



# Dynamics of the Salt Marsh

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## Where are Marshes Located? What are Their Features?

Salt marshes are transitional areas between land and water, occurring along the intertidal shore of estuaries and sounds where salinity (salt content) ranges from near ocean strength to near fresh in upriver marshes. South Carolina has more marsh acreage than any other Atlantic coast state (344,500 acres of salt marsh). Because salt marshes in South Carolina are influenced by the twice daily rise and fall of tides, they are subject to rapid changes in salinity, temperature and water depth.

Salinity, frequency and extent of flooding of the marsh determine the types of plants and animals found there. The low marsh zone floods twice daily in South Carolina, while the high marsh floods only during storms and unusually high tides. Animals and plants live in these zones of the marsh, depending on how well they can withstand the drier conditions of the upper marsh or the wet conditions that regularly occur in the lower marsh.

## Salt Marsh Cordgrass

One plant, smooth cordgrass (*Spartina alterniflora*), dominates the regularly flooded lowmarsh. Smooth cordgrass is the most abundant salt marsh plant in South Carolina and is responsible for much of the marsh's productivity. *Spartina's* successful adaptations enable it to live where few other plants could survive. It has narrow, tough blades and special glands that secrete excess salt, making it ideal to withstand the high heat and daily exposure to salt water. Few animals eat this plant, but many animals and plants live on it or on the marsh surface protected by its roots and stalks. *Spartina* stalks

are thick and are very tough and well anchored by a root system.

From a distance, the low marsh appears to be uniform; however, there are two forms of *Spartina*. A tall form grows along creek banks and can reach heights of 9 feet. A short form of *Spartina* occurs in interior parts of the low marsh and ranges from 2 to 3 feet in height. In contrast to the low marsh which has one major species of plant, the high marsh contains a



mixture of several species including black needlerush, salt meadow cordgrass and short-form smooth cordgrass. This high marsh area grades into a marsh-upland border which is a transitional zone between the salt marsh and the maritime shrub community that consists of wax myrtle, yaupon and cedar.

South Carolina also has brackish marshes which occur in water of lower salt content. Salinity, however, still controls what species of plants and animals occur in brackish marshes. Common plants in these marshes include a mixture of black needlerush and big cordgrass. Brackish marshes are also a transitional habitat between freshwater marshes and salt marshes and contain species from both.

## Salt Marsh Ecology: What Lives in the Salt Marsh?

Salt marshes rank among the most productive ecosystems on earth. Live *Spartina* is not a source of food but dead marsh plants are a source of nourishment for many species. Decaying *Spartina* breaks into small pieces called detritus that fuels the marsh and its animals. In spring and summer, marshes are lush green, highly productive and grow in height. In late fall, the green *Spartina* begins to turn brown as leaves die and decomposition begins. Water, waves, wind and storms dislodge and break up decaying leaves, and transport them to mud flats and other locations around the marsh. This dead plant matter, or detritus, forms an attachment site for microscopic organisms such as bacteria, fungi and small algae. These organisms colonize the broken bits of plant material and break down portions of the detritus that are not digestible by animals.

