. Detritus is partially decomposed plant material. In tidal wetlands systems, some or most, of the material is exported to the estuary.

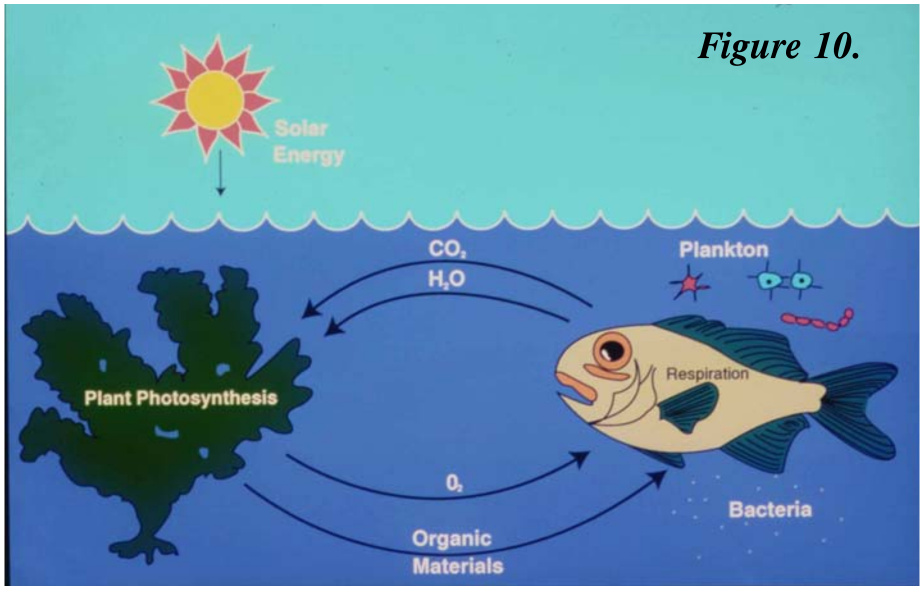


Figure 10.

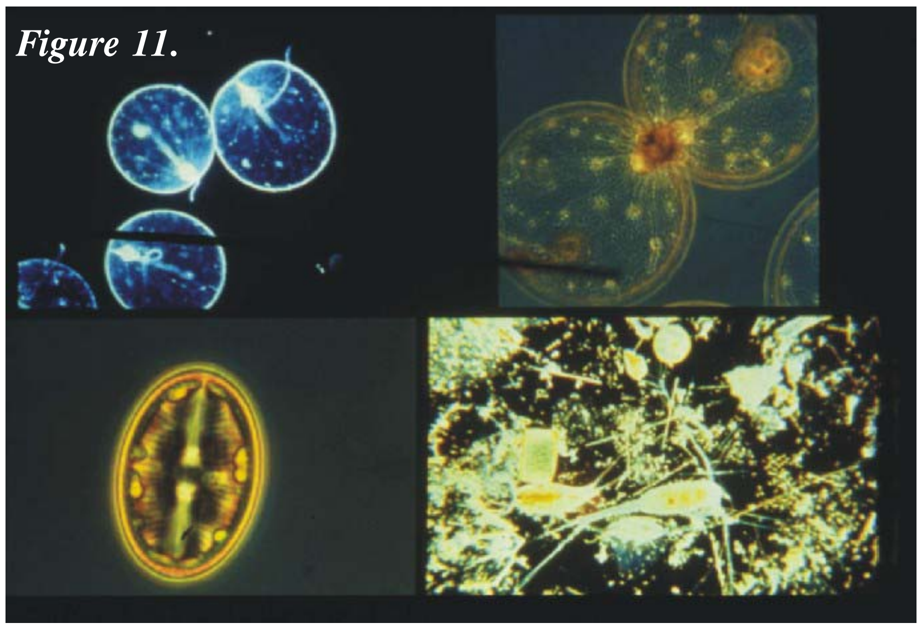


Figure 11.

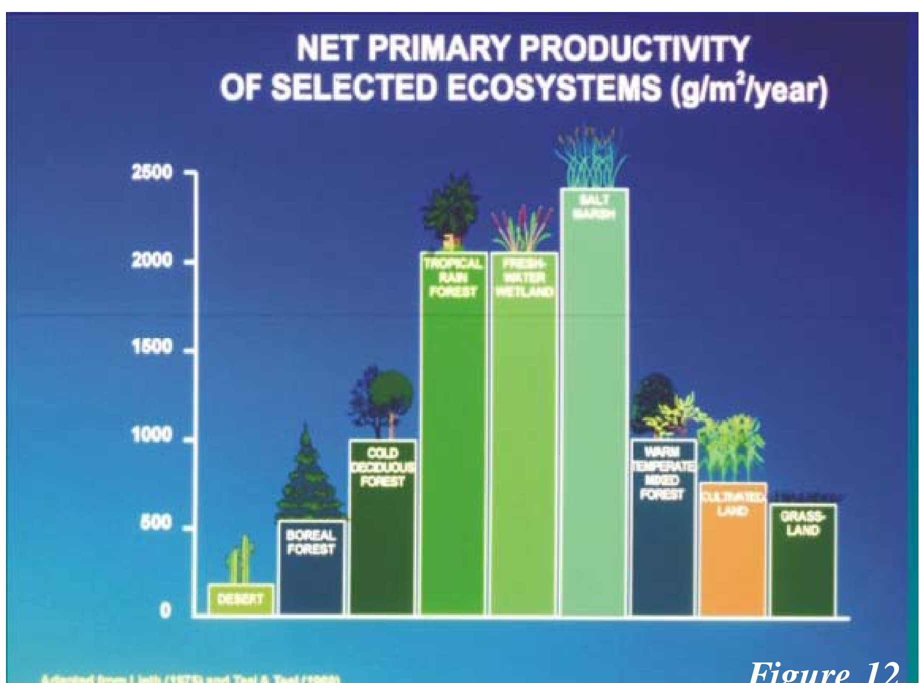
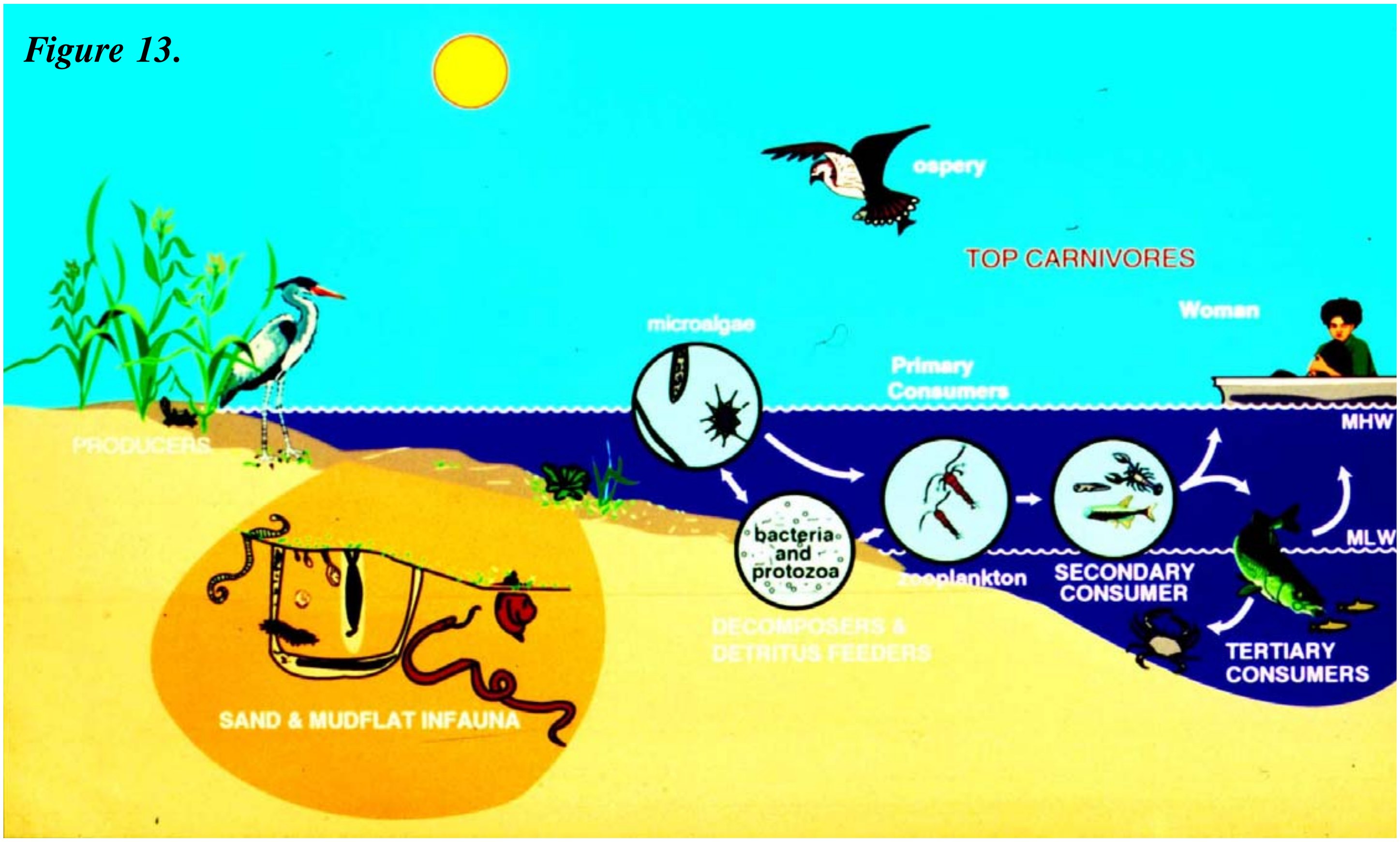


Figure 12.

Figure 13.



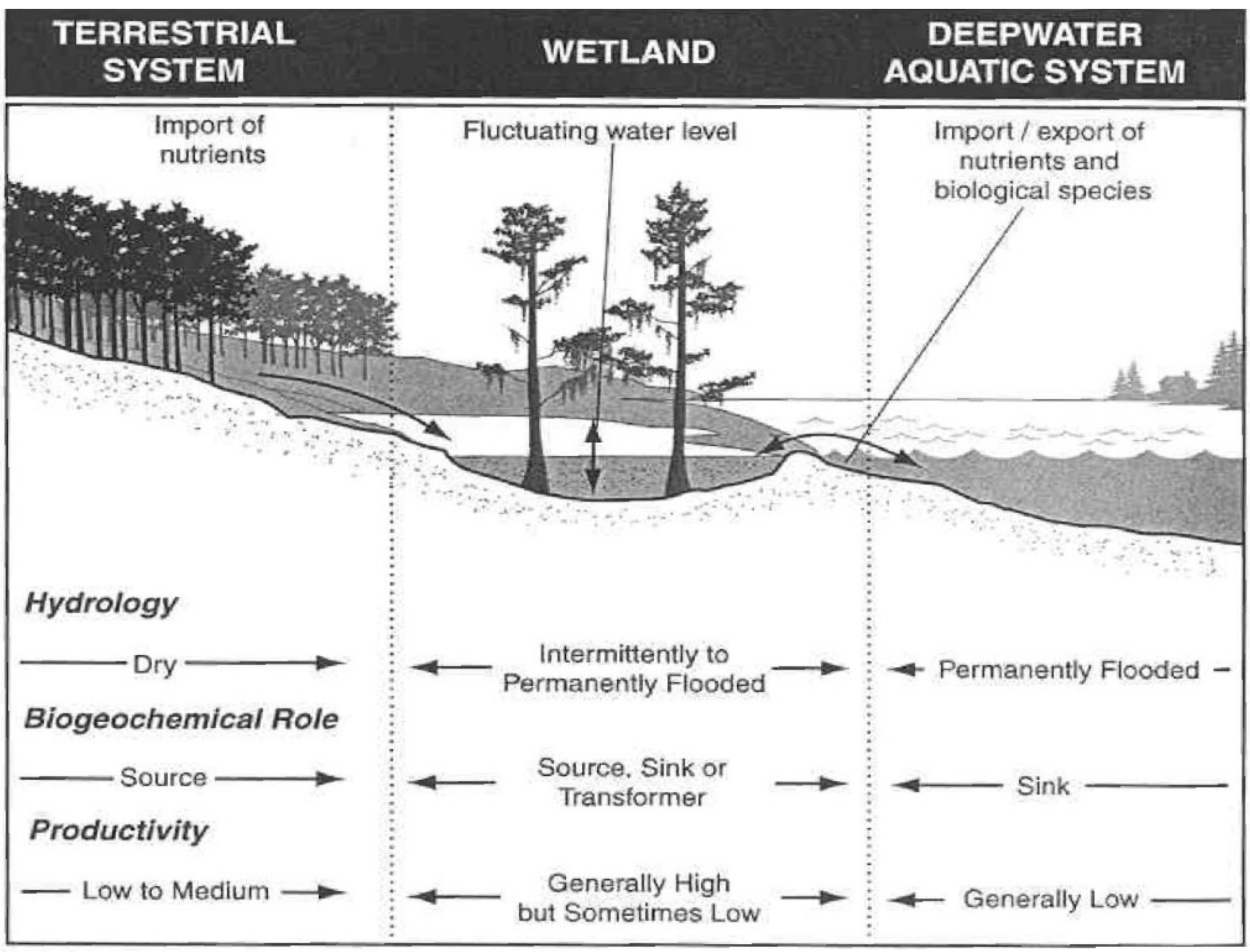


Figure 14.

Figure 15.

Many types of microorganisms grow on the detritus. The tiny plants and animals which populate the detritus increase the value of the detritus as food for estuarine organisms. The detritus is consumed by many animals including crabs, fish and shellfish. The consumers digest the microorganisms growing on the detritus. However, the detritus is only partially broken-down and passes through mostly undigested. The detritus is repopulated with microorganisms and the process is repeated.

The higher level consumers in the process are those that feed on the detrital consumers. Examples of higher level consumers are shorebirds, finfish and mammals including humans. (Figure 13)

Water Quality

Wetlands occupy a strategic position in the landscape between uplands and the aquatic environment. (Figure 14)

Wetlands can intercept upland runoff and filter and trap pollutants and sediments before they reach the water-way. (Figure 15)

Several wetlands attributes have the potential to affect the flow of chemicals and sediments:

1. Wetlands vegetation slows water velocity, causing sediments and sorted chemicals to drop out of the water column on to the wetland.
2. High rates of primary productivity may lead to high rates of nutrient uptake and subsequent burial when the plants die.
3. The nutrients used by the growing wetlands plants are not available to support the development of algal blooms (Mitsch & Gosselink, 1986).

Fish and Wildlife Habitat

A great variety of birds, fish, mammals and invertebrates use wetlands for foraging, shelter, nesting, spawning and nursery areas. Some species of plants and animals can survive only in wetlands such as saltmarsh cordgrass and muskrats. However, many other species use wetlands for food or refuge but not as a primary residence.

Many species of finfish, including most commercial and game fishes use wetlands as habitat.

Striped bass, white perch and herrings are just some of the familiar fishes which use wetlands. (Figure 16) Crustaceans, like the blue crab and shrimp also use wetlands.(Figure 17)

Many species of shellfish are found in wetlands, and the adjacent shallow waters. Oysters, clams and mussels use wetlands as habitat.

Shoreline Erosion Control

Wetlands deter shoreline erosion by reducing wave energy and current velocity. (Figure 18)

Roots and rhizomes of wetland plants stabilize the substrate, and the stems and leaves slow the flow of waves and tidal currents. Although lacking vegetation, the natural slope of nonvegetated wetlands provide a buffer to shoreline erosion. Wave and tidal current energy is dissipated as the water spreads out over the flats.

Figure 16.

Figure 17.

Figure 18.

Flood Protection

Wetlands may slow and temporarily store flood waters. (Figure 19) The capacity for flood water storage is influenced by the tidal stage. Portions of the wetlands already flooded by tidal waters may be unable to assimilate additional flood waters.

This is particularly true of low marsh areas with daily tidal inundation. The absorption of flood water by wetlands and the ability of vegetation to slow flood waters desynchronizes peak flows minimizing flow rate and volume. (Figure 20)

Figure 19.