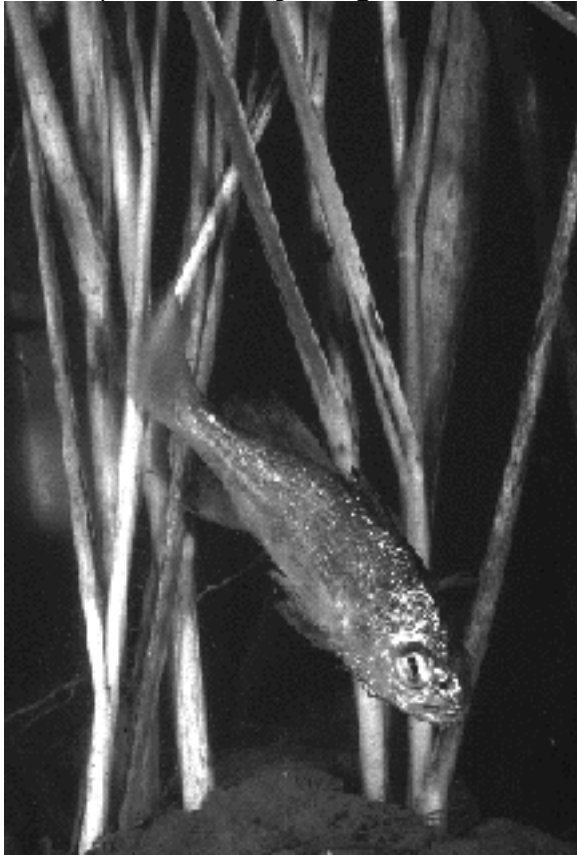
For the most part, this decomposition occurs on or in the sediments where bottom-dwelling scavengers such as worms, fishes, shrimps and crabs live. These animals eat the decaying plant material, along with the bacteria, fungi and attached organisms. They then digest the material and excrete the undigested plant remains in feces that can be colonized again by microorganisms. As the microorganisms utilize detritus and reduce it to smaller and smaller pieces, the remaining detritus

becomes fertilizer for the next *Spartina* crop. In this way, the whole food web cycle is repeated.

Microscopic animals associated with detritus also cover the surface of mud in the salt marsh. They help stabilize sediments, are food for larger organisms and contribute to an enrichment of the sediments. Large numbers of more sizable invertebrates (animals without backbones) inhabit salt marshes. Rapid changes in salinity, temperature and exposure create stressful conditions and thereby limit how many species occur in this habitat. Fiddler crabs, marsh snails and marsh mussels are typical invertebrate species which live in salt marshes. The popular and highly prized oyster generally borders salt marshes. Fiddler crabs and marsh snails shred dead plant material during feeding, aiding the decomposition process.

Insects are also abundant in the salt marsh. Most of these salt marsh invertebrates consume living plants, or fluids secreted by the plants. Some insects also feed on detritus, though the importance of their role in the food web as grazers and detritus feeders is small compared to their importance to the abundant species of birds who depend on them for food. The undigested grass eaten by insects is deposited as feces on the marsh surface where it becomes part of the detrital food web. Many fish species living near the salt marsh rely on insects for food during part of the year.

Fishes, crabs, and shrimps live in salt marshes where stems, leaves, and roots provide food and shelter from predators. The young of many species, such as the blue crab, white shrimp and spot tail bass utilize the salt marsh as a nursery. Without benefit of an abundance of food and protection given by marsh plants, few younger animals would survive to adulthood. Many fishes which inhabit marshes



move on and off the marsh surface with the tide. Once they leave the protection of the marsh surface to enter the adjacent tidal creek, they become more susceptible to being eaten by large predators living in creeks. Some marsh-dwelling fishes and shrimps remain on the marsh surface after the tide recedes. They live in potholes and standing pools of water. These common marsh inhabitants include mummichogs and grass shrimp.

Few reptiles live in salt marsh habitats. Diamond back terrapins are probably the most common species in the marsh, where they lay eggs and forage during high tide. American alligators do occur in brackish salt marshes but are not often found in high salinity marshes. The regularly flooded salt marshes of South Carolina provide excellent habitat for birds, with many places for feeding, reproducing and roosting. Species such as the red-winged black bird alternately eat insects and seeds depending on the season. Other birds, such as herons and egrets, feed on fishes, shrimps and fiddler crabs. These graceful predators are year-round residents of our marshes and frequently perch on mud banks watching for movement of prey in tidal pools. The commonly heard but seldom seen

clapper rail forms roosting areas on the marsh surface within the protective cover of marsh grass. Birds contribute important nutrients to the salt marshes through their feces, which accumulate in large quantities around nesting colonies. In turn, feces fertilize marsh grass, an important function in the marsh food web.