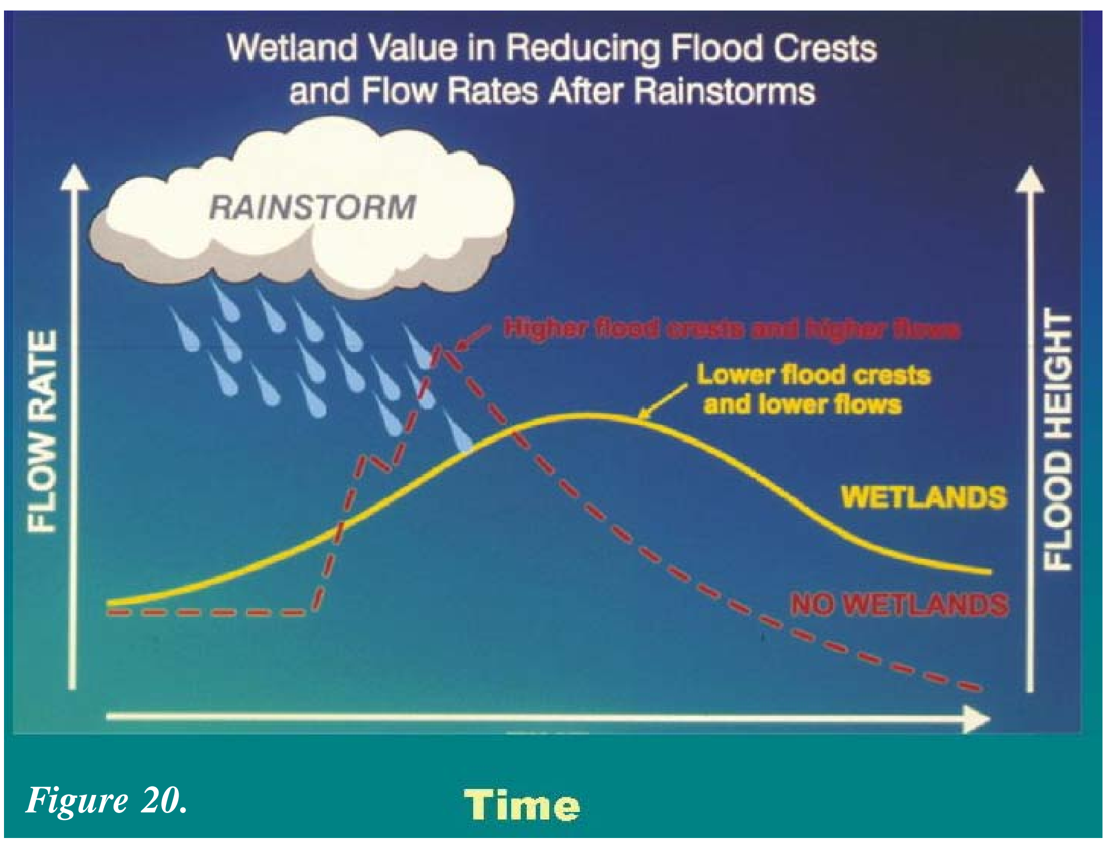


Figure 20.

Wetland Types

Wetlands may be grouped into categories according to salinity regimes. (Figure 21) Salinity influences the kinds of plants and animals present in the wetland.

Euhaline (Marine). Marine marshes have waters with a salinity close or equal to seawater. The vast expansive marshes behind the barrier islands on the eastern shore are saline marshes. Dominant vegetative species include saltmarsh cordgrass, saltmeadow hay, saltgrass and highwater bush. Zonation of the vegetation is simple and easily observed. Tall form saltmarsh cordgrass grows at lower elevations adjacent to the marsh creeks, short form saltmarsh cordgrass occurs in the mid-marsh, and the high marsh is a mixed community of saltgrass and salt-meadow hay with saltbush along the upland edge. Oyster-catchers, egrets, herons, blue crabs, fiddler crabs (Figure 22) and finfish are common inhabitants of the saline marsh.

Brackish (Polyhaline and Mesohaline). The seawater is gradually diluted by freshwater and the salinity ranges from above and below 16 parts per thousand. These marshes are found in

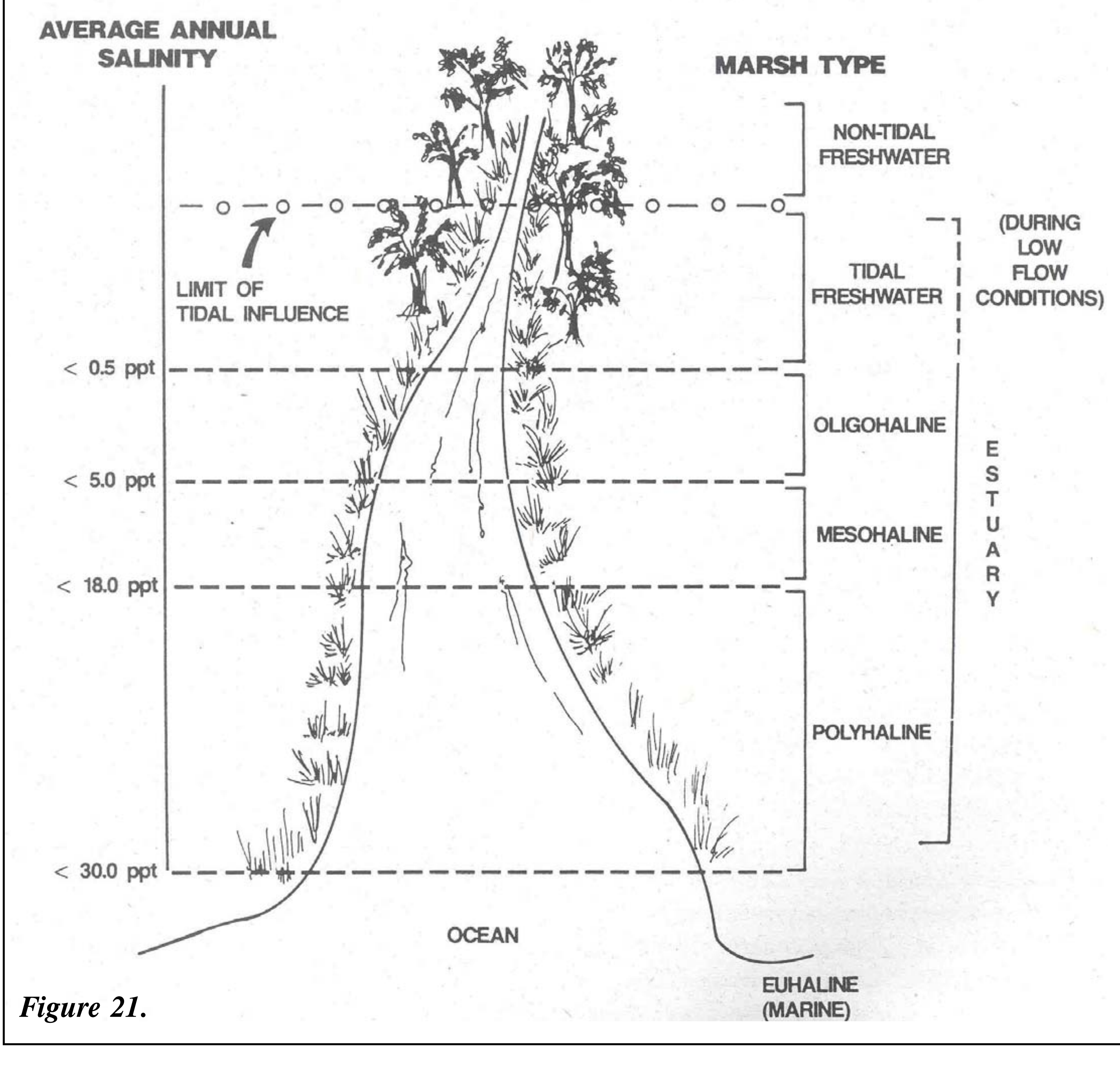


Figure 21.

the lower Chesapeake Bay and extending up the major tributaries and creek systems. The vegetation is more diverse than the saline marshes. Bulrush, sea lavender and cattails are common in addition to saltmarsh cordgrass, saltmeadow hay and saltgrass. Saltmarsh cordgrass grows adjacent to the creeks, salt-grass and saltmeadow hay with sea lavender and black needlerush occupy the mid-marsh and the upland edge is marked by highwater bush and marsh elder. Animals found in the brackish marsh include marsh snails, grasshoppers (Figure 23), clapper rails and fiddler crabs.

Figure 22.

Figure 23.

Oligohaline. These wetlands form the gradient from brackish to tidal freshwater. Located along the upper Bay, major tributaries and creeks, increased freshwater input dilutes the seawater to around 3 parts per thousand. Saltmarsh cordgrass may still be found along the waters edge, but many other less saline tolerant species are also found. Big cordgrass, sedges, marsh mallow and threesquare grow in these wetlands. While Saltmarsh cordgrass is still found at the lower elevations, big cordgrass, cattails, bulrush and marsh mallows may all occur at the higher elevations. A variety of reptiles and snakes inhabit these marshes searching for food. (Figure 24)

Tidal Freshwater. The average salinity is 0.5 ppt. or lower, except during drought. These wetlands occur upstream of oligohaline marsh and downstream of non-tidal wetlands. The vegetative diversity of the tidal fresh community is much greater than other tidal wetlands. Fifty species per acre is typical. Just a few of the common plants are; arrow arum, pickerelweed, wild rice, rice cutgrass, cattails, and smartweeds. Zonation is less sharply defined, however a general profile may be described (Odum, 1984). Arrow arum and pickerel-weed at the lower elevations adjacent the waterway, smartweeds, wild rice, big cordgrass and rice cutgrass at higher elevations, cattails near the

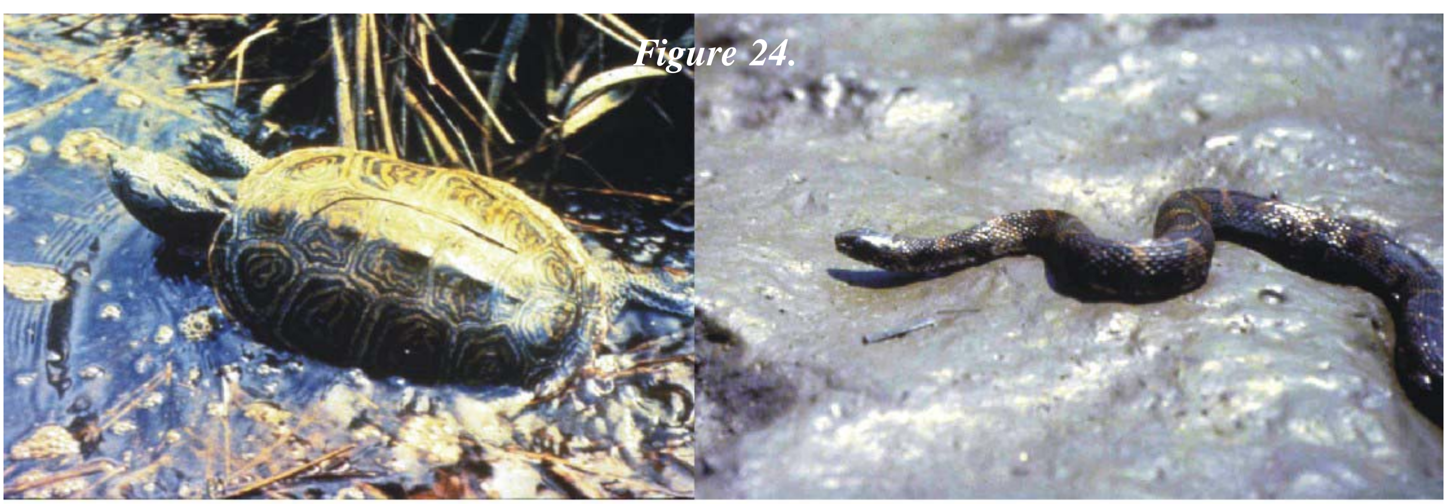


Figure 24.

upland and wax myrtle and red maple along the upland edge. A large diversity of animals is a consequence of the great variety of plants. Amphibians and reptiles are common, as are migrating waterfowl, muskrats, river otters, voles, raccoons and many other animals. (Figure 25)

Tidal Swamps. These wetlands are found at the upper end of tidal influence. The presence of trees differentiates tidal swamps from tidal marshes. (Figure 26)

In many swamps, the tidal swamp grades almost imperceptibly into a nontidal swamp. Trees in tidal swamps generally grow on hummocks. Trees within tidal influence are generally smaller and show autumn colors earlier than trees above tidal influence. Tree species found in tidal swamps include gums, red maple, green ash and bald cypress. Dragonflies and other insects are common. Amphibians and reptiles, including spring peepers, water snakes, bull-frogs and turtles, are found in tidal swamps. White-tailed deer, red fox and other upland animals wander into the swamps. Beavers, which were once gone from the Chesapeake Bay region, are once again inhabitants of tidal and nontidal swamps.

Figure 25.

Communities (Types are after the Virginia Wetlands Guidelines)

The Virginia Tidal Wetlands Act of 1972 defined 17 different communities (types) of wetlands based upon a combination of their vegetative composition and ecological function. (Figure 27) These wetland communities are discussed individually in the following section.

Type I. Saltmarsh cordgrass community.

This community is dominated by Spartina alterniflora. (Figure 28)

This species is a tall grass reaching 4-6 feet tall near the waters edge. There are distinct growth habits of Spartina according to height. There is a tall form, a short form and some have proposed an intermediate height form of the species exists. The tall form is found growing adjacent to the marsh creeks and the short form grows further from the creeks. It has been theorized that the tall form plants receive a "tidal subsidy" from the increased availability of tidal borne nutrients.

Spartina grows from about mean sea level to mean high water which is approximately the upper two thirds of the tidal range. The location of the community within the tidal

Figure 26.

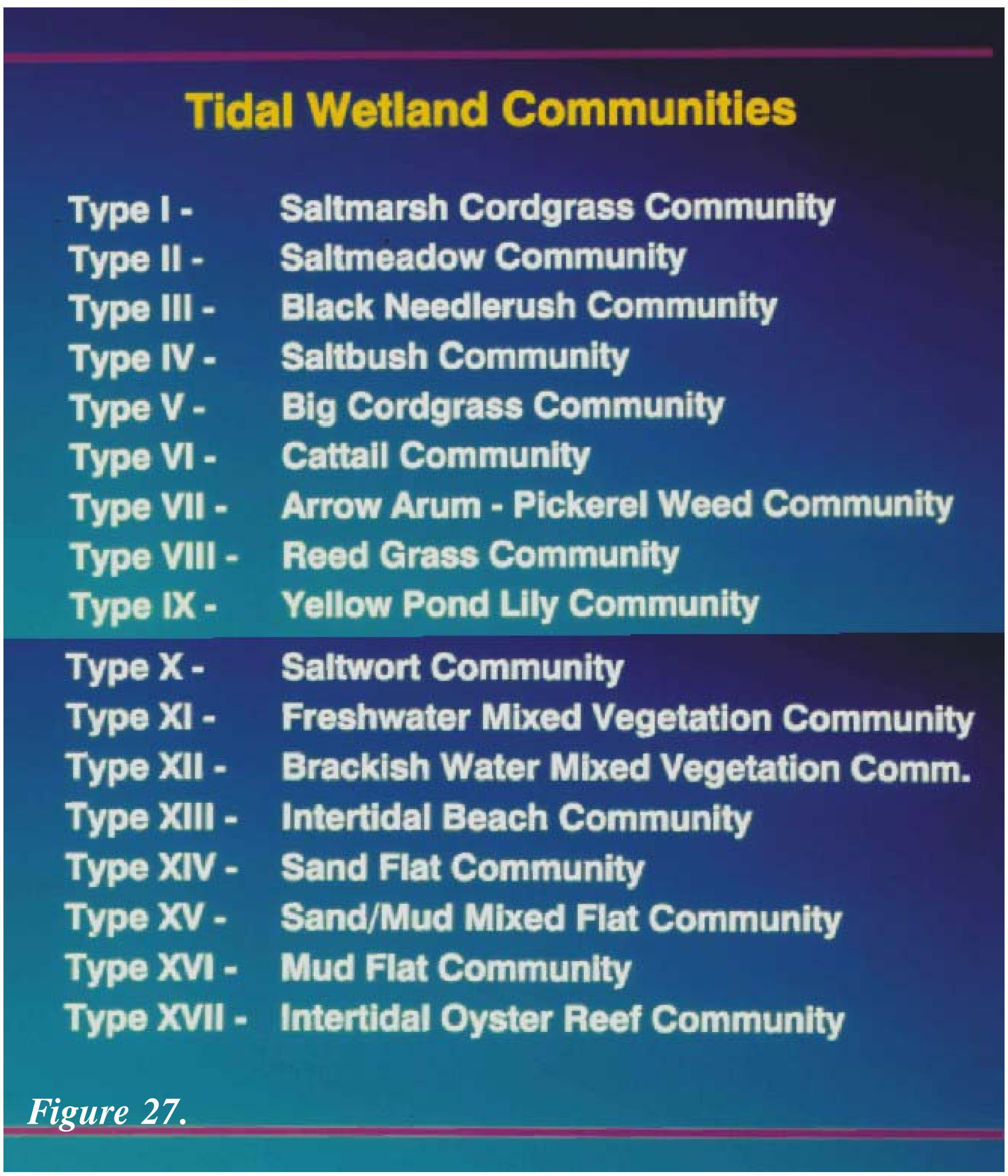


Figure 27.

zone results in daily flushing by the tide.