## **Impounded Salt Marsh: What is it? What are Some Features?**

In South Carolina, 14-16% of coastal marshes are functional impoundments. Originally, impoundments were constructed in brackish/fresh water for rice culture. After the Civil War, most were maintained or built to attract water fowl. Impoundments were so named because earthen dikes were built to impound an area of marsh and control the tidal flow into the area. In many instances, earthen dikes enclosed an entire marsh-creek system in which water control structures called trunks regulated water exchange, levels and salinity in the impoundments. A typical impoundment contains a shallow mud flat area that occupies 30-60% of the total surface area and is covered with plants. A ditch produced when earthen material was excavated to build the dikes generally borders the impoundment on three sides.

Water quality in estuarine impoundments varies. The salinity of the water may vary from near fresh to as much as 30 parts per thousand (ppt), depending on amount of rainfall and water exchange with the adjacent creek. Dissolved oxygen, which is essential for respiration by aquatic organisms, also varies greatly. When temperatures and salinities are high, water holds less dissolved oxygen than when the water is cold and the salinity is low. Organisms that live in the water also decrease levels of dissolved oxygen as part of their breathing process. Plants produce oxygen during photosynthesis and can actually enhance oxygen levels during the day.

In summer, when temperature and salinity are high, oxygen levels can be severely depleted in impoundments. Although plants are present in the impoundments, their decay and the resultant oxygen demand by decomposing bacteria can contribute to critically low dissolved oxygen levels. When dissolved oxygen levels become too low, fishes, crabs, shrimps and other bottom dwellers die or become so stressed that they are subject to easy predation by birds and alligators.

Sediments in the marsh play an important role in determining plant and animal communities, as well as influencing water movement between ground water and surface water. Sediments in impoundments generally consist of a layer of organic material over an impermeable clay-silt layer. The organic material is primarily derived from dead plants. Impoundments receive little input from groundwater because of the impermeable clay-silt layer. Most water exchange in impoundments occurs through the water control structures. Thus, the amount of nutrients and organisms that are exchanged between the adjacent tidal creek and the impoundment is controlled by human manipulation of the water control structure.

Diked marshes are generally managed by owners to enhance the growth of plants consumed by waterfowl, mainly migratory ducks. Primary management strategies usually involve the manipulation of salinity (from more salty to less salty), the regulation of water levels (draining and flooding) and the manipulation of impoundment beds (cultivation and burning). The intensity of management can have a significant effect on the plants and animals inhabiting an impoundment.

## **An Ongoing Controversy**

During the past two decades, many objections have been raised to the diking and impounding of

salt marshes. Most objections point out that: 1) dikes restrict water exchange which limits the movement of many aquatic species and can result in stressful water-quality conditions; and 2) dikes also prevent access by the general public to what is perceived as a public resource (saltmarsh). A major advantage of impoundments is that they provide valuable habitat for waterfowl. Management of these systems to permit water exchange would reduce many adverse effects for aquatic species.

The right of private ownership of currently impounded marshes will probably continue to be controversial. This controversy results from different values placed on the resources of marshes. Some seek better hunting areas for waterfowl, some cherish these areas for their scenic beauty and some value marshes as nursery areas for recreationally and commercially-important species. Although impoundments function differently from marshes in several ways, we still have much to learn about these differences.

## **Current Status of Salt Marshes**

Salt marshes have not always been regarded as valuable resources. Over half of our original salt marshes in the United States have been destroyed, many of them between 1950 and the mid-1970s. Most of that destruction was due to filling of marshes to create more land area for homes, industry and agriculture. Other losses were caused by ditching for mosquito control and diking to create impoundments. Fortunately, people are beginning to realize the importance of these habitats. Federal and state laws and regulations now reflect an appreciation by the general public for the function and value of marshes.

Salt marshes perform many functions valuable to human beings. As previously mentioned, they are a major producer of detritus and provide nursery grounds for numerous commercially and recreationally important species. In addition, salt marshes serve as filters to remove sediments and toxins from the water. Marsh plants break down many pollutants into less harmful forms. Uptake by sediments and burial in the marsh minimize the toxic effects of pollutants. There is a limit to this capacity to serve as a waste treatment center. Excessive pollutants can overburden the cleansing capabilities of marshes. Marshes also act as buffers for the mainland by slowing and absorbing storm surges, thereby reducing erosion of the coastline. In addition to all this, they provide a scenic vista in our state.