The primary productivity of Spartina is very high. The average production is about 4 tons per acre but may be as high as 10 tons per acre. Tidal action transports the detritus making it eadily available to the marine community.

Tidal fluctuations allow aquatic animals access to the marsh. Adults of small fish species (killifish, anchovies) and juveniles of many species (striped bass, spot, croaker) use the marsh for protection and a feeding area. Blue crabs and shrimp also forage and find refuge in the Spartina. The marsh periwinkle which clings to the stems of the vegetation, and the ribbed mussel are important as food for aquatic animals as well as bird and small mammals.

The roots and rhizomes of the plant are used as food by waterfowl. Some birds use the vegetation as nesting material including the clapper rail and willet. Muskrats use the plants in the construction of lodges. Raccoons and other small mammals can use the Spartina community as a foraging area.

The Spartina community is an effective deterrent to shoreline erosion. The high growing densities of the vegetation reduce wave energy. The peat is very resistant to wave energy due to the dense growth of roots and rhizomes. The baffling effect of the vegetation slows the flow of tidal waters and upland runoff. As the water velocity is reduced, sediments are deposited on the marsh. This property makes the Spartina community effective as a trap for sediments from upland runoff.

Figure 28.

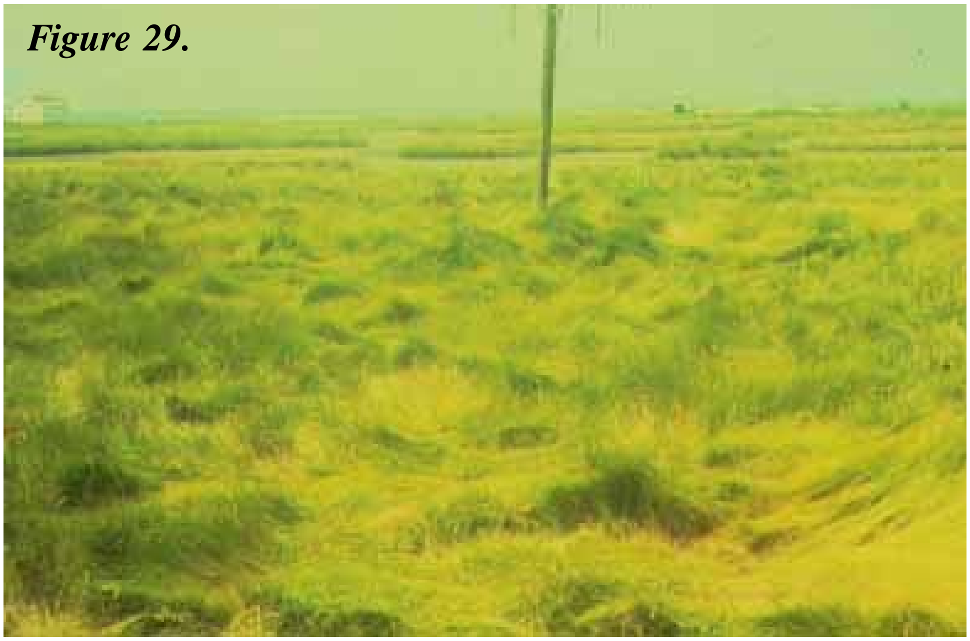
Type II. Saltmeadow community.

This community is dominated by saltmeadow hay *(Spartina patens)* and saltgrass *(Distichlis spicata.)* (Figure 29)

It is common to find saltmarsh cordgrass, marsh elder, groundsel tree and other plants growing in this community. Saltmeadow hay and saltgrass reach about 1-2 feet in height. Large expanses appear meadow-like with swirls. The saltmeadow is found growing from about mean high water to the limit of spring tides.

Primary productivity is around l-3 tons per acre. However, tidal flushing of this community is limited to spring and storm tides so much of the vegetative material remains in the marsh and

Figure 29.



is not available to the marine community.

The seed heads of the plants provide food for birds and some birds nest in this community. Invertebrates like the saltmarsh snail (Melampus) are important food for waterfowl, seaside sparrows and rice rats.

The dense growth habit of the vegetation provides an effective erosion deterrent, however, the position of the community at the higher elevations affords little opportunity

to guard against shoreline erosion. If the commonly occurring saltmarsh cordgrass is absent from the lower elevations, this community will deter shoreline erosion. The saltmeadow community is often the older part of the marsh with deep accumulations of marsh peat. Flood waters from high tides and upland runoff may be absorbed by the deep marsh peat. The salt-meadow acts as a trap, filtering the sediments, nutrients and toxics carried by the flood waters.

Type III. Black Needlerush Community.

This community is dominated by black needlerush *(Juncus roemerianus)*. (Figure 30)

This plant usually grows in pure stands with saltmarsh cordgrass, saltmeadow hay and saltgrass occurring at the edges. The plants have hard cylindrical stems tapering to a sharp tip. The plants appear leafless as the leaves form a sheath around the stem. The species blooms from June to August. Juncus grows from about mean high water to somewhat below spring tides. The community often grows in pannes, low areas of the marsh where waters accumulate and evaporation increases salinity.

Black needlerush produces about 3-5 tons per year of vegetative material. Due to the rigid nature of the species, plants decompose slowly and the location of the community in the high marsh limits the amount of material flushed by the tide.

It does not appear that any animals feed on Juncus, however the dense, stiff vegetation provides cover for some species. Clapper rails nest in the vegetation.

The dense system of roots and rhizomes is resistant to erosion. The opportunity to provide shoreline erosion protection occurs on some sandy shores and low sand berms. The vegetation is an effective trap for sediment, although not as effective as the densely matted salt-meadow community. The absorbent substrate acts to buffer coastal flooding.

Type IV. Saltbush Community.

This community is comprised of groundsel tree or highwater bush *(Baccharis halimifolia)* and marsh elder *(Iva frutescens)*. (Figure 31)

Saltmeadow hay, and saltgrass are often found growing underneath the bushes. Groundsel tree reaches about I5 feet in height, the leaves are alternately arranged on the branches, and it has conspicuous yellow-white flowers which bloom September through October.

Marsh elder is 3 to 10 feet high, the leaves are opposite on the branches, and the flowers are small greenish-white appearing from August to October. The bushes grow at the upper limit of the marsh (the marsh-upland ecotone).

Primary productivity is low, about 2 tons per year, and little vegetative material reaches the marine environment. The shrubs provide diversity to the grasses and reeds common to the marsh. Small birds, like the marsh wren, nest among the branches.

Figure 30.

The growth habit of the shrubs does not serve well as a sediment trap, but does effectively trap larger flotsam. Often found growing on sand berms in front of small marshes, the bushes do provide some erosion protection.

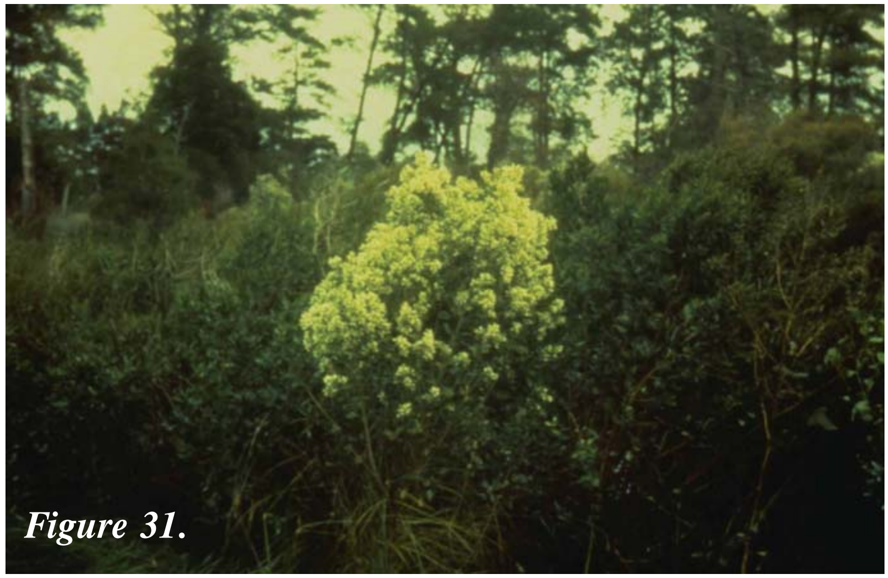


Figure 31.

Type V. Big Cordgrass Community.

Big cordgrass *(Spartina cynosuroides)* usually grows in monotypic stands. (Figure 32)

The grass is very tall, 6 to 12 feet, and has a distinct feathery fruiting head in the fall. The plants are very sturdy and standing dead plants often persist through the winter. Big cordgrass grows from just above mean high water up to the upland margin. The plant is most common in brackish and lower salinity marshes.

Figure 32.

Levels of primary productivity range from 3 to 6 tons per acre in this community. Primary productivity rates are similar to saltmarsh cordgrass and higher than most other species growing above mean high water. However, the position of the community at the higher elevations results in the transport of the vegetative material being limited to high spring, wind and storm tides.

Various animals use big cordgrass for cover, food or building materials. Muskrats use the material for building lodges. Geese eat the rhizomes and other birds feed on the stems and seeds. The meadow vole nests among the stems as does the marsh rice rat, often taking over the nest of a marsh wren.

As other species of marsh grass, the dense network of roots and rhizomes binds the marsh substrate providing a deterrent to shoreline erosion. Growing at higher elevations in the tidal zone the opportunity to provide shoreline erosion control is limited; however, it may be particularly important for low salinity wetlands where the lower inter-tidal zone is occupied by vegetative species that die back each fall.

Big cordgrass often is associated with the deep marsh peat common at higher elevations in the older portion of the marsh. The deep peat increases the capacity for holding flood waters. Where the community is found growing adjacent to the uplands, flood buffering may allow for the settling and trapping of upland sediment, nutrients and toxics. The plants are also effective at trapping larger flotsam.

Type VI. Cattail Community.

There are two common species of cattails in this community, the narrowleaf cattail *(Typha angustifolia)* and the broadleaf cattail *(Typha latifolia)*. (Figure 33.)

The plants may be found growing with other brackish and freshwater plants including; sedges, bulrushes, smartweeds, arrow arum and pickerelweed. Both species grow to heights of 4 to 6 feet, have long strap-like leaves with slightly rounded tips and have the characteristic fruiting head. Both the male and female flowers occur together on one flowering spike. In the broadleaf cattail the upper (male) spike and the lower (female) spike are touching, in the narrowleaf there is a space between the spikes.

Cattails prefer very wet soils and often grow in standing water. They prefer low salinity waters. Look for cattails along the upland margin where groundwater seepage keeps the soils wet and the salinity low. The vegetative material produced by cattails, about 2 to 4 tons per acre, is not readily accessible to the marine environment.

Some species of birds use cattails as habitat. Marsh wrens and rice rats build nests attached to the plants. The plant roots are eaten by muskrats.

The cattail community offers little erosion protection due to the preferred location adjacent to the uplands and the shallow root system of the plants. However, both of these characteristics make the community effective as a sediment trap, particularly from upland runoff.

Type VII. Arrow Arum - Pickerel Weed Community.

The dominant plants of this community are arrow arum *(Peltandra virginica)* and pickerelweed *(Pontederia cordata)*.(Figures 34 and 35)

The plants may grow in association with sedges, smartweeds, cattails and pond lily. Both species have dark green fleshy leaves and grow in clumps about 3 feet high. Arrow arum has leaves shaped like arrowheads, with a prominent midvein. Arrow arum blooms from May to July, but the flowers are concealed in a sheath called a spathe. Pickerelweed has heart-shaped leaves with parallel veins. The plants bloom from May to October and the

Figure 33.

Figure 34.

showy purple flowers are borne on flowering spikes up to 4 inches long.

Arrow arum and pickerelweed can be found in non-tidal freshwater wetlands as well as low salinity and tidal freshwater wetlands. The community grows from about mean sea level to about mean high tide in low salinity and freshwater tidal marshes. This is the same landscape position occupied by saltmarsh cordgrass in higher saline waters.

About 2 to 4 tons per acre of vegetative material is produced by this community. The organic material is readily available to the marine system. Unlike many other common wetland plants such as the marsh grasses, these species decompose quickly and completely in the fall.

The soft, unconsolidated intertidal muds where these plants are found are susceptible to erosion. Without a dense network of roots and rhizomes, the plants are able to reduce shoreline erosion only during the portion of the year when the leaves can act to baffle wave energy. Due to the complete die back of the vegetation each fall there is no standing dead material to protect the shoreline from erosion in the winter. The large leaves of the vegetation can slow tidal waters and waves to allow some sediment deposition.

Type VIII. Reed Grass Community.

This community is dominated by reed grass *(Phragmites communis)*.

This grass usually grows in pure stands, but may be found growing with saltbush and switchgrass. Phragmites is a tall stiff grass reaching 6 to 10 feet in height. The plants bloom in July and August and have a large, feathery seed head. After the leaves are shed in the fall, individual stems and seed heads often persist through the winter.

Phragmites usually grows above mean high tide, particularly in brackish areas. The plants will also invade the drier areas of disturbed sites. Primary productivity rates range from 4 to 6 tons per acre, but the relatively high elevation occupied by the community results in little transport of vegetated material.

Figure 35.

There is little evidence of wildlife use of this community. The Vegetation may provide cover for some birds and small mammals. Where Phragmites invades disturbed sites, there may be a detrimental effect on wildlife use due to the replacement of vegetative species which are important to wildlife.

The sturdy nature of the grass makes for a good shoreline erosion deterrent. Due to the ability to invade dry, disturbed areas, this species is often found growing on dredge material acting to stabilize the material.

Figure 36.

Type IX. Yellow Pond Lily Community.

Yellow pond lily *(Nuphar luteum)* grows in fresh-water and may be associated with arrow arum and pickerelweed. (Figure 37)


Figure 37.

The large saucer shaped leaves float on the water surface at high tide. The plants flower from June to September and have a large yellow flower. The leaves and flowers of the 2 to 4 foot tall plants are emergent at low tide.

The floating leaves of one plant occupy several square feet so plant densities are generally low. Primary productivity approaches one ton per acre. Vegetative material enters the marine environment, but the contribution is small compared to other marsh species.

Yellow pond lily is found in river stretches associated with spawning striped bass, white perch and river herring. The plants provide attachment sites for algae and aquatic animals. Wading herons, egrets and other waterbirds forage on the small fish and invertebrates among the floating leaves. Finfish also forage in the yellow pond lily. A resident of freshwater marshes, the eastern painted turtle may be found feeding here as well.


Figure 38.

While lacking stiff stems and leaves, the large leaves do provide some baffling of wave energy. By reducing wave action, the community provides some shoreline protection and allows for the settling of some water borne sediments.

Type X. Saltwort Community.

There are three species of vegetation commonly called saltwort found in Virginia. (Figure 38, previous page)

The three species are: *Salicornia virginica*, *Salicornia biglovii* and *Salicornia europa*. Saltworts are leafless succulents with thick green, edible stems. *S. europa* and *S. biglovii* are diffusely branched, fleshy annuals. *Saficornia virginica* is a perennial with woody stems which typically grows in dense mats. Saltworts grow in saline and higher salinity brackish marshes above mean high tide in pannes and sparsely vegetated areas.

Primary productivity is less than l/2 ton per acre. There is some evidence that some ducks eat the stems. Wading birds and other marsh birds may forage where small fish and invertebrates get trapped by the receding tide in *Salicornia pannes*.

The diminutive habit of the leafless plants, the shallow root system and the preferred location of this community offers little erosion protection, flood buffering or sediment trapping capabilities.

Type XI. Freshwater Mixed Community. This community type applies to freshwater wetlands, with a heterogeneous mix of vegetation and where no single species covers more than 50 percent of the site. (Figure 39)

Bulrushes, arrow arum, pickerelweed, smartweeds, wild rice and rice cutgrass are among the species which may occur in a freshwater mixed community wetland. Because this community encompasses many vegetative species, each with a preferred elevation, the community may be found growing from the subtidal zone to the upper limits of wetlands.