Outright destruction of salt marshes has been greatly minimized due to federal and state laws. Yet, a number of threats to salt marsh habitats still exists. Loss of quality and function of marshes is a serious problem. Over half of the nation's people now live and work within coastal counties. The cumulative

impact of these people within the watershed surrounding salt marshes can be significant. Subtle impacts which affect salt marshes include water flow modifications and pollution. Ditching to control mosquitoes has altered water flow in some marshes. This can cause water, with its vital load of nutrients, to bypass marshes. Birds that require low, wet marshes diminish along with the food supply in ditched marshes. Building canals for flood control is another modification that increases surface water levels on marshes which, in turn, stresses and kills marsh grass. Nonpoint-source pollution resulting from land runoff from diverse locations such as bridges, roads (petroleum products from cars), and air (industrial output) and from farms and lawns (pesticides and fertilizers) is difficult to control. Any one discharge may involve only small amounts of chemicals which are diluted by the receiving streams, but when combined with other chemicals from multiple other discharges, significant concentrations of pollutants may result. The precise effects of these pollutants are still largely unknown, but the potential for problems is clear. Pollution may disrupt the food web in the salt marsh by killing off some species and prompting others to greatly increase in number. Pollution also threatens the economic, aesthetic and recreational value of our marshes.



Permits regulate point-source pollution from a pipe or a single source industrial plant, but nonpoint source pollution is more difficult to monitor and control due to its multiple sources. Likely solutions include major changes in land use practices at the local level and adopting special methods to minimize runoff such as porous pavement, planting of buffer strips and construction of detention basins to contain road and agricultural runoff. Individual citizens can combat nonpoint source pollution by changing their everyday actions. There are a number of federal and state agencies and nonprofit groups that produce informational materials on regulations and conservation pertaining to salt marshes and other wetlands. It is important that citizens take a personal interest in conservation of marshes because of the benefits and values they provide for all of us now and for future generations.

## DNR Mission Statement

The South Carolina Department of Natural Resources is the advocate for and steward of the state's natural resources. The Department of Natural Resources develops and implements policies and programs for the conservation, management, utilization, and protection of the state's natural resources based upon scientifically sound resource assessment and monitoring, applied research, technology transfer, comprehensive planning, public education, technical assistance and constituent involvement. The Department of Natural Resources is pro-active in protecting the state's natural resources for use and enjoyment by future generations of South Carolinians.

## Special Note

This publication was made possible in part with funds from the sale of the South Carolina Marine Recreational Fisheries Stamp. Help ensure outdoor enjoyment for future generations by strictly adhering to all rules, regulations, seasons, catch limits and size limits. The South Carolina Department of Natural Resources publishes an annual Rules and Regulations booklet that lists all saltwater fishing regulations. Have an enjoyable fishing trip by reading these requirements before you fish.

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## **Saltwater Fishing**

### **Conservation & Ethics**

Although most people once considered ocean resources to be unlimited, recent rapid declines in the populations of many commercial and recreational species have demonstrated the opposite.

Numerous types of saltwater game fish now are being over harvested and other species will face a similar fate unless all anglers practice wise conservation and adopt an ethical approach to fishing. Size and catch limits, seasons and gear restrictions should be adhered to strictly. These regulations change from time to time as managers learn more about fish life histories and how to provide angling opportunities without depleting stocks.

The challenge of catching, not killing fish, provides anglers with the excitement and the reward of fishing. Undersized fish, or fish over the limit should be released to ensure the future of fish populations. The number of saltwater finfish tagged and released annually in South Carolina has increased significantly in recent years as more and more fishermen take up this practice that provides information on growth and movement of fish as well as conserving resources.

Saltwater fishermen can further contribute to conservation by purchasing a Marine Recreational Fisheries Stamp which is required to fish from a private boat or gather shellfish in South Carolina's saltwaters. Funds generated by the sale of stamps must be spent on programs that directly benefit saltwater fish, shellfish and fishermen.