Primary productivity of this community depends greatly on the species present. An average value is 3 to 5 tons per acre. The vegetative material produced by intertidal species is readily available to the marine environment.

The high diversity of the freshwater mixed wetland provides foraging areas, nursery areas and nesting sites for a myriad of wildlife species. These wetlands occur along river and creek stretches where striped bass, shad and river herring spawn. The juvenile fish can find shelter among the intertidal vegetation. Wildrice, arrow arum and smartweeds are consumed by native and migratory waterfowl, sora rails, redwinged blackbirds and upland birds. Insects, amphibians and reptiles are more common than in the brackish and saline marshes.

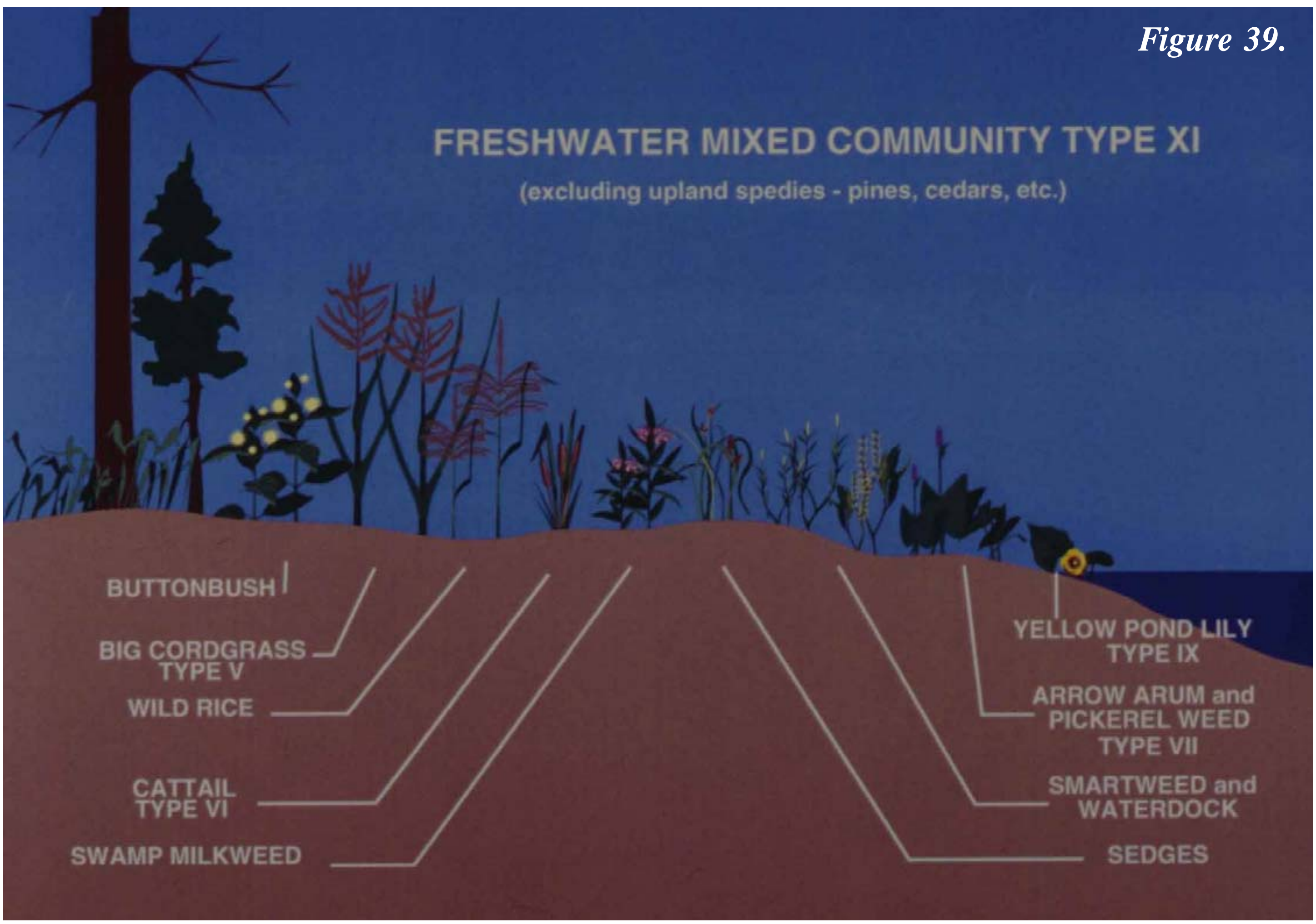


Figure 39.

The shoreline erosion deterrent of this community is the same as the arrow arum and pickerelweed community because these species grow at the lower elevations adjacent to the waterways. However, due to the presence of grasses, sedges, rushes and a peaty substrate at the higher elevations, the freshwater mixed community is effective as a sediment trap and assimilator of flood waters (Figure 4).

Type XII. Brackish Water Mixed Community.

This community is comprised of various brackish wetlands species. (Figure 40)

No single species covers more than 50% of the site. This diverse vegetative community may include saltmarsh cordgrass, saltmeadow hay, saltgrass, saltbushes, threesquares, big cordgrass, common reed and attails. This community may extend from the lower limit of saltmarsh cord-grass, about mean sea level, to the upland margin.

Primary productivity of the brackish mixed community ranges from 3 to 5 tons per acre. The detritus of the intertidal species is available to the marine food web.

As is the case with the freshwater mixed wetlands, a wide diversity of vegetation provides a variety of wildlife food and shelter. Many species of waterfowl feed on the seed heads. Shorebirds and wading birds forage for plentiful invertebrates. Fiddler crabs and marsh crabs are common. Raccoons forage for crabs and shellfish. Small mammals such as the meadow vole and rice rat, feed on the vegetation and invertebrates. Foxes are attracted by the small mammals, marsh birds and invertebrates.

As this community is most often bordered by saltmarsh cordgrass, the community provides effective shoreline erosion control. Likewise, the attributes of the commonly occurring saltmeadow community species, saltmeadow hay and saltgrass, provide effective sediment trapping and flood buffering capabilities (Figure 5).

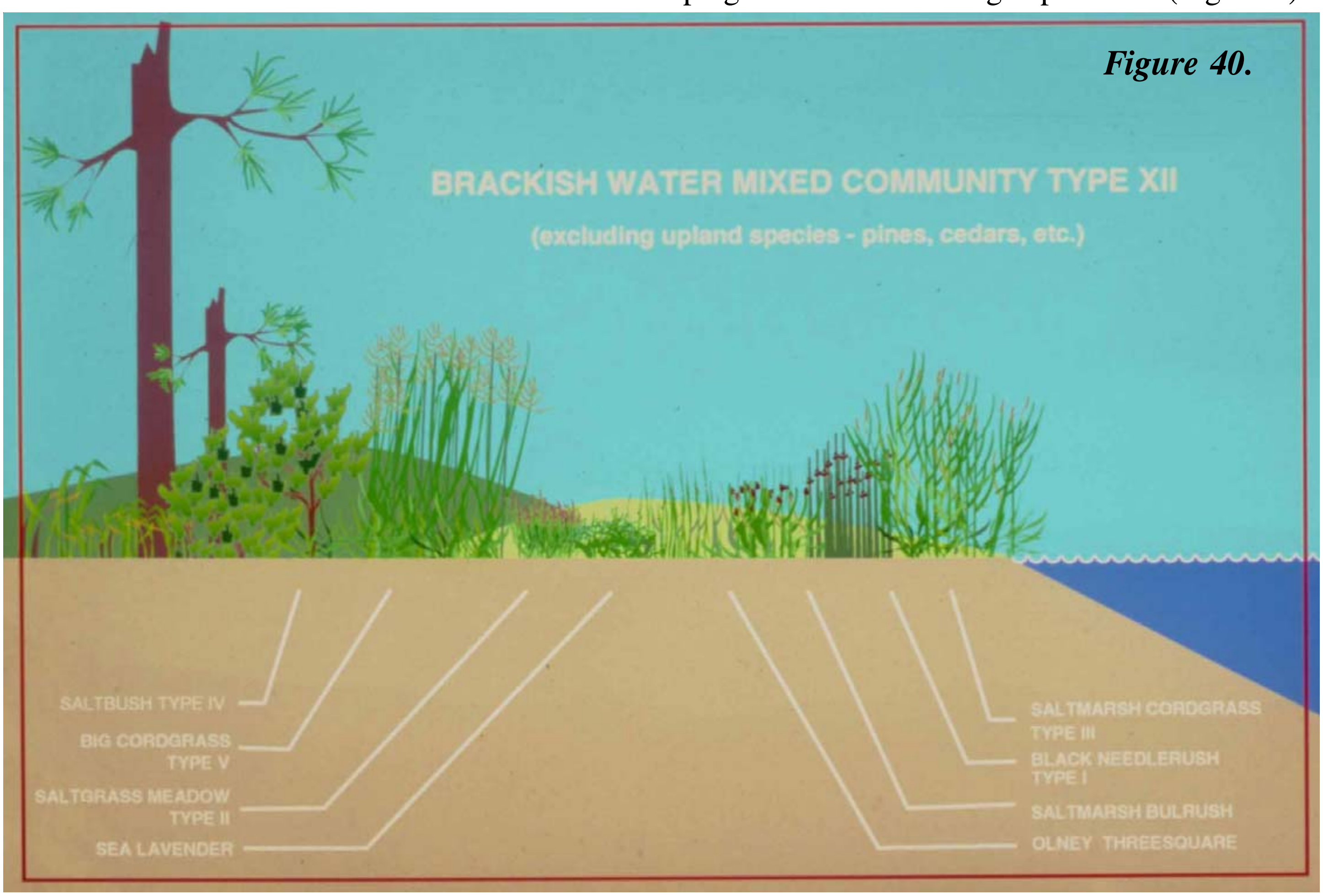


Figure 40.

Type XIII. Intertidal Beach Community.

The intertidal beach is nonvegetated. (Figure 41)

The dominant animal species are burrowing invertebrates. Animals that live in the substrate are called infauna. Wandering species and nonmobile species attached to hard substrates are called epifauna. There is some variability between species commonly found on bay beaches and those most often associated with ocean beaches. On the ocean beach, mole crabs, donax clams and haustorid amphipods are common. Amphipods are also common on bay beaches as are oligochaete worms and sand fleas. These animals occur in large numbers; in the summer there may be as many as 5000 individuals per square meter.

. The primary producers of the nonvegetated wetlands are microscopic plants including algae and phytoplankon. Lacking the macrophytes, large plants, of the vegetated wetlands, primary production is lower than vegetated areas.

The production of animals, or secondary production, is very high. The large numbers of invertebrates are important food for shorebirds. At high tide, finfish and blue crabs also forage for food. The areas above high tide are used as nesting sites for terns, plovers and skimmers.

The low slope of the beach makes it a natural wave dissipator. The dissipation of wave energy reduces the potential for shoreline erosion. The beach interacts with dunes, offshore bars and adjacent shoreline in the distribution of sand.

Type XIV. Sand Flat Community.

Sand flats are populated by various surface dwelling and burrowing animals. (Figure 42)

Sandworms, bloodworms, amphipods and clams are all found on the sand flat. Animal densities range from 300 to 3000 individuals per square meter.

Most of the animals complete their life cycle in one or two years. High rates of production and predation results in a rapid turnover of individuals. High predation acts as a control on the size of the animals, in general individuals are small.

Primary productivity by microscopic plants ranges from 100 to 200 grams per square meter. Primary consumers graze on the small plants incorporating the vegetative material into the food web. This community has a reduced role in nutrient cycling due to the low percentage of organics and the large particle size of the sand.

Sand flats are used as foraging areas by shorebirds, finfish and blue crabs. Juvenile blue crabs and fintish seek shelter in the shallow waters where larger aquatic animals cannot go. Some sand flats support high shellfish populations.

Like the intertidal beach, the low slope of this community acts as a natural dissipator of wave energy reducing the potential for shoreline erosion.

Figure 43.

Type XV. Sand/Mud Mixed Flat Community.

Hard clams, soft clams, mud snails, parchment worms and polychaetes are commonly associated with intertidal flats composed of sand and mud. (Figure 43)

The animals are surface dwellers, burrowers and some build permanent tubes. Variability in particle size allows some overlap of species common to sand flats and mud flats. As a result, population densities are generally higher than sand or mud flats and range from 5300 to 8300 individuals per square meter.

Primary production is similar to sand flats. However, the smaller particle size and high organic matter content means greater microbial activity. Bacteria and fungi, fundamental to the breakdown of detritus, are found in higher numbers in sediments containing small grain size particles. Nutrient cycling activity is greater than on the sand flat.

Shorebirds and wading birds feed on the invertebrate populations of the sand/mud flat. Waterfowl are attracted by the mollusks. Blue crabs and fish use the area for for-aging and shelter. This community often borders a vegetated marsh which may increase the role of both communities as wildlife habitat. The marsh provides habitat variety and organic material to support nutrient cycling and food webs. Shoreline erosion control is similar to sand flats.

Type XVI. Mud Flat Community.

Mud flat animal populations are dominated by spionid worms, mud snails, razor clams and bloodworms. (Figure 44)

These animals are mostly surface dwelling or shallow bur-rowers. The unstable, anoxic mud environment limits the presence of deep burrowers and deters species other than surface detrital feeders. Animal populations are highly variable. Generally lower than sand/mud flats

Figure 44.

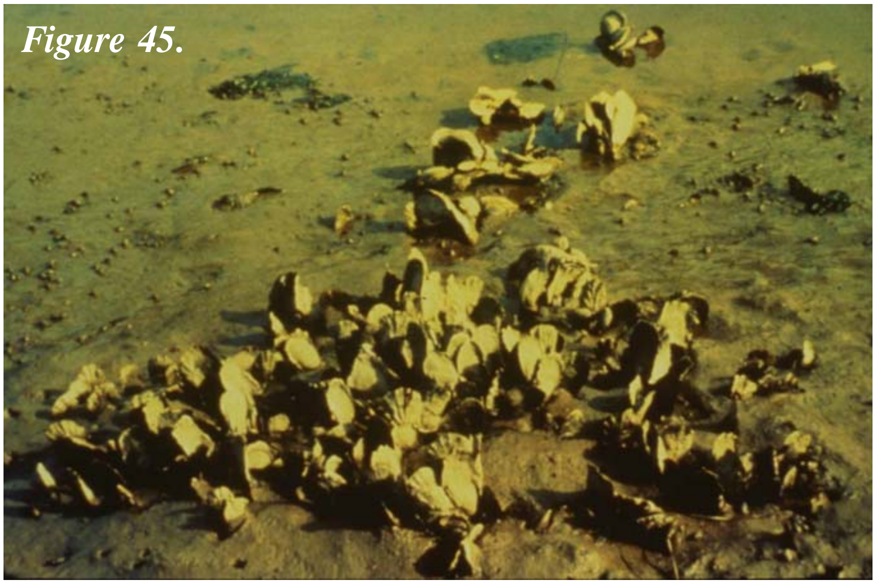


Figure 45.

but higher than sand flats, densities range from 50 to 5000 animals per square meter.

Of the nonvegetated wetlands, mud flats probably have the highest primary productivity. Mud flats interact with adjacent vegetated areas in nutrient cycling. The marshes provide organic material to the animal populations of the mud flats which breakdown and transform the organic material.

Foraging wildlife are attracted by the invertebrate populations. Waterfowl, wading birds, fintish and blue crabs all feed on the mud flats. Mud flats occur frequently in quiescent areas and have a limited opportunity to control shoreline erosion. However, the gradual slope of the mud flat acts like the other nonvegetated wetlands in the dissipation of wave energy.

Type XVII. Intertidal Oyster Reef Community.

Oysters are the dominant animal, but there is great diversity in the attached and associated organisms. (Figure 45)

Hard clams, mud crabs, sand worms, barnacles and sponges are associated with oyster reefs. When oyster reefs are managed by man, the oysters are most common. In a natural state, fouling organisms are dominant. Populations are very variable, but are generally greater than flat communities.

The nooks and crannies of the reef offer niches for many aquatic animals. Small finfish find shelter among the shells, larger fish forage on the reef. Blue crabs feed on the reefs extensively. Oystercatchers and other birds also forage on the reefs.

The rigid structure of the permanently attached shells are resistant to erosion and may dissipate wave energy.

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